



Presuppositions : an experimental investigation

Robert Reinecke

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Presuppositions : une investigation expérimentale

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Abstract

Speakers communicate more than what they explicitly state. For this reason, addressees rely on linguistic and extra-linguistic cues to recover different levels of explicit and implicit meaning. Presupposition triggers are one of these cues. These are linguistic expressions or constructions (e.g. change of state verbs, factive verbs, it-clefts, etc.) which trigger the recovery of propositions that the speaker *presupposes*, or takes for granted, for the purpose of the conversation.

This thesis investigates the phenomenon of presupposition within the framework of experimental pragmatics, and it comprises three studies based on the following experimental methods: judgement-tasks, EEG method and grip-force sensor method. This thesis combines a social perspective, which focuses on reputation-management via alternative discourse strategies (Study 1), with a cognitive perspective, which examines the cognitive costs and sensori-motor correlates associated with presupposition processing (Studies 2 and 3).

Study 1 examines the impact of different discourse strategies (saying, implicating and presupposing) on the attribution of speaker commitment towards the message communicated. By operationalizing commitment as a function of the reputational cost (drop of trust) related to the transmission of false information, Study 1 shows that presupposing is perceived as equally committal than saying and more committal than implicating.

Study 2 investigates the cognitive costs associated with targeting presuppositions in discourse continuations. By focusing on additive contexts introduced by the French discourse particle *aussi*, Study 2 shows that felicitous discourse continuations targeting a presupposition elicit the same ERP response than felicitous discourse continuations targeting an asserted context. This finding suggests that when presupposition processing is part of an appropriate, pragmatically felicitous, discourse strategy, it does not come with any additional cognitive costs.

Study 3 examines the sensori-motor correlates of processing action-related language in presuppositional constructions (complement clause of factive verbs) and non-presuppositional ones (complement clause of non-factive verbs). The results show that the former elicit a greater sensori-motor activation than the latter, thus revealing that presupposed information, whose truth is taken for granted, is processed differently from information whose truth has not been established in discourse.

Overall, this thesis contributes to the study of presupposition by providing empirical evidence in support of the theoretical distinction between different layers of meaning. On the one hand, it shows that their employment leads to different commitments in discourse and has implications on the interpersonal negotiation of trust. On the other hand, it shows that while presupposition processing is not inherently more costly from a cognitive perspective, its cognitive correlates (such as the engagement of the sensori-motor system) can differ from those mapping information with a different discourse status.

Keywords: commitment, language processing, discourse strategy, felicity, language-induced motor activity, experimental pragmatics

Résumé

Les locuteurs communiquent plus que ce qu'ils disent explicitement. C'est pourquoi les destinataires s'appuient sur des indices linguistiques et extra-linguistiques pour récupérer différentes strates de signification qui peuvent être explicites aussi bien qu'implicites. Les déclencheurs de présuppositions représentent l'un de ces indices. Il s'agit d'expressions ou de constructions linguistiques (par exemple, les verbes de changement, les verbes factifs, les clivées, etc.) qui déclenchent la récupération de propositions que le locuteur présuppose, ou considère comme acquises, pour les besoins de la conversation.

Cette thèse étudie le phénomène de la présupposition dans le cadre de la pragmatique expérimentale et comprend trois études basées sur les méthodes expérimentales suivantes : les tâches de jugement, la méthode de l'EEG et la méthode du capteur de force de préhension. Cette thèse combine une perspective sociale, qui se concentre sur la gestion de la réputation via des stratégies discursives alternatives (étude 1), avec une perspective cognitive, qui examine les coûts cognitifs et les corrélats sensori-moteurs associés au traitement des présuppositions (études 2 et 3).

L'étude 1 examine l'impact des différentes stratégies discursives (un locuteur qui communique une information explicitement, qui l'implique ou la présuppose) sur l'attribution de l'engagement du locuteur envers le message communiqué. En étudiant l'engagement du locuteur (sa responsabilité) en fonction du coût de réputation (perte de confiance) lié à la transmission de fausses informations, l'étude 1 montre que le présupposé est perçu comme étant tout aussi responsabilisant que le dire explicite et plus responsabilisant que l'implicite non présuppositionnel.

L'étude 2 examine les coûts cognitifs associés au ciblage des présuppositions dans les continuations du discours. En se concentrant sur les contextes additifs introduits par la particule discursive *aussi*, l'étude 2 montre que les continuations discursives appropriées ciblant une présupposition suscitent la même réponse en potentiels évoqués que les continuations discursives appropriées ciblant un contexte affirmé. Cette conclusion suggère que, lorsque le traitement de présuppositions fait partie d'une stratégie discursive appropriée et pragmatique, il n'entraîne pas de coûts cognitifs supplémentaires.

L'étude 3 examine les corrélats sensori-moteurs du traitement du langage lié à l'action dans les constructions présupposées (clause-complément des verbes factifs comme *savoir*) et non-présupposées (clause-complément des verbes non-factifs). Les résultats montrent que les

premières provoquent une activation sensori-motrice plus importante que les secondes, révélant ainsi que les informations présupposées, dont la vérité est prise comme acquise, sont traitées différemment des informations dont la vérité n'a pas été établie dans le discours.

Dans l'ensemble, cette thèse contribue à l'étude de la présupposition en fournissant des preuves empiriques à l'appui de la distinction théorique entre les différentes couches de signification. D'une part, elle montre que leur emploi conduit à des responsabilisations différentes dans le discours et a des implications sur la négociation interpersonnelle de la confiance. D'autre part, elle montre que, si le traitement des présuppositions n'est pas intrinsèquement plus coûteux d'un point de vue cognitif, ses corrélats cognitifs (tels que la mobilisation du système sensori-moteur) peuvent être différents de ceux qui mettent en correspondance des informations ayant un statut discursif différent.

Mots clés : engagement, traitement du langage, stratégie discursive, continuations discursives appropriées, activité motrice induite par le langage, pragmatique expérimentale

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Introduction

“When R., the famous novelist, returned to Vienna early in the morning, after a refreshing three-day excursion into the mountains, and bought a newspaper at the railway station, he was reminded as soon as his eye fell on the date that this was his birthday. His forty-first birthday, as he quickly reflected, an observation that neither pleased nor displeased him. He swiftly leafed through the crisp pages of the newspaper, and hailed a taxi to take him home to his apartment.”

(Stefan Zweig, 1922, *Letter from an unknown woman*)

As you read the incipit of this novella (one of my favourite ones), you start building a fictional world in which you imagine the story is taking place. You build this world by combining textual information with your own knowledge of the real world (your knowledge about Vienna, stations, newspaper kiosks, etc.). This world provides a context, constantly expanding and open to revisions, to interpret new pieces of information as the story proceeds. Crucially, the narrative voice invites you to take some information for granted and to integrate them into this context. For instance, it *presupposes*, that R. is a famous novelist (“*When R., the famous novelist, [...]*”) who lives in Vienna but had gone away (“*[...] returned to Vienna early in the morning [...]*”) for a short holiday (“*[...] after a refreshing three-day excursion into the mountains[...]*”). The way in which these pieces of information are presented suggests that they should be taken as part of the background to interpret what is going to happen and you expect that the story will proceed by ignoring the details of R’s recent trip and by focusing on something new. This mode of presentation is made possible by the use of expressions or linguistic constructions, such as definite descriptions, change of state verbs or temporal clauses, which linguists have called *presupposition triggers*.

When Stefan Zweig published this novella, *Letter from an unknown woman*, philosophers had already discussed the phenomenon of presuppositions for exactly 30 years. It was the philosopher Frege who in 1892 introduced the very first notion of presuppositions in relation to the use of definite descriptions: “If anything is asserted there is always an obvious presupposition that the simple or compound proper names used have referents” (Frege, 1892, p. 40). This was the beginning of a lively line of investigation, which has seen the contributions of philosophers, linguists and psychologists along the years, and that still represents one of the most hotly debated topics in the study of language use.

Indeed, in recent years, the study of presuppositions has incorporated new methods thanks to the development of the discipline of ‘experimental pragmatics’, which initiated an experimental approach (thus, ‘experimental’) to the study of language use and comprehension

(thus, ‘pragmatics’) (see Noveck, 2018 for an engaging discussion of the history of this field). This dissertation fits in this tradition of work, to which it contributes in two different ways. First, by submitting to experimental investigation theoretical questions that have not yet been addressed with empirical data. Second, by enlarging the repertoire of the experimental methods that are brought to the study of pragmatic phenomena. In both cases, this thesis testifies to the interdisciplinary approach of experimental pragmatics by creating new bridges with research in psychology and neuroscience. In what follows, I outline the main intended contributions of this dissertation and the underlying research questions.

New research questions in experimental pragmatics

I. How is speaker commitment pragmatically modulated?

Recent work in evolutionary and cognitive psychology has opened up the question of the role of speaker commitment in the choice of cooperative partners or sources of information. By focusing on the study of confidence as an expression of speaker commitment, Vullioud, Clément, Scott-Phillips, and Mercier (2017) found that overconfidence can backfire in cases in which false information is communicated. When comparing confident (“*I’m sure that ...*”) with unconfident speakers (“*I’m really not sure whether ...*”), the first are likely to be trusted more as sources of information; we rely on the advice of confident speakers to form new beliefs or orient our future actions. However, if the communicated message turns out to be false or unreliable, overconfident speakers, who are committed to the message, incur higher reputational costs than unconfident ones (Tenney, Small, Kondrad, Jaswal & Spellmann, 2011; Tenney, Spellmann & MacCoun, 2008). Reputational costs and benefits play a crucial role in ensuring that communication remains advantageous from an evolutionary perspective (Dawkins & Krebs, 1978; Krebs & Dawkins, 1984; Maynard Smith & Harper, 2003; Scott-Phillips, 2008). For this reason, the capacity to attribute speaker commitment, and to adjust the reputation of speakers based on whether their commitments are fulfilled or not, represents an important way to monitor the credibility of our sources of information and defend ourselves from the risk of misinformation (Sperber, Clément, Heintz, Mascaro, Mercier; Origgi & Wilson, 2010).

One of the aims of this dissertation is to address the question of whether attribution of speaker commitment is based on considerations about the way in which information is presented in discourse. If that was the case, presupposing a piece of information should lead to attributing a different degree of commitment towards the message communicated than explicitly stating or implicating it. The first study of this thesis extends the investigation of

speakers' commitment/ reputational cost to different levels of meaning and addresses the following research question:

- (1) Do different levels of meaning –saying versus presupposing versus implicating – convey different degrees of speakers' commitment?

This question, for which we find conflicting answers in the linguistics literature, has never been empirically investigated. Indeed, some argue that presuppositions may be more committal than assertions (e.g., Peters, 2016), whereas other scholars argue that a speaker using a presupposition is not directly responsible for this content (Ducrot, 1984, Lombardi Vallauri, 2016). The first study of this thesis will settle the issue by experimentally testing the relative degree of speaker commitment across different levels of meaning and borrow experimental designs employed in the psychological literature on partner choice and confidence expression.

II. What are the costs of targeting presuppositions in discourse?

When reading the following sentence *Peter stopped smoking because he liked it* or answering the question *Did Peter stop smoking?* with *Yes, he smoked for more than 10 years*, we immediately realise that targeting the presuppositional content *Peter used to smoke* via a discourse continuation or a reply is pretty odd. But what is odd about these discourse moves? What they have in common is the fact that they address a piece of information that is backgrounded and considered not 'at-issue'. Indeed, many scholars have shown that presuppositions are not typically available for discourse attachments (such as "*because [...]*", see Ducrot, 1972), they do not provide answers to questions (Grimshaw, 1979) and they do not usually carry the main point of the utterance (Simons et al., 2010).

However, this is possible in some special contexts. For instance, a discourse continuation involving an additive particle such as *too* can target a presupposition. In *Lemmy is proud to be a bass player, Roberto plays bass, too* the continuation targets the presupposition that *Lemmy plays bass*, and no discourse infelicity appears to arise (Winterstein, 2009). Little is known, though, of whether targeting a presupposition in discourse, even if occasionally possible, should always incur greater processing costs. If the backgrounded status of presuppositions made them less salient or accessible, this should result in extra processing cost when addressing them in a discourse continuation (be it a discourse attachment or an answer to a question). The second study presented in this thesis aims at uncovering the cognitive costs, if any, of targeting the presupposed content in discourse. More specifically, it addresses the following research question:

(2) How are presuppositions processed in felicitous discourse continuations?

This question has never been investigated before. Until now, experimental research has investigated conversational scenarios in which discourse continuations targeting presuppositions are typically considered as infelicitous by collecting acceptability ratings or other types of off-line judgments (e.g., Amaral & Cummins, 2015, Cummins et al., 2012; Jayez, 2010, Tonhauser et al., 2018). This opens up the following two questions: first, whether the results obtained are due to the pragmatic infelicity or to the presupposed status of the relevant content. Second, whether the use of on-line methods would give us any more specific insight on the processing of the presupposed content in discourse. Indeed, one of the main disadvantages of the judgment method is that it demands a certain awareness of language, which may have an impact on the judgment produced by the participants. For this reason, our study will focus on felicitous discourse attachments and will use the EEG method, which allows investigating the cognitive correlates of presupposition processing. Thanks to its time-locked sensitivity, this will shed new light on the immediate online processing costs of presuppositions in discourse attachments.

New research methods in experimental pragmatics

III. A grip-force study of presupposition processing

Recent research in neuroscience has explored the role of the motor system in language processing. It has been found, for instance, that action verbs elicit a sensori-motor activation (e.g., Hauk, Johnsrude & Pulvermüller, 2004; Tettamanti et al., 2005): while reading that *Rob writes his thesis*, the action verb *to write* will elicit the activation of the sensori-motor areas associated with the action of *writing*. Crucially, this activation appears to be modulated, among other factors, by the linguistic environment in which the action verb is embedded. For instance, it is reduced when the action verb falls under the scope of negation (*Rob does not write his thesis*, see Aravena et al. 2012; Tettamanti et al., 2008). This discovery opens up a very interesting line of research dedicated to the impact of the linguistic environment on language-related sensori-motor activation, one which has only started to be explored by linguists and neuroscientists together. Interestingly, for our purpose, most of these studies focus on the effect of linguistic expressions or operators (negation, volitional verbs as *to want* or *to desire*) but do not address the role of pragmatics and the distinction between different levels of meaning. A notable exception is represented by van Ackeren et al. (2012), who investigated the sensori-motor activation elicited by indirect requests that invite the addressee to act out in one way or another. For instance, they found that the sentence *It is very hot here* either presented with the

picture of a desert or with the picture of a closed window elicits a different sensori-motor response. In the latter case, the sentence is most likely to be understood as an indirect request – *open the window* – and thus elicits a sensori-motor activation. In contrast, when the sentence is taken in its literal meaning as a description of the picture – *It is very hot here* – no sensori-motor activation is elicited.

The third study presented in this thesis will address the following research question:

- (3) Does presupposed content elicit a different degree of sensori-motor activation than non-presupposed content?

In a series of three experiments, we will more closely examine the processing of factive and non-factive predicates, for instance *know* versus *suppose*. While the first presuppose the true of their complements, the latter do not. Not only does the employment of factive verb constructions (*Jacques knows that Rob writes his thesis*) allow to directly compare its presupposed action content to the same action content conveyed via an assertion (*Rob writes his thesis*), but it also puts us in the position to investigate whether factivity (*Jacques knows that Rob writes his thesis*) triggers a distinct sensori-motor response compared to non-factivity (*Jacques supposes that Rob writes his thesis*).

To our knowledge, this study is the first one in the experimental pragmatics literature to rely on a new experimental method: the grip force sensor method (e.g., Aravena et al. 2012; 2014). This method measures the variation of the force exercised by participants who hold the sensor with their index and thumb. This variation can be taken as a reliable measure of the activation of sensori-motor areas involved in the execution of hand-related actions (e.g. *writing*). By employing this innovative method, our third study will provide an answer to the following three specific research questions:

- (3)
 - a. Does the presupposed (action-related) content of factive verb constructions elicit an increase in grip force?
 - b. Does the entailed (action-related) content of non-factive verb constructions elicit an increase in grip force?
 - c. Does the presupposed (action-related) content of negative factive verb constructions elicit an increase in grip force?

By answering these questions, this study will contribute to the experimental literature on presupposition processing. In recent years, more and more studies have investigated the on-line processing of distinct presupposition triggers and this body of experimental work has provided

important insights into the time course of presupposition processing. Our study enriches this literature by investigating the cognitive correlates of presuppositions from a new angle. Here, we will focus on the relation between levels of meaning and sensori-motor activation and thus build an important bridge between experimental pragmatics and the neuroscience of language.

Outline of the thesis

This thesis is organized as follows. Chapter 1 provides a review of the theoretical and experimental literature on presupposition that is relevant for contextualizing the original empirical investigations I carried out in the three presented studies. Given the experimental orientation of this thesis, the review of the theoretical, on the one hand, and experimental literature on presupposition, on the other, are meant to serve very different purposes. The theoretical review aims at introducing the core theoretical notions that have prominently figured in the philosophical and linguistic literature on presupposition. These key notions include those of *presupposition triggers*, *presupposition accommodation*, *common ground*, *factivity*, among others. Furthermore, it introduces the main linguistic and discourse properties of presupposition, notably their projection behaviour, discourse attachment properties and discourse commitments. While the aim is not to provide the reader with an exhaustive review of the theoretical literature that touches upon these issues, this part will introduce the essential building blocks for an understanding of the experimental investigation carried out in this thesis. In contrast with this, the review of the experimental literature aims at offering a wide perspective on the growing body of experimental studies on presupposition, and to review them in such a way that the reader will profit from a systematic presentation organized around some topical research questions. This will set the background to present our three original experimental studies in Chapter 2, 3, and 4. Finally, a conclusion will bring together these studies and their implications will be discussed and combined in a unified picture (Chapter 5).

Chapter 1: State of the art and open questions

1. Theoretical background

1.1. Levels of meaning: Explicit and implicit levels of meaning

Since the seminal work of Grice (1975/89), it has become prevailing to distinguish between *what is said* and *what is meant* by a speaker who utters phrases of natural languages. In his inferential model of communication, Grice suggests that the linguistic meaning only provides a clue to infer the speaker's meaning. What a speaker means to communicate does not always correspond to what she has explicitly uttered. The intended meaning, that is, *what is meant*, often goes beyond the literal meaning, that is, *what is said* (Grice, 1975, 1989). In these cases, the hearer must *infer* the intended meaning of an utterance based on what is said, as well as the context of the utterance. For instance, when someone utters the question in (1), we do not expect just an answer to that question.

1. Would you mind opening the window?

In such a case, the hearer can derive the intended meaning of the speaker S, that is, that S intends to request indirectly to open the window (see Clark & Lucy, 1975). While the speaker is literally asking a question, the hearer can quickly derive the intended meaning conveyed by the utterance using a set of principles, or conversational maxims, which rational speakers are expected to observe in conversation, and which set the standards of informativeness, relevance and perspicuity of a cooperative exchange.

Grice's work on the inferential nature of communication laid the foundation for an analysis of the different levels of meaning that are involved in communication. It is widely acknowledged in the linguistic literature that we can distinguish at least four different levels of meaning (for an overview, see Domaneschi, 2016): (i) the *sentence meaning*, (ii) *what is said*, (iii) the *level of presuppositions*, and (iv) the *implicit level of implicatures*. To illustrate them, let us consider the following example (adapted from Carston, 2009):

2. A: How was Peter's party? Did it go well?

B: There wasn't enough drink, and everyone left early. Even his girlfriend left and went clubbing.

(i) Sentence meaning: This represents the encoded linguistic meaning. It is the invariant, or context-independent, meaning. The linguistically encoded meaning of B's response is a combination of the context-independent meanings of (i) 'there wasn't enough drink', (ii) 'everyone left early', and (iii) 'Even his girlfriend left and went clubbing'.

(ii) What is said: When a sentence is uttered, it is always enriched by some contextual information.¹ Consequently, the conversational context contributes to what is said. Minimally, this contextual contribution is needed to fix reference assignment and avoid ambiguity. For instance, the pronoun *his* needs to be taken to refer to Peter. However, the context in which B's answer may also be taken to licence further contextual enrichments. For instance, *drink* in this context refers to alcoholic drinks and not, for instance, to some kind of tea. Moreover, the quantifier *everyone* does not refer to everyone living on the planet earth, but to everyone who attended the party. For this reason, what B directly communicates (says, states, or asserts) may roughly be described as follows (where the italicised elements go beyond what has been linguistically encoded):

2. B: There wasn't enough *alcoholic* drink to satisfy the people at [*the party*]_i and so everyone *who came to* [*the party*]_i left [*it*] early. Even his [*Peter's*] girlfriend quit [*the party*]_i and [*then*] went clubbing.

(ii) Presuppositions: Presupposed content is content that is considered as backgrounded information, information that is taken for granted (or can be taken for granted) by the interlocutors. For instance, in B's answer the use of the linguistic expression *enough* presupposes that there was some alcoholic drink, the focus sensitive particle *even* presupposes that Peter's girlfriend was not supposed to quit the party, the definite description *his girlfriend* presupposes that Peter has a girlfriend, and the change of state verb *quit* presupposes that Peter's girlfriend attended the party. Presupposition is, thus, information which is old, previous, or given, or at least presented as such (Stalnaker, 1974). The presupposed content of B's answer in (2) does not contribute to the main point of the utterance, but implicitly conveys information that is assumed to be shared and/or uncontroversial.

(iv) Implicatures: In contrast to presuppositions, implicatures are implicitly communicated contexts which contribute new information and are often the main point of the utterance. They are the result of a wholly inferential process, and are thus context-dependent. In (2), B's response is not an explicit answer to A's question. The implicit meaning that *the party was not a success* can be derived from B's answer and represents his main point.

The overall meaning of B's answer is a composition of all different levels of meaning. This thesis focuses on presuppositions. In what follows, I will discuss the linguistic and

¹ The extent to which contextual enrichments are taken to contribute to the level of what is said varies according to different theoretical approaches (see, e.g., Penco & Domaneschi, 2013). In what follows, we follow the contextualist analysis of Carston (2009).

discourse properties of presuppositions, highlighting their specificities when compared to other levels of meaning.

1.2. Presuppositions: A special kind of implications

When a speaker presupposes something, she usually assumes something or takes it for granted². Such a characterization is close to the very first notion of presuppositions introduced by Frege (1892, p. 40), when discussing the issue of the reference of proper names: “If anything is asserted there is always an obvious presupposition that the simple or compound proper names used have referents.” Following this, a speaker who utters (3) presupposes – takes for granted – that there is a person called *Pierre* and that there is a place called *Iceland*.

3. Pierre went to Iceland.

For Frege, presuppositions are special conditions that must be met for a sentence to have a denotation. When this pre-requirement of reference is fulfilled, the sentence can be either *true* or *false*³.

Presuppositions have received different definitions in distinct linguistic traditions (for an overview see, Geurts & Beaver, 2011). In what follows, I point out some of the core properties attributed to presuppositions, which crosscut alternative characterizations. First, presuppositions are typically conceived as a special kind of implication. Chierchia and McConnell-Ginet (1990) define presuppositions as follows:

“a sentence *S* presupposes a proposition *p* if (the utterance of) *S* implies *p* and further implies that *p* is somehow already part of the background against which *S* is considered, that considering *S* at all involves taking *p* for granted.”

(Chierchia & McConnell-Ginet, 1990, p. 280)

² It is important to mention that there is a debate on the source of presuppositions. Some hold a pragmatic account of presuppositions and suggest that they arise because of conversational principles (e.g. Stalnaker, 1974). Others hold a semantic account and maintain that presuppositions are related to the conventional aspects of meaning (e.g. Karttunen, 1973; Chierchia & McConnell-Ginet, 1990).

³ Frege’s view was later challenged by Russel (1905), who strongly disagreed with the Fregean account and developed a new theory of definite descriptions. For Russel, every sentence has a truth-value even if a sentence refers to a non-existing expression. Independently of its truth-value, a sentence is either true or false. Contrary to Russel’s view, Strawson (1950) *On referring* follows a similar argumentation as introduced by Frege while emphasising that the meaning and the implication that arises from the use of definite descriptions are distinct from one another. In contrast to Frege and Russel, Strawson clearly distinguishes between the notions of expressions and uses of expressions. He illustrates this crucial difference as follows:

“the expression [*the king of France*] cannot be said to mention, or refer to, anything, any more than the sentence [*The king of France is wise*] can be said to be true or false [...] ‘Mentioning’ or ‘referring’ is not something an expression does; it is something that someone can use an expression to do. Mentioning, or referring to, something is a characteristic of a *use* of an expression, just as ‘being about’ something, and truth-or-falsity, are characteristics of a use of a sentence.”

(Strawson, 1950, p. 325)

In their definition, two characteristics of presuppositions are important. First, the presupposition p is already part of the background and second, p is taken for granted. This highlights that presuppositions are not the subject to discussion and are typically assumed to be shared or accepted by all interlocutors. Given these characteristics, presuppositions can be clearly distinguished from asserted information, or what is said, that is, information that is typically conveyed as new information. If a sentence S asserts q and presupposes p , then denying q , wondering whether q is true, hypothesising about q , or supposing q can only have an impact on the asserted content – the new information. In all these cases, the implication that p survives and p is assumed to be true. In other words, when an operator suspends or shifts the truth of a sentence containing a presupposition trigger, it only has an impact on the asserted content, but it leaves the presupposition untouched. The so-called *family of sentences test* proposed by Chierchia and McConnell-Ginet (1990) assesses the backgroundness of implications under different operators. For instance, using the change-of-state verb *stop* in (4a) presupposes that *Charlotte used to eat candy before lunch* (4f). The presupposition remains unaltered under different operators such as negation (4b), a question (4c), a conditional (4d), or a modal operator (4e).⁴

4. **Family of sentences test for *stop***

- a. **Simple Sentence**
Charlotte stopped eating candy before lunch.
- b. **Negation**
It is not the case that Charlotte stopped eating candy before lunch.
- c. **Question**
Did Charlotte stop eating candy before lunch?
- d. **Conditional**
If Charlotte stopped eating candy before lunch, then she lives healthier.
- e. **Modal**
Charlotte might have stopped eating candy before lunch
- f. **Presupposition in (a) to (e)**
Charlotte used to eat candy before lunch.

The S family test can be applied to all presupposition triggers. For instance, all examples in (5) using the factive verb *know* presuppose the truth of the factive complement that *Rob is working on his thesis* in (5f).

⁴ There are also other operators that do not alter the presupposition. For instance, possibility modals (4g), evidential modal or a probability adverb (4h), or a belief operator (4i) (see Geurts & Beaver, 2011).

- 4. g. Maybe/ It is possible that Charlotte stopped eating candy before lunch.
- h. Presumably/ Probably Charlotte stopped eating candy before lunch.
- i. Lucie thinks that Charlotte stopped eating candy before lunch.

5. **Family of sentences test for the factive verb *know***

- a. **Simple Sentence**
Jacques knows that Rob is working on his thesis.
- b. **Negation**
Jacques does not know that Rob is working on his thesis.
- c. **Question**
Does Jacques know that Rob is working on his thesis?
- d. **Conditional**
If Jacques knows that Rob is working on his thesis, he will be relieved.
- e. **Modal**
Jacques may know that Rob is working on his thesis
- f. **Presupposition in (a) to (e)**
Rob is working on his thesis.

In example (5), the implication that *Rob is working on his thesis* is not only true when embedded in the complement clause of the factive verb construction (*to know that*) (5a), but also when the knowledge attribution is denied (5b), questioned (5c), part of a hypothetical assumption (5d), or embedded under a modal operator (5e). Since the implication *Rob is working on his thesis* remains unaltered under all these operators, the information is considered as backgrounded. Contrary to presuppositions, entailments fail the S family test. For instance, the implication in (6e) that *Mary touched Sarah* is an entailment of the sentence in (6a). When applying the S family test, the entailment disappears. More precisely, denying the assertion as in (6b) no longer entails that *Mary touched Sarah* (see Chierchia & McConnel-Ginet, 1990). In addition, the entailment of sentence (6a) does not survive the application of any other operators as in (6c – 6e).

6. **Family of sentences test for an entailment**

- a. **Simple Sentence**
Mary kissed Sarah.
- b. **Negation**
Mary did not kiss Sarah.
- c. **Question**
Did Mary kiss Sarah?
- d. **Conditional**
If Mary kissed Sarah, then she will be happy.
- e. **Modal**
Mary may have kissed Sarah.
- f. **Implicated meaning of (a)**
Mary touched Sarah.

In summary, the S family test allows distinguishing entailments from presuppositions⁵. Entailments strictly depend on the truth-condition of the sentence, whereas the truth of the presupposition remains unaltered even if an operator suspends or shifts the truth of the sentence. This and similar observations on questions and modal verbs correspond to what linguists have called the phenomenon of *projection* of the presupposed content (e.g., Ducrot, 1972; Langendoen & Savin, 1971; Geurts, 1999).

1.3 Cancellability

As we have seen in the previous section, sentences as those in examples (4) and (5), in which the presupposition trigger is embedded under various operators, leave the presupposition untouched. While these represent instances in which the presupposition projects, presuppositions do not always project. Indeed, as discussed by Geurts and Beaver (2011), when the presupposition trigger is embedded under certain operators like negation (7a), a conditional (7b), or a question (7c), the presupposition can also be directly denied. In these scenarios, it is said that the presupposition is *cancelled*.⁶

7.
 - a. Charlotte didn't stop eating candy before lunch: Since Charlotte was little, she believes that candy is bad for her health, so she never ate candy.
 - b. If Charlotte stopped eating candy before lunch, then I'm the new king of France: Charlotte never ate candy before lunch.
 - c. Did Charlotte stop eating candy before lunch? Certainly not, she never ate candy.

In contrast with this, the denial of an *unembedded* presupposition by the same speaker is usually considered infelicitous (see example 9). Geurts (1999) remarks that a speaker uttering a sentence containing a presupposition *p* commits herself to the truth of the presupposition *p*. So, cancelling one's commitment to the presupposition within the same utterance would be considered as a very odd discursive move.

⁵ Chierchia and McConnell-Ginet note that backgroundedness does not only apply to presuppositions. Some implications that are not presupposed also survive the S family test. For instance, the implication that *Jill lost something* in the nonrestrictive relative clause *Jill, who lost something on the flight from Ithaca to New York, likes to travel by train* survives the family of sentences test. Importantly, a characteristic that is only attributed to presuppositions is that the information must be taken for granted, the information must, thus, be part of the common ground. This is not the case in the presented nonrestrictive relative clause. This point is well-illustrated in Potts (2005, p. 33f.). His example in (8) shows that the appositive in (8a) is redundant in cases in which the information has already been introduced, whereas this is not the case for the factive predicate *know* in (8b).

8. Lance Armstrong survived cancer.
 a. #When reporter interview Lance, a cancer survivor, he often talks about the disease.
 b. And most riders know that Lance Armstrong is a cancer survivor.

⁶ In cases in which the presupposition is cancelled, the presupposition is first derived and then cancelled. It is worth distinguishing between 'cancellability', on the one hand, and 'suspendability', on the other hand. The latter term, adopted for instance by Abusch (2002) tend to describe cases in which the presupposition is not derived, for instance in ignorance contexts.

9. #Charlotte stopped eating candy, but she never ate candy.

The characteristic that presuppositions are not cancellable with unembedded triggers is one of the apparent differences between presuppositions and implicatures. First, in example (10), the conversational implicature can directly be cancelled (10b) or suspended (10c) indicating that the speaker is not committed to the implicature. The content of the sentence is still true even if the implicature that *the cat ate most but not all of the sausages* is not.⁷ In contrast, cancelling the presupposition that there is no cat (10d) renders the sentence infelicitous.

10. a. The cat ate most of the sausages.
b. The cat ate most of the sausages – in fact, it ate all of them.
c. The cat ate most, maybe all, of the sausages.
d. #The cat ate most of the sausages, but there is no cat.

When it comes to presuppositions, though, the possibility of cancelling or challenging the presupposition of an unembedded trigger is only available for someone other than the speaker herself. However, as suggested by Shanon (1976) and von Stechow (2004, 2008), challenging or even cancelling a presupposition requires a particular discourse move that is metalinguistic in nature. This discourse move is the so-called '*Hey, wait a minute!*' test. To reject the presupposition of speaker A in (11), B must disrupt the normal flow of discourse.

11. A: When did Charlotte stop eating candy before lunch?
B: Hey, wait a minute! Charlotte didn't used to eat candy before lunch.

In summary, presuppositions are information that is backgrounded and taken for granted. Typically, presuppositions project, which is a characteristic that clearly distinguishes them from entailments and implicatures. Second, presuppositions cannot be cancelled when unembedded, but implicatures can (for a summary of these characteristics, see Table 1).

⁷ According to Grice (1975/1989), all conversational implicatures can be explicitly cancelled, even by the same speaker without rendering the meaning of the sentence infelicitous. An adapted version of his original example is shown in (12).

12. A: Is Mary still single?
B1: She has been visiting New York quite a lot lately.
Mary has a boyfriend (Implicature)
B2: She has been visiting New York quite a lot lately, but I don't mean to imply that she is seeing someone. In fact, she is still in love with her ex.

Table 1. *Characteristics of entailments, presuppositions, and conversational implicatures (see Geurts & Beaver, 2011).*

	Entailments	Presuppositions	Implicatures
Project from embeddings	no	yes	no
Cancellable when embedded	/	yes	/
Cancellable when unembedded	no	no	yes

1.4. Different levels of meaning = Different levels of commitment?

A distinct, and complementary, way of looking at the distinction between explicit and implicit levels of meaning within a pragmatic perspective involves focusing on the social implications of communicating a message at one level rather than another. There is an emerging literature in pragmatics that aims to better understand how different levels of meaning convey varying degrees of speaker commitment.

Commitment is a key notion in linguistics that aims to capture the degree to which a speaker can distance herself from the content of her utterance or express her endorsement towards it (Boulat & Maillat, 2017). It has been shown that several linguistic markers convey different degrees of commitment: (1) modal auxiliaries (*must* versus *might*), (2) adverbials (*certainly* versus *maybe*), and (3) evidentials (*I saw* versus *I guess* versus *people say*; for a more exhaustive list, see Boulat & Maillat, 2017). In a recent theoretical proposal, Moeschler (2013) addresses the issue of how different levels of meaning can affect speaker commitment to varying degrees.


To illustrate the variability of commitment across different levels of meaning, Moeschler (2013) compares four levels of meaning: (i) entailments, (ii) presuppositions, (iii) what is said/explicatures, and (iv) implicatures. The notion of commitment proposed by Moeschler is tightly linked to that of *strength*. He points out that the strength of an assumption depends on two factors: (1) the nature of the inference – semantic versus pragmatic – and (2) the accessibility of the inferred content. Based on this notion, Moeschler suggests that distinct levels of meaning commit the speaker differently. In what follows, I will consider them in turn.

The first factor “depends on the nature of the inference it gives rise” (Moeschler, 2013; p. 88). The speaker shows a higher commitment to levels of meaning that are semantic in nature compared to the pragmatic ones. Therefore, using an entailment or a presupposition is more committal than using an explicature or an implicature. Moeschler provides a detailed

explanation of why some levels of meaning are more committal than others. In his proposal, he relates his analysis to truth-functional values showing that entailments are more committal than presuppositions, presuppositions are more committal than explicatures, and lastly, explicatures are more committal than implicatures (see Table 2). In the following, I will illustrate how Moeschler assigns the truth-functional values for each level of meaning and discuss the implications for our discussion on commitment.

Table 2. *Order of strength (adapted from Moeschler, 2013)*

P	Q	Entailment	Semantic presupposition	Explicature	Implicature
1	1	1	1	(3) 1	1
1	0	0	0	0	1
0	1	1	1	0 (2)	0
0	0	1	1 ∨ 0 (1)	1	1



strength of the content

First, let us turn to the distinction between entailments and presuppositions. As pointed out in the previous section when discussing the phenomenon of presupposition projection, sentences containing a presupposition trigger as the factive verb *know* in (13) presuppose Q under affirmation (13a), and the presupposition also holds under negation (13b). That is, whether P is true or not, the presupposition Q is true in these cases. However, presuppositions do not always project and can be cancelled under certain circumstances.

13. a. Jacques knows that Laure is at school. (P = 1 and Q = 1)
- b. Jacques does not know that Laure is at school. (P = 0 and Q = 1)
- c. Jacques does not know that Laure is at school, since she never went to school. (P = 0 and Q = 0)

Indeed, Moeschler points out that in cases of metalinguistic negation, as in (13c), the sentence is acceptable even if both P and Q are false. In (13c), the sentence asserts that *Jacques does not know X* (P = 0) and the presupposed information that *Laure is at school* is false (Q = 0). However, since the point of the speaker is to cancel the presupposing relation by metalinguistic negation, (13c) is acceptable (1=true). Therefore, when P = 0 and Q = 0, there are two possibilities; the sentence can be either false or true (see Table 2).

Concerning entailments, they behave similarly to presuppositions concerning their truth-values when P is true. However, when both P and Q are false (see blue rectangular (1) in Table 2), as in (14c) the entailment relation is always preserved.

14. a. Peter ate strawberries. Peter ate something. (P = 1 and Q = 1)
- b. Peter didn't eat strawberries; he ate raspberries. (P = 0 and Q = 1)
- c. Peter didn't eat strawberries; he drank a glass of milk. (P = 0 and Q = 0)

In contrast with this, as pointed out before, the survival of the presupposition relation under these circumstances depends on whether it is cancelled or not. For this reason, according to Moeschler, entailments are more committal than presuppositions. Second, let us now turn to the difference between presuppositions and explicatures (or contextually enriched of *what is said*).

15. a. It is raining.
- b. It is raining [today] [in Lyon].

While presuppositions are true under negation, the explicature as in (15) cannot be true if the proposition expressed by the sentence is false (see 15b). This is exactly what separates them from presuppositions (blue rectangular (2) in Table 2). For this reason, presuppositions are stronger than explicatures. However, Moeschler points out that the speaker is more strongly committed to the content conveyed via what is said/the explicature than via an implicature. Implicatures differ from explicatures since they are not truth functional. An utterance as in (16) is true independently of the truth of the implicature. Even if the implicature that *Abigale visits her girlfriend* is not true, the utterance can still be true.

16. Abigale takes the train every weekend to Lyon.
 Implicature: Abigale visits her girlfriend.

Taking these logical constraints into account, Moeschler's truth-value analysis points out that (1) entailments are stronger than presuppositions, (2) presuppositions are stronger than explicatures, and (3) explicatures are stronger than implicatures. However, this is only one part of the story. Moeschler claims that the logical truth-value constraint is not the sole factor determining speaker's commitment. Contextual factors, and more specifically, the *accessibility* of the content, also play an important role. For instance, both sentences (17) and (18) express true propositions, but they typically vary in their accessibility. It appears that the proposition in (17) is more accessible than the proposition in (18), which is less salient since it is more difficult to verify.

17. Cairo is the present capital of Egypt.
18. Thebes is the capital of Egypt under the 20th dynasty.

Moeschler notes that the previous ordering of the four different levels of meaning changes once we take accessibility as the criterion. Given that entailments and presuppositions are backgrounded, the hearer must not necessarily evaluate their truthfulness. These contents are, therefore, less accessible. In contrast, explicatures and implicatures are foregrounded information. Consequently, their contents are more accessible compared to the backgrounded contents of entailments and presuppositions. Moreover, Moeschler maintains that explicatures are also stronger than implicatures in terms of accessibility since their content is explicit and need not be totally inferred by the addressee.

In summary, in his analysis, Moeschler points out that speaker commitment depends on the logical truth-value ranking. Entailments are stronger than presupposition, which are stronger than explicatures, and lastly explicatures are stronger than implicatures (see 19). However, when taking the notion of accessibility into account, the relevant distinctions are based on (i) foregroundedness versus backgroundedness and (ii) between explicitness versus implicitness. Foregrounded information is more accessible than backgrounded information, and explicit content is more accessible than implicit content. Therefore, the commitment rankings given by accessibility is the following: explicatures > implicature > entailments = presuppositions (see 20).

19. Ordering based on the nature of the inference
entailments > presupposition > explicature > implicature
20. Ordering based on the accessibility of the resulting content
explicature > implicature > entailments = presupposition

When evaluating speaker commitment, the hearer may take into account both factors; however, Moeschler does not make any clear prediction about the relative weight of these two factors. This leaves us with no clear empirical predictions about the speaker's commitment with respect to the place of presupposition when compared to other levels of meaning.

Furthermore, other scholars, such as Lombardi Vallauri (2016), have focused on other features of presuppositions that might be relevant to the question of the degree of speaker commitment they convey. Lombardi Vallauri (2016) claims that the speaker can more easily distance herself from their presuppositions because of their backgrounded nature and the fact that they are typically assumed to be accepted, and shared, by interlocutors. In his proposal, he sees presuppositions as marginal information, which only provide a context to understand the asserted information more easily. In most of the cases, the presupposed content has already

been put forward by another source, to who responsibility is deferred. For this reason, it is not the speaker, but the other source that is in principle accountable for the truth of the presupposed content. Lombardi Vallauri notes that “messages containing presuppositions encode their notional content explicitly, but they conceal the very act of proposing it as true, as if the speaker has no commitment to transferring” (p. 3).

In contrast with this kind of proposals, Peters (2016) notes that speakers are strongly committed towards the presuppositions of their utterances because of their cancellability properties. If the speaker attempted to cancel her communicated presupposition in the same sentence, this would result in an infelicitous discourse move (Geurts, 1999). Moreover, Simons (2005) indicates that presuppositions tend to be non-controversial. Typically, contents conveyed as a presupposition are not under discussion. Consequently, they should be considered as committal as the speaker is avoiding the possibility of exposing them to challenge. What all these proposals have in common is their focus on the kind of attitudes that speakers have, and assume their interlocutors should share, towards the content that is presupposed. These attitudes refer to notions such as mutual knowledge, acceptance, non-controversiality, all notions that have played a prominent role since the early literature on presuppositions, and that have been analysed with respect to the discursive properties of presuppositions. In the next section, I will focus on some of these notions by looking at the common ground framework of presuppositions.

In summary, recent theoretical proposals suggest that different levels of meaning may convey different degrees of speaker’s commitment. These theoretical proposals do not offer a coherent perspective on this issue and they have not yet been empirically investigated. For this reason, the first study of this thesis (Chapter 2) will experimentally assess the relative degree of speaker’s commitment carried by assertions (what is said/explicatures), presuppositions, and implicatures.

1.5 Common ground, informative presuppositions, and presupposition accommodation

Stalnaker (1974, 1998, 2002) has put forward an influential theory of presuppositions. One of the core ideas of his account is the notion of *common ground*. The common ground comprises the propositions that are mutually assumed, as well as accepted, by all participants in the conversation. This determines a set of worlds, the so-called ‘context set’, in which all propositions that are in the common ground are true. According to Stalnaker, the point of an assertion is to add a piece of new information *p* to the common ground (a process by which the common ground is *updated*). When this is attained, the worlds of the context set in which *p* is

true are kept and the others, those where p is false, are removed. After the update has taken place, the new information is taken for granted and in principle is not subject to any further discussion. According to Stalnaker, sentences can have presuppositions in the sense that their use impose some constraints that the common ground needs to satisfy for the asserted content to be updated. For instance, an appropriate use of the sentence “*Paul stopped smoking*” would require the common ground to include the proposition that *Paul used to smoke* for an update of the context set to be possible.

According to Stalnaker (1974), presuppositions are a pragmatic phenomenon: while speakers can presuppose a content, sentences do so only indirectly (i.e. in virtue of being uttered by a speaker who is making certain assumptions about the common ground). When a speaker presupposes something, she is treating that information as information which is mutually accepted. This idea, which represents one of the pillars of Stalnaker’s common ground theory of presuppositions, has been adopted widely, even by scholars that consider presuppositions as *hardwired*, that is, as encoded into the semantics of certain words or linguistic expressions. Von Stechow (2008), who belongs to this second group, acknowledges for instance that “at the pragmatic level, speakers need to consider what it takes for an assertion of such a sentence to be successful” (p. 21) and that the information conveyed by the presupposition should be uncontroversial (e.g., Soames, 1989; von Stechow, 2008). Presuppositions, whether intended as a purely pragmatic phenomenon or a semantic one, are information towards which speakers entertain a specific epistemic attitude, that of *acceptance*, and assume or expect the hearer to do the same.

One objection raised by many scholars (e.g., Abbott, 2006; Gauker, 1998) towards Stalnaker’s common ground theory relates to the phenomenon of ‘informative presuppositions’, that is, instances of utterances in which the presupposition is not already part of the common ground but conveyed as such. All examples of (21)⁸ presuppose something that is not already part of the common ground, but it seems to be that all utterances can be understood without a problem and are not in the way of a successful conversational exchange.

⁸ Examples (21a) - (21c) are taken from Tonhauser (2015).

21. a. [A recent hire who nobody knows anything about excuses himself from his first meeting.]
I can't come to the meeting – I have to pick up **my cat** from the veterinarian.
- b. [A Linguistics professor introduces his new partner to her colleagues saying:]
He **stopped** doing linguistics before he met me.
- c. [A young woman (not wearing glasses) backs her car into that of another driver. The young woman's mother says:]
I'm sorry this happened; she **knows** that she has to wear glasses to drive
- d. [A person that just moved in a shared flat says to her new roommates:]
My sister is coming to lunch tomorrow.

What exactly happens in these examples? How can it be that informative presuppositions do not lead to an inappropriate utterance, but can be understood successfully? In order to account for cases like these, Stalnaker (1998) suggested that presuppositions need not be part of the common ground before the time of utterance, but they must be part of it before the update of the assertion occurs. Therefore, the presupposition is timely linked to the assertion:

“The point of the speech act – an assertion for example – is to change the context, and since the way the speech act is supposed to change the context depends on its content, interpretation must be done in the prior context – the context as it is before the assertion is accepted, and its content added to what is presupposed. But the prior context cannot be the context as it was before the speaker began to speak. [...] The prior context that is relevant to the interpretation of a speech act is the context as it is changed by the fact the speech act was made, but prior the acceptance or rejection of the speech act.”

(Stalnaker, 1998, p. 283).

To better illustrate this context dynamics, von Stechow (2000) uses the example in (22).

22. [A recent hire who nobody knows anything about excuses himself from his first meeting.]
I can't come to the meeting – I have to pick up **my cat** from the veterinarian.

The speaker presupposes that she has a cat, while the information is unknown to all hearers (and the speaker is aware of this). In order to add the asserted content *that she cannot attend the meeting* to the common ground, the presupposed content must first be added to it. Once added, the common ground now entails that the speaker has a cat and subsequently the assertion can be added to the common ground. In the proposed analysis, the presupposition is not already part of the common ground prior the utterance (see **Figure 1**, T_0), but the presupposition is added to the common ground as soon as the utterance is made. This process is known in the literature as ‘presupposition accommodation’.

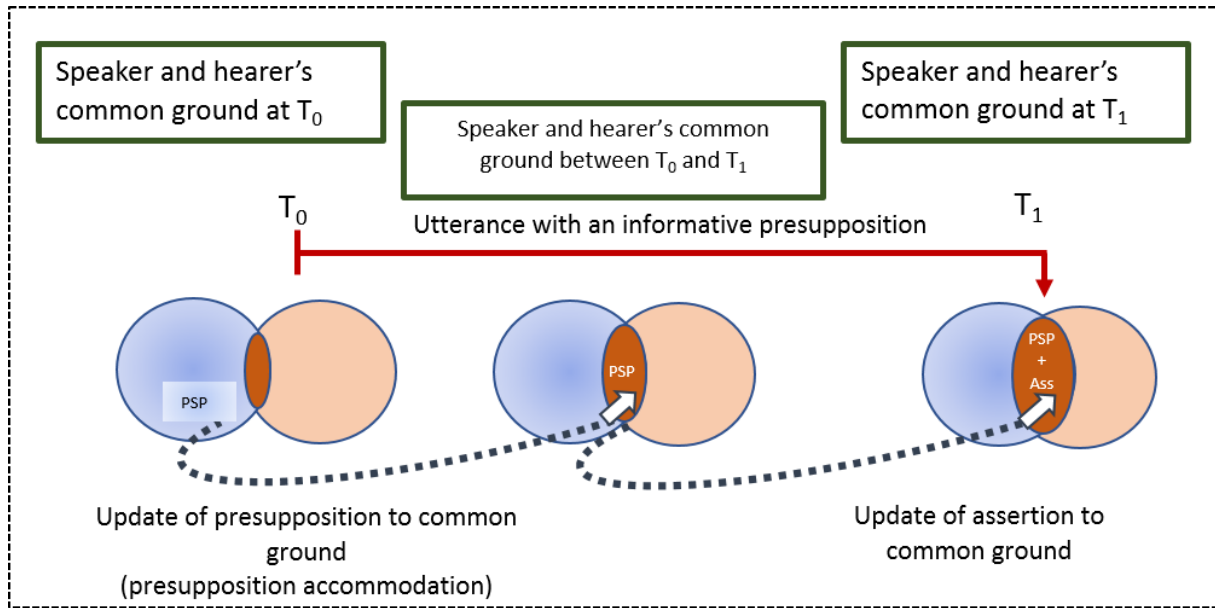


Figure 1. The process of presupposition accommodation (adapted from Greco, 2003).

The first scholar that acknowledged the successful integration of informative presuppositions, as in (22), was Lewis (1979), via his *rule of accommodation for presupposition*:

“If at time t something is said that requires presupposition P to be acceptable, and if P is not presupposed just before t , then – *ceteris paribus* and within certain limits – presupposition P come into existence.”

(Lewis, 1979, p. 340)

There are two important notions in Lewis’ *rule of accommodation for presuppositions*. First, *presuppositions can come into existence* even if they are not presupposed at t , and second this coming into existence, called accommodation, can only occur within certain limits. In a similar vein, von Fintel (2008) notes:

“Presupposition accommodation is the process by which the context is adjusted quietly and without a fuss to accept the utterance of a sentence that imposes certain requirements on the context in which it is processed.”

(von Fintel, 2008, p. 1)

Crucially, presupposition accommodation only occurs if the *context is adjusted quietly and without a fuss*. This idea elaborates on Lewis’ remark that accommodation takes place *ceteris paribus* – *within certain limits*. According to von Fintel, informative presuppositions will be accommodated if (i) the hearer trusts the speaker that is that she does not communicate inappropriate or even false information and (ii) the hearer does not want to dispute the speaker. However, presuppositions will not be accommodated in cases in which the hearer wants to

dispute p ⁹. In these cases, the presupposition is not accepted and is subject to further discussion. In addition, there are also cases in which the speaker “is trying to smuggle an important piece of information into the common ground that merits more attention” (von Fintel, 2000, p. 16¹⁰). These cases will not result in presupposition accommodation, but rather in a presupposition failure. This is exactly what is likely to happen in example (24). If we *compare* example (24) to utterance (23), the fact that the speaker will go to the vet with her giraffe is much more unlikely than scenarios in which the speaker takes her cat to the vet. In the former case, presupposition accommodation will most likely not take place. In cases in which the hearer wants to dispute the presupposition, he cannot directly refute it but must use a strategy to refute the presupposition, that is, using the previously mentioned ‘*Hey, wait a minute!*’ test (Shanon, 1976; von Fintel, 2004).

23. [A recent hire who nobody knows anything about excuses himself from his first meeting.]
I can’t come to the meeting – I have to pick up **my cat** from the veterinarian.
24. [A recent hire who nobody knows anything about excuses himself from his first meeting.]
I can’t come to the meeting – I have to pick up **my giraffe** from the veterinarian.

To sum up, common ground accounts of presuppositions have highlighted the special epistemic status of presupposition in discourse: presuppositions are introduced as information that is accepted, or acceptable, by all participants of the conversation and, as such, felicitous uses of presuppositions require interlocutors to be willing to take this epistemic stance. This is the reason why presuppositions, be they informative or not, will typically represent an appropriate vehicle for the transmission of information only if this information is plausible and non-controversial. In what follows, I carry on with the analysis of the discourse properties of presupposition by discussing two fundamental features: their unavailability to discourse attachment and their typically not at-issue status.

1.5 Discourse attachment properties

The investigation of the discourse properties of presupposition is very much indebted to the work of Ducrot (1972), who first put forth the observation that presuppositions cannot be the

⁹ Kadmon (2001, p. 20 – 21) mentions two constraints on the process of accommodation: (1) consistency and (2) bridging. In the experimental part of this thesis, a study by Singh et al. (2015) investigating plausible versus implausible accommodated presuppositions using a stop-making sense task will be presented.

¹⁰ In his article (von Fintel, 2000), von Fintel’s original example is the one presented in (25). He points out that it is pragmatically inappropriate to utter such a sentence. Given that the first mentioning of *my fiancé* would deserve more attention, it is inappropriate to disguise such a pertinent information as a presupposition.

(25) O dad, I forgot to tell you that my fiancé and I are moving to Seattle next week.

target of discourse attachment. According to his '*linking law*' ('*la loi d'enchaînement*'), discourse attachment can only target the asserted content, whereas the presupposed content remains inaccessible to attachment.

Linking law (*La loi d'enchaînement*)

When an utterance A is linked to another utterance B by means of a coordinating or a subordinating conjunction, or by means of an implicit logical link, the link which is established between A and B never concerns what is presupposed by A and B, but only what is asserted by A and B.

(Ducrot, 1972; p. 81; my translation from French)

According to Ducrot's *linking law*, it is only the asserted content of an utterance A that can be addressed by another utterance B by means of a coordination conjunction, for instance *because* (the French equivalent to *parce que* in Ducrot's original analysis) or by a subordinating conjunction containing for instance *so* (in French *donc*). More precisely, consider the following example in which (26a) represents the asserted content and (26b) the presupposed content:

- 26. Paul stopped eating caviar.
 - a. Paul does not eat caviar.
 - b. Paul used to eat caviar.

A discourse continuation as in (27a) is considered felicitous since the continuation addresses the asserted content *Paul does not eat caviar* (26a). Furthermore, the linking law does not allow a discourse attachment that targets the presupposition *Paul used to eat caviar* (26b). A continuation as shown in (27b) is, therefore, not an acceptable discourse continuation.

- 27. a. Paul stopped eating caviar because he no longer likes it.
 - b. # Paul stopped eating caviar because he liked it.

The same rule applies for the subordinating conjunction *so* as pointed out in example 28. Once again, a continuation which targets the presupposition is considered infelicitous (see 28b), whereas a discourse continuation addressing the asserted content as in (28a) is a felicitous one.

- 28. a. Paul stopped eating caviar. So, he will be able to pay his taxes.
 - b. # Paul stopped eating caviar. So, he must have been rich.

Ducrot acknowledges that in certain cases, the discourse continuation can target both contents simultaneously, as in (29), (see Ducrot, 1972, p. 85).

- 29. John must be happy because only Mary came.

Presupposed content: Mary came.

Asserted content: Nobody else came.

The happiness of John appears to be linked to both the asserted as well as the presupposed content, that is, that Mary came and nobody else did. Crucially though, the presupposition cannot be the sole target of attachment.

Moreover, the *linking law* states that when the logical link between utterance A and B is implicit, this always relates the asserted contents of A and B, and not their presupposed contents. The presuppositions, as shown in example (30) only serve as a precondition for felicitous utterances, but no logical connection exists between these contents (31a). There is no certainty that *John used to smoke because Marie used to drink*. The only certainty concerning the presupposed contents that arises from this example is that *John used to smoke* and *Marie used to drink*. The causal link that exists in example (30) only concerns both asserted contents. For this reason, the asserted contents constitute the complex meaning parts (30b and 31b) of the sentence which give rise to the implicit logical link between utterance A and B.

- 30. John stopped smoking because Marie stopped drinking.
 - a. John used to smoke and Marie used to drink. (Presuppositions)
 - b. John does not smoke because Marie does not smoke. (Assertions)
- 31. **Elementary and complex parts of meaning**
 - a. Elementary parts of the utterance (Presuppositions)
What is presupposed by A **AND** what is presupposed by B
 - b. Complex parts of the utterance (Logical link) (Assertions)
What is asserted by A **X** what is asserted by B

Finally, Ducrot also points out that utterances have to satisfy two requirements: (1) the requirement of progress and (2) the requirement of coherence. First, every utterance is supposed to add new information without repeating itself. To avoid endless repetition, the discourse must move forward, which is only possible by the means of an assertion. Second, discourse should be coherent, that is, a certain degree of redundancy must be present. Skipping from one argument to another without the necessary background information would make it difficult to follow. For this reason, a certain redundancy is reached by allowing a certain degree of repetition; however, in order to adhere to the first requirement – the requirement of progress – the repeated information must be presented as the presupposition. In summary, according to Ducrot, using a presupposition allows the discourse to be coherent, while making possible a certain progression from already established information to new information. Given the key characteristics of presuppositions – conveying old, shared, backgrounded information – they

are not suitable for moving the discourse forward and are thus excluded from any discourse attachment.

After Ducrot, many other scholars have acknowledged that presuppositions are background assumptions that do not directly address the most recent accepted discourse goal. Horton and Hirst (1988) note that “a presupposition is a proposition that is conveyed by a sentence or utterance but is not part of the main point” (p. 255). In the same vein, Abbott (2000) points out the following:

“what is asserted is what is presented as the main point of the utterance – what the speaker is going on record as contributing to the discourse [...], typically, asserted proposition in an utterance will correspond to the main clause of the uttered sentence [...] anything else will have to be expressed in another way, typically by being presupposed.”

(Abbott, 2000, p. 1431f).

Recently, Roberts, Simons, Beaver and Tonhauser (2009) have distinguished between content that is ‘at-issue’ and content that is ‘non-at issue’. The notion of at-issueness has been developed within the *Question under Discussion* (QUD) framework proposed by Roberts (1996). For my purposes, it will suffice to consider that in the context of this framework, a discourse carries out a strategy of inquiry, articulated in a sequence of questions (explicitly articulated or left implicit), which are hierarchically ordered and progressively addressed in the context of a conversation. With this in mind, at-issue content is considered as the main point of the utterance, that is, content that contributes to the current question under question. More precisely, at-issue content has been defined as follows:

32. Definition of at-issueness (Simons et al., 2010)

- a. A proposition p is at-issue iff the speaker intends to address the QUD via $?p$
- b. An intention to address the QUD via $?p$ is felicitous if:
 - i. $?p$ is relevant to the QUD, and
 - ii. the speaker can reasonably expect the addressee to recognise this attention.

Crucially, presuppositions are typically considered as not at-issue content. As illustrated by Roberts et al. (2009), a content is considered at-issue only if it can be the target of a direct denial or confirmation. As the example (33) shows, this is not the case for the presupposition p (33b).

33. Have you stopped drinking beer for breakfast?

- a. p = You have been in the habit of drinking beer for breakfast

b. Direct denial or confirmation: “No” or “Yes”

Effect: Replying yes or no commits to p , i.e. having drunk beer for breakfast

c. Indirect rejection: “Hey, wait a minute!” What d’ya mean?” I have never done that.

Effect: *p* is rejected.

Challenging *p* requires a particular discourse move that is more indirect in nature (33c). This metalinguistic discourse move, already described as the ‘*Hey, Wait a minute!*’ test (Shanon, 1976; von Fintel, 2004, 2008) disrupts the normal flow of discourse since it corrects or questions the content that is taken for granted. In this example, it becomes evident that the presupposition *X used to drink beer for breakfast* is not part of the normal flow of discourse, if a challenge is required, this must be done by means of an indirect correction¹¹.

Until this point, the conclusions drawn based on Ducrot’s *linking law* and Simon et al.’s definition of at-issueness with respect to presuppositions are pretty similar. Discourse attachments to the presupposition as well as addressing the current question under discussion with a presupposition are typically considered infelicitous discourse moves. With respect to the latter, though, it is important to point out that a felicitous QUD addressing is occasionally possible via a presupposition, even if the answer to the question is provided by non-at-issue content. Let us have a look at example (34) (Simons et al., 2010).

34. Context: Quentin, Ann and Bob have just eaten dinner at a restaurant where the tip is usually incorporated into the bill. Bob handed Quentin what he said was his share of the bill, then left the table. Quentin is confused by the amount of money Bob has handed him:
- a. Quentin: Are we supposed to leave a tip?
 - b. Ann: Bob doesn’t realise that the tip is included in the price.

In a decontextualised scenario, Ann’s answer to Quentin’s question would be considered infelicitous. The answer is conveyed by the presupposition, which is typically considered as the not at-issue content. However, in this example, Ann’s answer does not appear to be infelicitous. Why is this the case? Simons et al. (2010) point out that the contextual information renders the

¹¹Tonhauser (2012) presents a more detailed analysis of how to diagnose (non-)at-issueness. In total, she identifies three distinct properties: (1) At-issue content can be directly assented or dissented, (2) at-issue content addresses the question under discussion (QUD), and (35) at-issue content determines the relative set of alternatives. For instance, for the first property, the at-issueness content assents/dissents (1) with positive continuation or (2) with adversative continuation. In (35), the continuation before // represents a positive continuation and the one after an adversative one. This example indicates that continuations that target the content *that man stole your money* addresses the QUD, and thus make this content at-issue ((35a) and (35b)). In contrast continuations addressing *my mother’s friend* are considered infelicitous, thus the content they address is taken as not-at issue (35c) and (35d).

35. That man, my mother’s friend, stole your money.

- a. Yes, true, he stole my money. // Yes, true, but he is not my mother’s friend.
- b. That’s not true, he didn’t steal my money. // That’s not true, but he is not my mother’s friend.
- c. #Yes, true, he’s my mother’s friend. // #Yes, true, but he didn’t steal my money.
- d. #That’s not true, he’s not my mother’s friend. // #That’s not true, but he stole my money.

For a more exhaustive description of the other diagnostics, the interested reader is referred to the original paper.

dialogue between Quentin and Ann felicitous. The felicity is not related to Quentin's question, but is related to a higher question that is the question '*Why did Bob give me this amount of money?*'. With the higher question in mind, the presupposed content, the non-at-issue content, does no longer provide the answer to Quentin's explicit question, but allows to construct an implicit question to which it provides an answer to.

As we have just seen, there are cases in which the non-at-issue content can address the QUD. However, Jayez (2010) points out that addressing the QUD does not make attachment to the presupposition more likely. We can illustrate this by putting forward two alternative continuations of (34b). In (36a), the continuation addresses the at-issue content and it is felicitous. In contrast, the continuation addressing the non-at-issue content (36b) is perceived as infelicitous¹².

36. a. Bob didn't realise that the tip is included in the price because he didn't read the receipt.
b. #Bob didn't realise that the tip is included in the price because this makes it more likely to receive it.

The difference between QUD addressing and discourse attachment constraints becomes even more evident when looking at scenarios in which the presupposed content is implicit. Let us look at the example provided by Jayez (see 37 and 38). In (37), B's answer addresses the at-issue content *Paul does not smoke* as well as the non-at-issue content *Paul used to smoke* to support the conclusion that he has a strong will. However, in (38) it is impossible to interpret the meaning in such a way that *Paul smoked because he liked it*.

37. A: Does Paul have a strong will?
B: Generally speaking, yes. He has stopped smoking, for instance.
38. #Paul didn't stop smoking, for instance, because he liked it.

The discussion of these examples highlights the fact that even if attachment constraints generally pattern with QUD addressing, the former are somehow independent from the latter. That is, even in those cases in which the presupposition addresses the QUD, it is still not an available site for attachment. For this reason, attachment constraints appear to be stronger than the constraints imposed by non-at-issueness and should deserve being investigated in an independent way. This is indeed one of the objectives of the present thesis, which is addressed by Experiment 2 (see Chapter 3).

¹² It is worth acknowledging that the explicitness of the asserted and presupposed content may make it less obvious that discourse attachment to the presupposed content is impossible.

1.7. Heterogeneity of presupposition triggers

To conclude this overview of the relevant notions for the study of the phenomenon of presupposition, I will focus on the notion of ‘presupposition triggers’, which comprises the different specific words and constructions that can trigger a presupposition. Levinson (1983) put forth a classification of presupposition triggers that comprises the following categories (see Table 3).

Table 3 indicates the variety of specific words and constructions that trigger a presupposition.

Table 3. *List of presupposition triggers (Levinson, 1983)*

	Presupposition trigger	Example	Presupposition
(a)	Definite descriptions (Frege, 1892; Strawson, 1950)	John met <u>Mary's boyfriend</u> .	Mary has a boyfriend
(b)	Factive verbs (Kiparsky and Kiparsky, 1971)	Martha <u>knows</u> that Fiona took part in the transcontinental race. Martha <u>is sad</u> that Michael did not obtain the scholarship. <i>Other factive verbs:</i> take into account, realise, notice, recognise, is aware, etc., and emotive factives like be shocked, be surprised, be bothered, be glad, etc.	Fiona took part in the transcontinental race Michael did not obtain the scholarship.
(c)	Implicative verbs (Karttunen, 1971)	Melanie <u>managed</u> to enrol in a speech therapy program. John <u>forgot</u> to lock the door Some further implicative predicates: X happened to V (presupposes X did not plan or intend to V, X avoided Ving (presupposed X was expected to, or usually did, or ought to V, etc.	Melanie tried to enrol in a speech therapy program. John intended to lock the door.
(d)	Change of state verbs (Karttunen, 1973; Stellar, 1954)	John <u>stopped</u> smoking.	John used to smoke.

		Further change-of-state verbs: begin, continue, enter, arrive, leave, etc.	
(e)	Iteratives	<p>The flying saucer came <u>again</u>.</p> <p>Carter <u>returned</u> to power.</p> <p>Further iteratives: another time, to come back, repeat, restore</p>	<p>The flying saucer came before.</p> <p>Carter held power before.</p>
(f)	Verbs of judging (Fillmore, 1971)	<p>Agatha <u>criticised</u> Michael for running away.</p> <p>Arguably presuppositional</p>	(Agatha thinks) Michael ran away.
(g)	Temporal clauses (Frege, 1892; Heinämäki, 1972)	<p><u>Before</u> Strawson was even born, Frege noticed presuppositions.</p> <p>Further temporal clause constructors: after, during, whenever, as</p>	Strawson was born.
(h)	Cleft sentence (Atlas & Levinson, 1981, Soames, 1982)	<u>It was Henry that</u> kissed Tom.	Someone kissed Tom.
(i)	Implicit clefts with stressed constituents (see Chomsky, 1972)	Linguistics was invented by <u>CHOMSKY</u> .	Someone invented linguistics.
(j)	Comparisons and contrasts	Carol is a <u>better linguist than</u> Peter.	Peter is a linguist.
(l)	Counterfactuals	<u>If Hannibal had only had twelve more elephants</u> , the Romance languages would not this day exist.	Hannibal didn't have twelve more elephants.
(m)	Questions (e.g., Lyons, 1977)	<u>Who</u> is the professor of linguistics at MIT?	Someone is the professor of linguistics at MIT.

In what follows, I will present more in detail the presupposition trigger represented by factive predicates and compare them to non-factive predicates, as they will be the object of interest of two of the experimental studies presented in this dissertation. Lastly, I will present three different accounts that differentiate between different classes of presupposition triggers.

1.7.1 Factive versus non-factive predicates

Kiparsky and Kiparsky (1970) are the first authors that recognized the difference between factive and non-factive predicates. In their analysis, they point out the existence of an interrelationship between syntactic and semantic features with respect to factive and non-factive complements. In Table 4, their initial list of factive and non-factive predicates is presented.

Table 4. *List of factive and non-factive predicates (Kiparsky & Kiparsky, 1970)*

Factive predicates	Non-factive predicates
regret	suppose
be aware of (of)	assert
grasp	allege
comprehend	assume
take into consideration	claim
take into account	charge
bear in mind	maintain
ignore	believe
make clear	conclude
mind	conjecture
forget (about)	intimate
deplore	deem
resent	fancy
care (about)	figure

The starting point of their analysis is the semantic difference between these two predicates. A sentence containing a factive predicate, but not one containing a non-factive one, presupposes the truth of the embedded clause. For instance; the factive predicate *regret* in (39) presupposes the proposition that *it is raining*, whereas the non-factive predicate *suppose* in (40) does not. It is important to note that the notion of factivity is based on the truth of the presupposition and does not depend on the assertion.

39. I regret that it is raining.

40. I suppose that it is raining

Furthermore, Kiparsky and Kiparsky indicate that there is a correlation between this semantic difference and syntactic differences of factive and non-factive predicates. First, factive

predicates can have as their objects the noun *fact* with a gerund or a *that*-clause, whereas non-factive predicates cannot. For instance, the sentences in (41) containing factive predicates are felicitous, whereas the ones in (42) containing non-factive predicates are not.

41. a. I regret the fact that I don't intend to participate.
b. You have to keep in mind the fact of his having proposed several alternatives.
42. a. # I assert the fact that I don't intend to participate.
b. # We may conclude the fact of his having proposed several alternatives.

Second, factive predicates can have objects as gerunds, but non-factives cannot. The example in (43a) using a factive predicate is felicitous, whereas the non-factive one in (43b) is not.

43. a. Everyone ignored Joan's being completely drunk.
b. # Everyone supposed Joan's being completely drunk.

Lastly, factive predicates differ from non-factive predicates since they do not allow the accusative and infinitive construction. Sentences in (45) using the non-factive predicates *believe* and *suppose* allow this accusative and infinitive construction, whereas the factive predicates in (44) do not.

44. a. # I resent Mary to have been the one who did it.
b. # He took into consideration there have been a mistake somewhere.
45. a. I believe Mary to have been the one who did it.
b. He supposed there to have been a mistake somewhere.

Kiparsky and Kiparsky do not only point out the existence of a syntactic-semantic correlation between the two types of predicates, but also propose an explanation of this correlation. They hypothesise that the difference between factive and non-factive predicates is reflected by their syntactic deep structure. This difference is graphically depicted in **Figure 2**. Sentences reflecting the factive deep structure are sentences like the one in (46).

46. I regret the fact that John is ill.

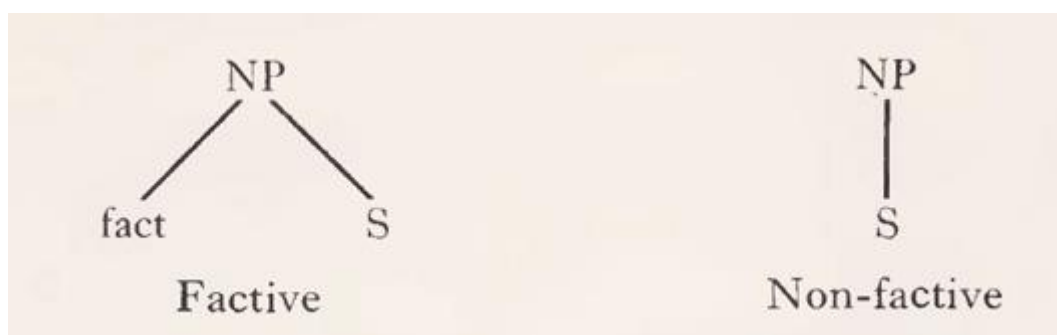


Figure 2. Deep structure of factive and non-factive predicates (Kiparsky & Kiparsky, 1970)

The deep structure of factive predicates is based on two transformations that have been pointed out a priori. Factive predicates allow as their objects the noun *fact* with a gerund or a *that*-clause. When the gerund-transformation to the initial factive sentence *I regret that John is ill* is applied, the sentence is the one as in (47a). Once *the fact* which comes from the factive deep structure is deleted, we get a sentence as in (47c). In cases in which the fact-deletion is immediately applied to the basic form (48b), a simple *that-clause* comes out, which exactly corresponds to the form we are familiar with. The latter form has the very same superficial form as a sentence containing a non-factive predicate as in (49); however, these two forms, that is, the factive versus the non-factive ones, differ largely with respect to their deep structures¹³.

- | | | |
|-----|--|-----------------------|
| 47. | a. I regret the fact of John's being ill. | Gerund transformation |
| | b. I regret the fact of John's being ill. | Fact-deletion |
| | c. I regret John's being ill. | |
| 48. | a. I regret the fact that John is ill. | |
| | b. I regret the fact that John is ill. | Fact-deletion |
| | c. I regret that John is ill. | |
| 49. | I imagine that John is ill. | |

1.7.2. Factives and semi-factives

As we have seen above, Kiparsky and Kiparsky (1970, 1972) were the first scholars that acknowledged the distinction between factive and non-factive predicates. In a subsequent analysis of factive predicates, Karttunen (1971) points out that not all factive predicates behave in the same way. He distinguishes between factives and semi-factives. According to him, factives and semi-factives are similar with respect to affirmative and simple negative assertions but differ in contexts involving certain modal operators. On the one hand, the predicates like *regret*, *realise*, and *discover* presuppose their factive complement *that John had not told the truth* in negative assertions as can be seen in (50).

- | | | | |
|-----|----------------|----------|----------------------------|
| 50. | a. | regret | |
| | b. John didn't | realise | he had not told the truth. |
| | c. | discover | |

On the other hand, in questions, not all these predicates presuppose the complement that *John had not told the truth* (see 51).

¹³ The interested reader is referred to the original article by Kiparsky and Kiparsky (1970), in which the authors illustrate the way in which the deep structures of factive complements accounts for the syntactic patterns presented above (Kiparsky & Kiparsky, 1972, p. 356 -362).

51. a. regret
 b. Did you realise that you had not told the truth?
 c. discover

According to Karttunen, *regret* and possibly *realise* presuppose the factive complement, whereas the complement of *discover* is not presupposed. It seems that the speaker's question is about the addressee's discovery of *not having told the truth*. By the time of the utterance, the addressee may simply have not discovered it yet. Following this line of argumentation, the speaker is not entirely certain about the truth of the factive complement and she "is prepared to accept the addressee's discovery of the fact" (Karttunen, 1971; pg. 63). With respect to the latter, the speaker's question can thus be understood as a sincere request of information giving rise to a non-factive reading in which the complement is not presupposed. Moreover, the example in (52) shows that *realise* can also lose its factivity under certain circumstances.

52. a. regret
 b. If I realise later that I have not told the truth, I will confess it to everyone.
 c. discover

In conditionals, the only verb that maintains its factivity is *regret*, whereas both *discover* and also *realise* no longer presuppose the complement *that you had not told the truth*. For this reason, Karttunen distinguishes between semi-factives and true factives. In the former group, the complement is not always presupposed, it disappears in some linguistic environments (see 53b and 53c). In contrast, in the latter group, the factive complement is always presupposed.¹⁴

53. a. regret
 b. It is possible that I will realise later that I have not told the truth.
 c. discover

In summary, according to Karttunen, not all factive predicates behave alike. Factives that do not presuppose the truth of its complement in questions or conditionals are classed as semi-factives, whereas verbs whose presupposition remains untouched under those modal operators are classed as factives.

1.7.3. A pragmatic account on factives

Until now, I have presented the notion of factivity which is syntactically/ semantically oriented. A different account is proposed by Stalnaker (1974) who attempted to explain factivity as a result of conversational principles. His account is thus rooted in a pragmatic-oriented analysis.

¹⁴ Using this analysis, Karttunen points out that *regret*, *forget*, *resent*, and other verbs that are not specified but where complement can be inferred using this analysis can be considered factives. Verbs like *discover*, *realise*, *find out*, *see*, *notice*, and other verbs that behave similarly are considered semi-factives.

In the following, I will present his analysis of factivity and illustrate how this analysis is meant to capture Karttunen's observations.

According to Stalnaker's view, a speaker uttering (54) conveys two pieces of information: (1) a claim about the fact that *Peter passed the exam* and (2) a claim about Harry's belief state, that is, that *Harry knows P*.

54. Harry knows that Peter passed the exam.

For Stalnaker, it would be unreasonable to make an assertion that *Harry knows P* in a context in which *P* is in doubt or under discussion. In such a case, the speaker would leave it unclear whether her main point is about the epistemic situation of Harry – 'the belief entailment' – that is that *Harry knows P* or about the 'factive entailment *P*'. If both were at-issue, this would be a highly inefficient communicative strategy. Therefore, when the speaker asserts that *X knows P* and it is assumed that the speaker is cooperative, the hearer can take for granted that the speaker utters (54) in a context in which *P* is not at-issue. Consequently, it is the factive complement that comes out as the presupposition and the belief entailment is, therefore, the main point of the speaker's utterance.

Moreover, according to Stalnaker, the pragmatic view of factives can also explain why the factive complement of *discover* in questions is not presupposed (as pointed out in Karttunen's analysis). For Stalnaker, this is because "the speaker could not make the presupposition without assuming an affirmative answer to the question he is asking" (ibid. p. 477). Concerning questions in general, the speaker is not presupposing a particular answer. Consequently, the answer can be affirmative or negative, which is exactly the response set with respect to the other two verbs *regret* or *realise*. For Stalnaker, the difference is linked to the semantics of *discover* rather than to the notion of factivity.

51. a. regret
b. Did you realise that you had not told the truth?
c. discover

Furthermore, Stalnaker clearly illustrates that Karttunen's observed difference between *discover*, *regret*, and *realise* can also be linked to the second-person-pronoun. For instance, using a third-person-pronoun, a question containing *discover* as in (55) seems to presuppose the factive complement, which Stalnaker takes as another sign of evidence that the "constraints on presuppositions can vary without the truth-conditions changing" (ibid. p. 477).

55. Did Sam discover that he had not told the truth?

Lastly, Stalnaker points out why the presupposition for *discover* and *realise* in Karttunen's analysis (see example 52b and 52c) does not hold. In cases in which the speaker utters *If I realise later* or *If I discover later*, she does not presuppose P at the given time since it cannot be assumed that P is already known. Therefore, the speaker cannot assume P, which in turn does not give rise to the presupposition of P. In contrast, if a different type of analysis is applied as the one in (56), Stalnaker claims that the presupposition *that X (=Harry's wife is or has been playing around)* is always presupposed by the speaker, even if the presumption may be stronger in some examples than in others.

56. a. If Harry discovers that his wife is playing around, he will be upset.
- b. If Harry had discovered that his wife was playing around, he would have been upset.
- c. If Harry had realised that his wife was playing around, he would have been upset.
- d. Harry may realise that his wife has been playing around.
- e. Harry may never discover that his wife has been playing around.

In summary, Stalnaker's pragmatic account shows that some differences between factives and semi-factives proposed by Karttunen can be accounted for by: (1) The semantic properties of the particular verb (see the analysis of *discover*) and (2) very general and simple facts with respect to the relation between pragmatic presuppositions and questions, assertions, and suppositions (as pointed out by defeating Karttunen's analysis *If I realise/discover later*).

The pragmatic or semantic nature of factivity is part of an ongoing debate (e.g., Dagnat & Jayez, 2020; Simons, 2007; Simons et al., 2017; Stalmaszczyk, 2019.). Whatever the source of the presupposition triggered by factive predicates in certain contexts, it is widely recognized that they behave differently from similar embedding constructions (such as non-factive predicates). The third study of this thesis will shed light on this difference by looking at the cognitive correlates of processing factive and non-factive complements.

Factive verbs are one type of presupposition triggers. As indicated before, many different words and linguistic constructions can trigger a presupposition. It is commonly assumed that presupposition triggers behave differently from one another; however, there are different proposals that attempted to group the heterogeneous class of triggers into different subcategories. In what follows, I will present three proposals that group different triggers into different categories according to different criteria.

1.8 Differences between presupposition triggers: 3 proposals

1.8.1. Resolution and lexical trigger: Different accommodation properties

Zeevat (1992, 2002) distinguishes between resolution and lexical triggers. Within the former category, he acknowledges the existence of two subcategories, that are, referential anaphoric presupposition triggers and non-referential anaphoric presupposition triggers.

According to Zeevat, resolution triggers are anaphoric in nature, that is, their presupposed content can be retrieved from a contextual antecedent: “their primary function is – like anaphora – to collect entities from the environment in order to say new things about them” (Zeevat, 1992, p. 397). Crucially, he distinguishes between referential anaphoric triggers and non-referential anaphoric triggers. Referential anaphoric triggers, such as definite descriptions, *when* and *after* clauses and cleft constructions refer to an antecedent, whose existence is given, and say new things about that reference. For instance, the definite *the cherry tree* in (57) points to an antecedent, which is *some cherry tree*, and says something new about it, namely that *it was cut down*.

57. The cherry tree was cut down.

These triggers require the addressee to be in a position to figure out what the referential antecedent is. In order to accommodate the presupposition, the trigger must have a unique referential anaphora. In cases in which the antecedent – the presuppositional content – cannot be retrieved, a discourse failure arises, and therefore the utterance can be considered infelicitous. The second sub-category of resolution triggers poses weaker constraints on the felicity of the utterance. Triggers such as *too*, *also*, *another*, and *again* fall into the category of non-referential anaphoric presupposition triggers. As the previously mentioned category, these triggers also have an anaphoric nature; however, Zeevat (2002) notes that they “do[es] not make a contribution to the truth conditions of the sentence in which it occurs” (p. 70). For instance, the sentence in (58), using the particle *too*, which can either refer to a context in which someone else won an award as in (58a) or to a context in which Mary did something different than winning an award, for instance winning a race as in (58b).

58. Marie won an award too.

a. Peter won an award.

b. Marie won the race.

Crucially, even in cases in which the addressee is not in a position to recover the intended antecedent, an utterance of (58) can still be considered as acceptable.¹⁵ This represents a considerable difference with the first sub-class of resolution triggers. As pointed out before, a definite as *the cherry tree* in (57) must be taken to refer to an existing entity for an utterance containing it to be acceptable. If the referent is not identifiable, i.e. there is no salient cherry tree, the presupposition failure makes the discourse infelicitous.

The last category of presupposition triggers in Zeevat's distinction is that of lexical triggers. In order to correctly use these types of presupposition triggers some preconditions must be met. Zeevat uses an analogy to illustrate his claim more clearly. Let us imagine that you want to post a letter. In order to do this action, some preconditions must be met. First, the letter must be written and second, you must have paper and a pen to write it. This is very much the same when looking at lexical presupposition triggers. For instance, in sentence (60), Paul's sadness is triggered by the existence of the event that *Mary left the party*. In order to be sad about an event, the event must have occurred, and the subject *Paul* must believe that the event occurred. It is not possible that Paul is sad about an event that did not occur¹⁶.

60. Paul regrets that Mary left the party.

In these cases, presuppositions correspond to the applicability conditions of the concept encoded by the lexical trigger. Other lexical triggers are aspectual verbs like *stop* or *start*. In general, the presupposition of lexical triggers can always be recovered by the hearer and he can add it to the discourse model. It is important to mention that the presupposition is unambiguous, as can be seen in (60), which is not the case for triggers like *too* as pointed out before.

In summary, Zeevat's distinction of different triggers is based on their different accommodation properties. Anaphoric referential triggers must have access to their antecedent in order to be accommodated. In contrast, anaphoric non-referential triggers do not necessarily have to be accommodated since the sentence is considered as true even if the presupposition cannot be recovered. Lastly, the presupposition of lexical triggers can be recovered by the hearer by accessing the lexical entry of the trigger even if the presupposed content has not been mentioned in prior context.

¹⁵ It should be noted though that using the triggers like *too*, *again*, *also*, and *another* in contexts in which the presupposition is not common ground appears to be a dispreferred option (see Amaral & Cummins, 2015).

59. A: Mary has never had any success with her novel.

B: Didn't you hear? She just won another award.

¹⁶ Zeevat's analysis follows Heim's notion of accommodation (Heim, 1983).

1.8.2. Soft and hard triggers: The criteria of defeasibility/suspendability

A second proposal pointing out the heterogeneity of presupposition triggers is put forward by Abusch (2002). In her account, defeasibility/suspendability is taken as the criteria to divide presupposition triggers into two different groups. She considers one group of presupposition triggers that give rise to easily defeasible/suspendable presuppositions, and another group of triggers that do not. The former are called *soft triggers* and the latter are called *hard triggers*. For instance, the aspectual verb *to stop* can be considered as a soft trigger since its suspendability is context-dependent. For instance, consider the examples in (61):

61. a. John stopped smoking.
- b. John didn't stop smoking.
- c. If John stops smoking, Mary will buy him a camera.
- d. In a brochure addressed to residents: If you stopped smoking in 2001, you are eligible for a payment from the Tobacco Indemnity Fund.

The presupposition triggered by the aspectual verb *stop* remains unaffected under negation (61b) and under a conditional (61c). However, the presupposition is suspended in (61d). In the latter example, the presupposition is not part of the common ground since the authors of the brochure have no or only very little information about the addressee. According to Abusch, given that the presupposition of soft triggers depends on linguistic and extra-linguistic factors, the presupposition is not semantically encoded. In which sense thus do soft triggers give rise to a presupposition? Abusch argues that soft triggers semantically encode an alternative set. For instance, in the case of (61a), the alternative set C includes two propositions: *John stopped smoking (at t)* and *John continued smoking (at t)*. In most conversational contexts, speakers pragmatically presuppose that some alternative in C is true. As shown in Table 5, since both alternatives entail that *John smoked right before t*, by presupposing that one of them is true (that is, that their disjunction is true), speakers end up presupposing that *John smoked right before t*.

Table 5. *Alternative set for John stopped smoking*

John stopped smoking.		
Alternative set: C	{John stopped smoking (at t);	John continued smoking (at t)}
Entailments of the proposition	John smoked right before t	John smoked right before t
Disjunction	John smoked right before t	

However, as example (61d) shows, the truth of some of the alternatives encoded by *stop* is not always pragmatically presupposed. The writer of the brochure does not presuppose that the disjunction *The addressee_x stopped smoking in 2001* \vee *The addressee_x continued smoking in*

2001 is true. It follows that the potential presupposition that *The addressee_x smoked before 2001* is suspended.

In contrast, presupposition triggers that are considered as ‘hard triggers’ encode a semantic presupposition, which cannot be suspended. In cases in which the presupposition of hard triggers should be suspended, the sentence becomes infelicitous. In example (62), A asks whether anyone won the football pool this week. In doing so, she does not take for granted that someone did.

62. a. A: Did anyone win the football pool this week?
b. B: #Probably not, because it’s unlikely that it’s Mary_F who won it, and she’s the only person that ever wins.

B’s answer is infelicitous. Indeed, while B initially claims that probably no one won the football pool, this appears to be contradicted by the continuation introduced by *because*. The *it*-cleft construction, which is a hard trigger, gives rise to the presupposition that *someone won the football pool*, and this presupposition cannot be suspended even when embedded in the context provided by B’s initial claim. Compare (62) with (63) in which the *it*-cleft construction is substituted by focus, a soft trigger, and the presupposition becomes suspendable:

63. A: Did anyone win the football pool this week?
B: Probably not, because it’s unlikely Mary_F won it, and she’s the only person that ever wins.

Using suspendability as a criterion, the following presupposition triggers can be classified as soft triggers: achievement verbs like *win*, *wh*-questions like *Who took Mary’s bike?*, inchoatives like *break*, *grow up*, etc., contrastive statives like *bachelor*, *newcomer*, verbs of reciprocal and accompanied action like *accompany*, the factive verb *know* and the earlier mentioned group of aspectual verbs and focus intonations. In contrast, *too*, *also*, *even*, *again*, *negative polarity*, *either*, and *it*-cleft constructions are considered hard triggers.

1.8.3. Felicity and presupposition triggers: Optional and obligatory repair

Another proposal addressing the differences between presupposition triggers is the one by Glanzberg (2003, 2005). In his proposal, which bear some similarity to Zevaāt’s analysis outlined above, he argues that the heterogeneity of presupposition triggers can be linked to the notion of felicity/infelicity which, according to him, is not a uniform notion. In order to better understand his distinction, let us have a look at the examples in (64) and (65):

- 64. That palm tree is about to fall.
 - a. Context: no salient palm tree.
- 65. Even John solved the problem.
 - a. Context: assumed that John was the most likely to solve the problem.

In both cases, sentences (64) and (65) are considered to be infelicitous. Glanzberg argues, though, that both sentences are not infelicitous in the same way. Concerning sentence (64), the demonstrative *that palm tree* sets up the discourse in such way that the context must contain *a palm tree* in order to make this proposition salient for the discourse. In cases like (64), in which this discourse referent is not salient, the update of the asserted information that *that palm tree is about to fall* is then undefined. As a consequence, the asserted information, which Glanzberg calls the second instruction cannot be computed unless the first instruction, that is the background assumption – the existence of *a palm tree* – is obligatory repaired. In contrast, sentences using the presupposition trigger *even* as in (65) do not need an obligatory repair. The presupposition in (65) that *it was unlikely or unexpected that John solved the problem*, and that *someone other than John solved it* are not relevant in order to correctly process the second instruction that *John solved the problem*. For this reason, no obligatory repair is needed. In the latter case, a repair, if needed, is only optional.

In his proposal, two repair tests are also offered: (1) the echo-assessment test and (2) the indirect speech test. Concerning the echo-assessment, the defective construction is usually avoided. As can be seen in Table 6, the echo-assessment of the demonstrative in (66a) is denied and the repair as in (66b) targets the demonstrative in order to correct the defective constructions. In contrast, for *even*, the repair is not about the truth-value of the entire sentence, but only addresses the presupposed content as can be seen in (67a). A second diagnostic is the indirect speech test. When reporting the defective construction, the repair is initiated by using a direct quotation. In the example of the demonstrative, the reported speech targets the defective content *that palm tree* (68b), whereas in the *even* example, the defective construction is about the presupposed content and not about the asserted content (69). In the latter cases, the repair is optional; however, in the former cases the repair is obligatory.

Table 6. *Echo-assessment and indirect speech test (Glanzberg, 2003)*

	Demonstrative	Even
Echo Assessment	<p>66. Is that palm tree about to fall?</p> <p>a. # No, that palm tree is not about to fall.</p> <p>b. #Er ... no ... there is no palm tree, so I guess that palm tree is not about to fall.</p>	<p>67. Even John solved the problem.</p> <p>a. Yes, John did ... but why did you say <i>even</i>?</p> <p>b. #That's NOT SO. He would have solved it if anyone did.</p>
Indirect speech test	<p>68. Is that palm tree about to fall? (said by George)</p> <p>a. # George said that that palm tree is going to fall.</p> <p>b. George uttered 'That palm tree is going to fall', but there is no palm tree.</p>	<p>69. Even I solved the problem. (said by John)</p> <p>a. John said that even he solved the problem ... but of course, that's a bit odd, as he would if anyone did.</p> <p>b. #John said 'Even I solved a problem', but that doesn't make sense, because he was most likely to have done it.</p>

In cases in which infelicity occurs, the infelicity is not uniform since different repair strategies occur. For this reason, Glanzberg distinguishes between two subcategories of presupposition triggers: (1) strong presupposition triggers, which need an obligatory repair and (2) weak presupposition triggers for whom repair is optional (see Table 7).

Table 7. *Strong and weak presupposition triggers (Glanzberg, 2005)*

Strong presupposition triggers		Weak presupposition triggers	
<i>Clefts</i>		<i>Iteratives</i>	
<p>It was John that solved the problem.</p> <ul style="list-style-type: none"> • PSP: Someone solved the problem • Trigger: Structure of the cleft 		<p>John solved the problem too.</p> <ul style="list-style-type: none"> • PSP: Someone other than John solved the problem. • Trigger: too 	
Factives		Focus sensitive particles	
<p>John regrets voting for Bush</p> <ul style="list-style-type: none"> • PSP: John voted for Bush • Trigger: Factive verb <i>regret</i> 		<p>Even John solved the problem</p> <ul style="list-style-type: none"> • PSP: Someone other than John solved the problem and it was unlikely that John solved it • Trigger: <i>even</i> 	
Demonstrative NPs		Again	
<p>That palm tree is about to fall.</p> <ul style="list-style-type: none"> • PSP: Contextually available value of that palm tree • Trigger: Demonstrative NP <i>that palm tree</i> 		<p>Mary went out with Peter again.</p> <ul style="list-style-type: none"> • PSP: Mary went out with Peter before. • Trigger: <i>again</i> 	

2. Experimental literature on presuppositions

In this section, I review the experimental literature on presuppositions. More precisely, I will focus on two key properties of presuppositions discussed in the previous section, that is, (i) their backgroundedness and (ii) their non-at-issueness. The first property raises different research questions, whose investigation offers important insights into the processing of presuppositions. Specifically, the following research questions will be addressed:

- (1) Does presupposition accommodation come with a processing cost?
 - a. How are presuppositions processed in non-supportive contexts?
 - b. How is a contextually inconsistent presupposed information processed?
 - c. Is ambiguous information involving a presupposition treated differently compared to ambiguous information involving an assertion?
 - d. Is presupposed information without a discourse antecedent processed differently compared to asserted information?

After having addressed these research questions, I will then discuss the property of non-at-issueness, and provide answers to the following questions:

- (2) Are presuppositions part of the normal flow of discourse?
 - a. Is answering a question with a presupposition less acceptable than answering a question with an asserted content?
 - b. How is an inappropriate answer to a question processed when it is conveyed via a presupposition and via an assertion?

The properties of backgroundedness and not-at-issueness have typically been addressed separately; however, some scholars have recently attempted to investigate them simultaneously. In the last part of this review of the experimental literature on presuppositions, I will present studies that simultaneously investigate the projective behavior of presupposed, backgrounded, content and its not-at-issueness., These aim to respond to the following question:

- (3) Is there a relationship between projectivity and non-at-issueness?

Before presenting the experimental studies on presupposition processing, I'll briefly introduce some experimental techniques and more extensively present the EEG method and the underlying event-related potentials that are related to pragmatic processes.

2.1. Experimental Methods

Different methodologies have been used to investigate presuppositions from an experimental perspective: (1) the acceptability judgment method, (2) self-paced reading, (3) and event-related potentials. In what follows, I briefly discuss each method and their respective advantages and disadvantages.

First, the acceptability judgment method has enhanced our understanding about the acceptability of sentences involving a presupposition. Judgment data can provide important information by distinguishing possible from impossible constructions (Schütze, 2016). In an acceptability judgment task, the participant is asked to judge the acceptability of a sentence, which can be assessed by different types of judgment tasks such as a Likert-scale task, a forced-choice task, a magnitude estimation task, etc. (for a review see Schütze & Sprouse, 2014). This method comes with some advantages and some disadvantages. On the one hand, one major advantage of judgment tasks is that they provide important insights into phenomena that may not occur very often in natural language and, as a result, are difficult to find in corpora. For instance, answering a question with a presupposition. On the other hand, one disadvantage of judgment tasks is that they demand a certain awareness of language, known as metalinguistic awareness, which may make them more artificial compared to other methods (Schütze, 2016).

Second, another experimental method, which is often used in the investigation of presupposition processing, is the method of *self-paced reading*. The participant reads a passage in a word-by-word, segment-by-segment or phrase-by-phrase manner. In order to see the next word, segment or phrase, the participant has to press a button. This method allows one to record reading time of each word, segment or phrase, that is how much time the participant spends reading that designated word, segment, or phrase. So, reading times of critical regions across several conditions can be compared. One disadvantage of the self-paced reading paradigm is that the cause of the increase in reading time cannot be accurately determined since the paradigm cannot exactly pinpoint whether the slow-down is related to syntactic, semantic or discourse-related processing difficulties. In order to precisely identify which processes are involved during sentence processing, the EEG method, which will be presented next, has proven to be a powerful method to better understand the underlying mechanisms of language processes.

The use of the EEG method has provided important insights into the understanding of presupposition processing. Everyday pragmatic computation rapidly occurs when reading or listening to a sentence. This is the reason why, in order to better understand the pragmatic processing of an utterance, researchers nowadays use methods that can help us understanding how cognitive operations rapidly unfold. Besides the presented methods of acceptability judgment tasks and self-paced reading, the EEG method has nowadays attracted the attention of researchers in the domain of experimental pragmatics in order to better understand the cognitive correlates of pragmatic processes. I will start by giving a short general presentation

of the EEG method, which will be followed by a more detailed presentation of the event-related potentials (ERPs) that play a key role during the processing of pragmatic phenomena.

2.1.1 EEG

EEG recordings measure “voltage changes that are consistent with a single neural generator site and that systematically vary in amplitude across conditions” (Luck, 2005, p. 68). These voltage fluctuations are usually referred to as event-related potentials (ERPs), which indicate spontaneous electrical activity of the brain and are elicited by prior events such as the response to a cognitive or motor stimulus. Event-related potentials are non-invasively measured by electrodes placed on the scalp. One of the main advantages of the EEG method is its temporal precision. Typically, rapid serial word paradigms are used in which one single word appears on the screen for a limited amount of time. During the presentation of a single word, ERPs are elicited and reveal how humans respond to that particular word. Another advantage of the EEG method is its *covert measurement of processing*, which means that it allows measuring activity on-line without the necessity of a behavioural response. This is a huge advantage over behavioural methods since it allows one to study covert monitoring during the processing of language as well as to study populations with, for instance, neurological disorders that impede behavioural responses. Moreover, ERP recordings allow identifying multiple neurocognitive processes at the same time, which provide more insights into the underlying mechanisms that are involved during language processing. ERPs do not only tell us that one condition differs from the other, but they also give us a precise indication of whether this difference is related to syntactic, semantic/pragmatic processes and/or processes that are related to the reanalysis/reinterpretation of a word. The use of the EEG method has increased our understanding of language processing to a great extent. In the following, I will focus foremost on two event-related potentials that are of interest for studying the processing of discourse: the N400 and P600 components. The former component is a negative deflection between 300 and 500ms after the stimulus onset and peaks around 400ms and the latter is associated with a late positivity that arises between 500 and 900ms.

After the discovery of the N400 component by Kutas and Hillyard (1980), there has been a large body of evidence that the N400 is modulated by the semantic incongruity of an incoming word and is also inversely proportional to the lexical probability of an incoming word: the lower the probability of an upcoming word, the higher the N400 amplitude (e.g., Federmeier & Kutas, 1999). Moreover, recent research points out that the N400 component is not only modulated by the retrieval or access of semantic features, but also by contextual features (for an interesting

proposal, see Kuperberg, 2016). Event structure, situation models, and the overall message itself represent important constraints in order to generate predictions of the upcoming word and therefore aid to access the incoming specific lexical entry (Kuperberg, 2016). The more expected the upcoming word is in a given context, the lower is the amplitude of the N400. In the following, some key findings in the experimental literature with respect to the N400 component will be reviewed. A special focus will be given to the conjunction between semantic features and pragmatic ones in order to derive meaning and how this interaction yields important insights into the understanding of the N400 component.

2.1.1.1 N400

In their influential study, Kutas and Hillyard's (1980) findings indicate that a semantic anomaly (e.g. *He spread the warm bread with socks*) elicits a negative deflection around 250 ms after the onset of the critical word and peaks around 400 ms when compared to sentences where this anomaly is not present (e.g. *He spread the warm bread with butter*) or containing a syntactic anomaly (e.g. *He spread the warm bread with besides*). This negative deflection is nowadays known as the N400 effect. Over the past forty years, it has been shown that the amplitude of the N400 is modulated by several factors such as the degree of predictability of a word in a given context. (for a review, see Kutas, van Petten & Kluender, 2006; Federmeier & Kutas, 2011). For instance, the upcoming word's expectancy, measured off-line with the so-called cloze probability, has an impact on the deflection of the N400 (Kutas & Hillyard, 1984). The N400 amplitude is inversely related to a word's plausibility (e.g., Otten & van Berkum, 2007). Unlikely continuations (*Dale was very sorry and knew he owed Mary **a check***) and less probable continuations elicit higher N400 deflections compared to very likely continuations (*Dale was very sorry and knew he owed Mary **an apology***; e.g. DeLong et al., 2005). These findings indicate that the anticipation of the upcoming word has an impact on the underlying cognitive response to words processed in a single sentence, where no enrichment of further contextual information occurs.

To better understand whether the N400 is not only sensitive to local semantic relations, but also to pragmatic factors, St. George, Mannes and Hoffman (1994) compared the processing of ambiguous paragraphs preceded by a title or without one. As depicted in Table 8, the story was either shown with the title *Making and Flying a Kite* or without. Their findings show that ambiguous paragraphs without a preceding title elicit larger N400 effects in comparison to the same paragraphs presented with a title. Their study provides the first evidence that the N400

component is sensitive to not only local coherence – semantic expectancy –, but also global coherence, that is, pragmatic expectancy.

Table 8. *Sample story used by St George, Mannes & Hoffman (1994)*

Making and Flying a Kite

A newspaper is better than a magazine. A seashore is a better place than the street. At first it is better to run than to walk. You may have to try several times. It takes some skill but it's easy to learn. Even young children can enjoy it. Once successful, complications are minimal. Birds seldom get too close. Rain, however, soaks in very fast. Too many people doing the same thing can also cause problems. One needs lots of room. If there are no complications, it can be very peaceful. A rock will serve as an anchor. If things break loose from it, however, you will not get a second chance.

Further evidence that discourse anomaly elicits an N400 response comes from a study conducted by van Berkum, Hagoort and Brown (1999). When comparing discourse coherent final words vs discourse anomalous final words (see a sample story in Table 9), the discourse anomalous word elicits an N400 relative to the discourse coherent word. This confirms the finding by St. George et al. (1994) showing that the integration of a word does not only depend on the local – sentence level – linguistic context, but also on its global level, that is, the discourse context. In summary, both findings highlight that the generation of expectations on the upcoming word occurs in a very rapid manner depending on semantic, but also on pragmatic aspects.

Table 9. *Sample story of van Berkum et al.'s (1999) experiment*

Context

As agreed upon, Jane was to wake her sister and her brother at five o'clock in the morning. But the sister had already washed herself, and the brother had even got dressed.

Discourse-Coherent condition

Jane told the brother that he was exceptionally **quick**.

Discourse-Anomalous condition

Jane told the brother that he was exceptionally **slow**.

Processing a sentence does not only depend on the local and global context, but in many situations, discourse processing also depends on global knowledge that has only little to do with linguistic competence, but is related to broad-based knowledge, so-called general world knowledge. When reading the following information '*Romeo and Juliet*' is one of Lagarce's early tragedies', we immediately realize that the provided information is anomalous because the contemporary French play writer Jean-Luc Lagarce did not write the play *Romeo and Juliet*, but Shakespeare did. In order to better understand whether general world knowledge violations

have an impact on on-line language processing, and more particular on the event-related potential between 300 and 500ms, Hagoort, Hald, Bastiaansen and Petersson (2004) investigated the brain response of three distinct sentences: (i) sentences as in (1b) containing a semantic violation, (ii) sentences as in (1c) containing a world knowledge violation and (iii) sentences as in (1a) containing no violation at all.

1. a. The Dutch trains are **yellow** and very crowded. (correct sentence)
- b. The Dutch trains are **sour** and very crowded. (semantic violation)
- c. The Dutch trains are **white** and very crowded. (world knowledge violation)

In line with previously presented results, semantic violations, as in (1b), elicit an N400 effect in comparison to baseline sentences as in (1a). More interestingly, Hagoort et al.'s results also indicate that a world knowledge violation in (1c) elicits an N400 when compared to the baseline sentence. No significant difference between both anomalous conditions – between (1b) and (1c) – was found during this interval. Their study represents one of the first pieces of evidence that extralinguistic elements of meaning are integrated as rapidly as it is the case for the local and global semantic interpretation of a sentence.

Further evidence that pragmatics has an impact on the immediate on-line processing comes from a study conducted by Nieuwland and van Berkum (2006). In experiment 1 of their study, the authors investigated the impact of contextual animacy violations (see Table 10, Sample Story 1 Experiment 1).

Table 10. *Sample Story Experiment 1 conducted by Nieuwland & van Berkum (2006)*

Sample Story Experiment 1

- 1) Once upon a time, a psychotherapist was consulted in her home office by a yacht/sailor with emotional problems.
- 2) The yacht/sailor confided in her that everything in life had gone wrong and started crying.
- 3) The psychotherapist consoled the yacht/sailor by stating that everybody experiences these kinds of trouble every now and then.
- 4) But the yacht/sailor doubted whether to continue outlining his problems to her.
- 5) The psychotherapist advised the yacht/sailor to be honest not only with her, but especially with himself.
- 6) At that moment the yacht/sailor cried out that he was absolutely terrified of water.

When presented in isolation (Sentence 1), the anomaly *yacht* as in “a psychotherapist was consulted in her home by a *yacht*” elicits the well-known N400 component (see **Figure 3**, sentence 1); however, this effect disappears in the continuation of the story (see Figure 3,

sentence 3). This result echoes the very first finding on global discourse comprehension by St. George et al. (1994). When the reader is presented with unexpected information for the first time “a psychotherapist was consulted in her home by a yacht”, the unexpectedness of the animacy violation ‘yacht’ elicits a different waveform when compared to a more predictable upcoming word such as ‘sailor’. However, after having integrated the information into global discourse, the animacy violation does no longer represent a discourse violation in the context of the story. Consequently, the animacy violation no longer elicits an N400 (see Figure 3, Sentence 3 with context).

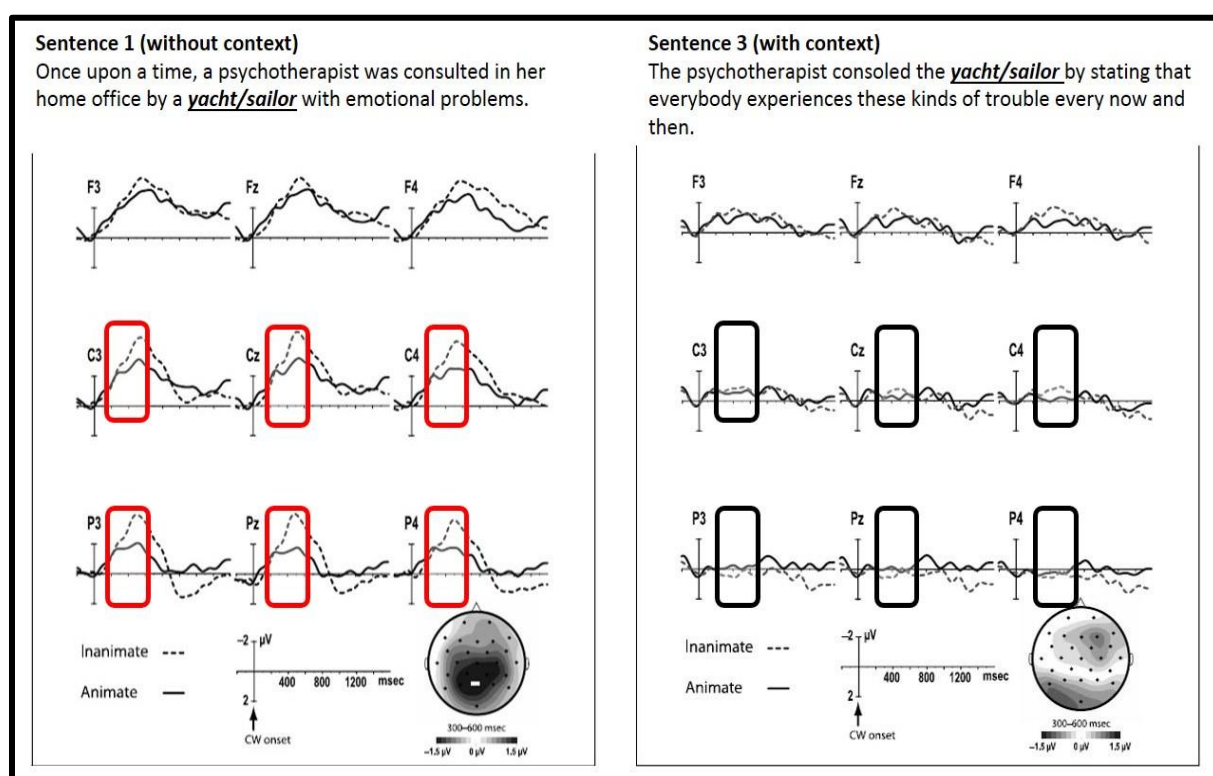


Figure 3. Study conducted by Nieuwland & van Berkum (2006). Left: ERP response of yacht/sailor without a context (sentence 1). Right: Contextually supported ERP response of yacht/sailor (sentence 3). The rectangles in red indicate a significant N400 effect, whereas the black ones represent a $p > .05$.

Nieuwland and van Berkum’s finding suggests once more that context plays a powerful role during sentence processing; however, it must be noted that from a statistical perspective, no conclusions can be drawn by the absence of an effect. For this reason, Nieuwland and van Berkum conducted a follow-up experiment. In their famous experiment *When peanuts fall in love*, the authors set up cartoonlike stories in such a way that the animacy violation, for instance “the peanut was in love” was supported by the context, whereas the canonical predicate “the peanut was salted” was not. Their findings show that an N400 was elicited by the latter (“the

peanut was salted”) and not by the animacy violation (“the peanut was in love”). This finding indicates, once more, that contextual appropriateness can override semantic violations.

Nieuwland and van Berkum’s (2006) findings were extended by Filik and Leuthold (2008), who compared stories that were non-anomalous (baseline – (2a)) with non-fictional anomalous stories (2b) and fictional anomalous stories (2c).

2. a. Terry was very annoyed at the traffic jam on his way to work. He glared at the **lorry** and carried down on the road (non-anomalous – baseline)
- b. Terry was very annoyed at the traffic jam on his way to work. He picked up the **lorry** and carried down on the road. (non-fictional anomalous)
- c. The incredible Hulk was annoyed that there was a lot of traffic in his way. He picked up the **lorry** and carried down on the road. (fictional anomalous)

Even though the story type in (2c) appears to be locally anomalous, the well-known fictional scenario *the incredible Hulk* renders the story globally acceptable. It is the context that makes it different from the non-fictional anomalous story in (2b). *Picking up the lorry* can be anticipated in a fictional context featuring *the incredible Hulk*, whereas it appears to be odd in a non-fictional story. This is exactly what Filik and Leuthold found in their experiment. Non-fictional anomalous stories elicit an N400 when compared to the fictional anomalous and baseline stories, whereas no significant difference between the fictional anomalous and baseline stories was reported. This finding adds further evidence to the claim that contextual information plays a crucial role in the construction of expectations about the upcoming word.

Altogether, the aforementioned studies illustrate that semantic and pragmatic information is rapidly integrated during sentence processing. The N400 event-related potential is not only sensitive to linguistic aspects of meaning, but also to extralinguistic ones. Given the evidence of the reported literature, the N400 can be considered as an event-related potential that is sensitive to predictive and anticipatory aspects of meaning independently from the semantic or pragmatic nature of these aspects.

The reviewed literature suggests that the integration of upcoming information relies on predictive and anticipatory mechanisms. Readers and listeners actively try to anticipate what the speaker is going to say next. As shown before, linguistic and extralinguistic factors can give the reader or listener a clue of what to expect in the upcoming discourse. In his review, van Berkum (2009) shows that contextual expectations can rely on many more different factors. First, speaker-specific information, such as her social class. More specifically, listening to an ‘upper-class’ accent increases the possibility of certain continuations such as *I have a big car*

and decreases the possibility of others such as *I have a big tattoo* (van Berkum, van den Brink, Tesink, Kos & Hagoort, 2008). Second, personal values also impact the anticipation of upcoming words. When an upcoming word is strongly opposed to the reader's value system, this word is less expected, which in turn elicits an N400 (van Berkum, Holleman, Nieuwland, Otten & Murre, 2009). The evidence presented suggests that the reader and the listener "generate[s] information that is needed in the immediate future" (van Berkum, 2009, pg. 304) and that this generation occurs in a rapid manner. This means that the speaker must set up her discourse in such a way that the interlocutor is able to anticipate what comes next. When the speaker's discourse structure is set up in an unexpected manner, this comes with an extra processing cost.

Until now, I have presented empirical evidence that pointed out that multiple types of information, i.e. semantic and pragmatic cues as well as discourse coherence and real-world knowledge interact with one another in language processing. As discussed in the first part of this chapter, backgrounding or foregrounding information are essential operations with respect to the way in which speakers structure their discourse. It is important to note that recent research on processing referential expressions indicates that the more ambiguous the referential link to prior discourse, the higher is the N400 amplitude. First, Streb, Rösler, and Henninghausen's (1999) findings show that the degree of referent identification modulates the N400 component. The authors compared sentences in which the proposition of the target sentence refers either to the subject or to the object of a previously introduced anaphoric reference. Their results reveal that violations of the expected grammatical relationship between the target sentence and its anaphoric reference, as it is the case when an object pronoun follows a preceding subject noun phrase, elicit an N400. Second, less salient discourse antecedents also elicit an N400. When comparing given versus inferential information, Burkhardt and Roehm's (2007) findings suggest that deriving inferential meaning comes with an extra processing cost. Inferential information elicits an N400 in comparison to given information. Interestingly, Burkhardt (2006) shows that contextual coherence modulates the N400 component in a graded fashion. When compared to given information, the N400 shows the highest negative deflection in the inferential condition, whereas the deflection is only intermediate when information must be bridged. Burkhardt's finding will be more closely presented in section 2.2.1. On the basis of findings with respect to referential processing, Schumacher (2009), Schumacher and Hung (2012), and later Wang and Schumacher (2013) proposed a model in which the N400 indexes *Discourse Linking* mechanisms, i.e. the attempts of locating an entity or a referent in the

ongoing discourse representation. The most important underlying principle of the model is that linking costs are nearly non-existing when the most anticipated expression is encountered. However, as soon as the upcoming referential expression departs from the anticipated expression, a higher negative amplitude of the N400 is observed since linking the encountered information to prior information becomes more costly. According to Wang and Schumacher, distinct extra-linguistic factors such as co-textual expectations (van Berkum et al., 1999), prosodic cues (e.g; Heim & Alter, 2006, Schumacher & Baumann 2010, Röhr, Brilmayer, Baumann, Grice & Schumacher, 2020), and discourse salience (Schumacher & Hung, 2012; Wang & Schumacher, 2013) can modulate the N400 when unexpectedness is encountered. Moreover, the model can also account for factors violating information structure (Cowles et al., 2007).

This model is interesting for the processing of presuppositions since they are not always part of the common ground but are often conveyed in the form of informative presuppositions. In addition, Schumacher's model does not only make a contribution to better understanding which extra-linguistic features trigger an N400, but it shed light on the P600 component, the previously mentioned late positivity brain potential. According to her, late positive ERP effects, such as those involving the P600 component, reflect *Discourse Updating mechanisms*, i.e. the correction, modification or enrichment of the current representation of the discourse. For instance, in cases, in which (i) new discourse referents must be added (e.g., Burkhardt, 2006), (ii) previously encountered discourse information must be corrected (e.g., Shetreet et al., 2019), and (iii) new topics are introduced (e.g., Hung & Schumacher, 2012), the update of the discourse is reflected by an increased processing cost, which in turn result in a higher positive deflection between 500 and 900ms.

After this general overview of the experimental methods and specifically of the EEG technique and its components, I have set the stage to better understand the experimental findings related to the processing of presuppositions. I will now address the questions outlined in the introduction of this section in a stepwise manner starting with the processing of presupposition in supportive and neutral (non-supportive) contexts.

2.2. Processing Presuppositions: State of the art of the experimental literature

2.2.1. Supportive versus neutral contexts

Much research in pragmatics has highlighted the important role of context in modulating the processing of presuppositions. One important distinction is that between supportive and neutral

contexts¹⁷. Supportive contexts are defined as those contexts in which the presupposition is satisfied. Presupposed content in supportive contexts is content that has already been introduced in prior discourse, whereas presupposed content in neutral contexts is not yet part of the common ground. In order to correctly derive the presupposed content in neutral contexts, the speaker must accommodate the presupposition, that is, accept it as at least provisionally true (Heim, 1983; Lewis, 1979; von Stechow, 2000). Recent experimental investigations on presupposition processing indicate that presuppositions in neutral contexts are integrated rapidly (for a review, see Schwarz, 2015). However, it is also well established that the processing of presuppositions in neutral contexts, when compared to supportive contexts, comes with an extra processing cost and that this processing cost partially depends on the type of presupposition trigger. In this section, I will present a series of studies that compare the processing of presuppositions in supportive versus neutral contexts.

In the early days, a respectable amount of the experimental literature has focused on phenomena associated with the presupposition trigger represented by definite descriptions. More precisely, Haviland and Clark (1974) were the first researchers who investigated cases of *bridging*. In bridged contexts, a definite description points to a discourse antecedent which has not been explicitly introduced. For instance, as can be seen in example (4), the definite *the beer* in (4a) is a coherent discourse continuation, which implicitly relates back to the context sentence *We checked the picnic supplies* while lacking an explicit discourse antecedent. In the given information condition, as for instance in example (3), the definite *the beer* has an explicit discourse antecedent, i.e. *some beers*.

3. We got some beer out of the trunk.
 - a. The beer was warm. (Given information)
4. We checked the picnic supplies.
 - a. The beer was warm. (Bridged information)

Haviland and Clark compared reading times of bridged information to given information. Their results show that sentences without an explicit antecedent in prior discourse – *bridged information* – are read slower compared to sentences with an explicit discourse antecedent – *given information*. Their seminal work pointed out that conceptual discourse representations play a crucial role in the creation of local discourse coherence (Grosz, Joshi, & Weinstein; 1983) and opened up distinct lines of research. The first research line focuses on the understanding of which bridged contexts trigger higher reading times. The second one examines

¹⁷ In the literature, the terms *satisfied* versus *accommodated* contexts is also often used.

the cognitive correlates of processing bridged information. The latter has provided an excellent starting point for the investigation of presupposition processing. The main contributions to these three interrelated research lines are discussed in what follows.

In an eye-tracking study O'Brien, Shank, Myers and Rayner (1988) extended the findings of Haviland and Clark (1974) to other discourse contexts. As displayed in Table 11, context sentences were either highly constraining or loosely constraining with respect to the expected continuation. In particular, in the highly constraining context condition, a verb like *stab* was used, which was subsequently followed either by *knife* – given information – or *weapon* – bridged information. In contrast, in the loosely constraining context condition the verb *stab* was exchanged by the verb *assault* keeping the remaining part of the sentence constant in comparison to the highly constraining context conditions.

Table 11. *Experimental design used by O'Brien, Shank, Myers and Rayner (1988)*

Condition	Context sentence	Target sentence
Loosely constraining context + given information	All the mugger wanted was to steal the woman's money. But when she screamed, he assaulted her with his knife in an attempt to quiet her. He looked to see if anyone had seen him.	He threw the knife into the bushes and ran away.
Highly constraining context + given information	All the mugger wanted was to steal the woman's money. But when she screamed, he stabbed her with his knife in an attempt to quiet her. He looked to see if anyone had seen him.	
Loosely constraining context + bridged information	All the mugger wanted was to steal the woman's money. But when she screamed, he assaulted her with his weapon in an attempt to quiet her. He looked to see if anyone had seen him.	
Highly constraining context + bridged information	All the mugger wanted was to steal the woman's money. But when she screamed, he stabbed her with his weapon in an attempt to quiet her. He looked to see if anyone had seen him.	

O'Brien et al.'s (1988) results show that an explicit prior mention of the definite is not required if the contextually introduced verb is highly constraining. More precisely, the gaze duration was only longer for the bridged information compared to the given information in loosely constraining contexts, but not in highly constaining contexts. Their results point out that processing bridged definites is not only modulated by the presence or absence of an explicit

discourse referent, but also by the degree of constraints imposed by the sentences preceding the target information.

According to Carlson and Tannenhaus (1988), the acceptance of a certain discourse interpretation, as well as the the processing cost it incurs, depend on the saliency of an *open thematic role* that can be plausibly filled. For instance, a sentence like *Bill hurried to unload his car* not only introduces *Bill* and *unloading the car*, but also it introduces entities that are not explicitly specified, which Carlson and Tannenhaus call an *open thematic role*. Contexts involving such an *open thematic role* can more easily be filled with a specific definite as can be seen, for instance, with the definite *the suitcases* in (5a). In contrast, contexts that do not introduce an open thematic role, as *Bill hurried to catch the plane* in (6), give rise to a number of different discourse continuations. In this case, (6a) *the suitcases were very heavy* is only one of the many possible continuations: when processing (6), there is no set up expectation that the discourse continuation will involve *suitcases*.

5. Bill hurried to unload his car.
 - a. The suitcases were very heavy.
6. Bill hurried to catch the plane.
 - a. The suitcases were very heavy.

Investigating this issue from an experimental perspective, Carlson and Tannenhaus' (1988) results point out that continuations following a context containing an open thematic role, as in example (5), are not only processed faster compared to sentences that follow a context lacking an open thematic role, as in (6), but are also judged as more acceptable. In summary, their results show that the degree of inferential demands has an impact on the processing pattern of the bridged information.

In order to better understand the cognitive correlates of processing bridged information, Burkhardt (2006, 2007) investigated the processing of bridged information in two EEG studies by examining definite determiner phrases. In her first study, Burkhardt (2006) varied the degree of contextual availability of the discourse antecedent. As shown in Table 12, three conditions were used, i.e. (i) a given context, (ii) a bridged context, and (iii) a new context condition. In the given context condition, the definite determiner of the target sentence *the conductor* has an explicit discourse antecedent *a conductor* in the preceding sentence. In the bridged condition, the link between the determiner *the conductor* and the discourse antecedent is not explicit, but inferential. The discourse antecedent can thus be inferred by the encyclopedic knowledge related to concerts. In contrast, the new context condition does not provide any inferential link between the determiner *the conductor* and the context *Tobias talked to Nina*.

Table 12. *Experimental stimuli used in Burkhardt (2006)*

Condition	Context	Target
Given context	Tobias visited a conductor in Berlin.	He said that the conductor was very impressive.
Bridged context	Tobias visited a concert in Berlin.	
New context	Tobias talked to Nina.	

Burkhardt’s results reveal an interesting pattern: First, the definite determiner in the new context condition elicits an N400 when compared to the definite determiner in the given and bridged context condition. Furthermore, the determiner in the bridged and new context condition elicit a P600 when compared to the given context condition. These findings show that (i) bridged information, that is, information with an inferential relationship to the antecedent, only elicits a P600, whereas (ii) new information that is seemingly unrelated to the context, that is, information without an inferential relationship to prior discourse, elicits not only a P600, but also an N400. Burkhardt argues that in order to integrate new information in discourse memory, the process of updating the mental model, which is reflected by the P600 plays a crucial role. In order to integrate the information in the bridged and new condition, the mental model must be updated, which comes with a processing cost reflected by the P600. In addition, her results also show that new information without a given or bridged discourse antecedent not only elicits a P600, but also an N400. Burkhardt argues that the “unavailability of a dependency (or failure to form one)” (Burkhardt, 2006, p. 166) may be the driving force behind the triggering of the N400 effect in the new condition. The elicited N400 effect in the new context condition compared to the other two conditions – *bridged* and *given* – represents, according to Burkhardt, accrued linking costs. When the referent can easily be located in the ongoing discourse representation, as it is the case in the given and bridged conditions, no linking costs arise since the most anticipated referent is encountered. In contrast, in cases in which the referent cannot be easily linked to prior discourse, extra processing costs arise. In summary, Burkhardt’s findings show that the N400 also plays a role in coreferential discourse relations. Moreover, her results indicate that updating the mental model with bridged or new information elicits a late positive deflection¹⁸.

¹⁸ In a follow-up study, Burkhardt (2009) investigated the processing of definites versus indefinites using similar contexts and target sentences as those in the presented study (Burkhardt, 2006). Compared to the definite conditions, the definite article *the* was replaced with the indefinite *a* in all three conditions. The findings of this study suggest that definiteness marking, that is difference between definites and indefinites, does not have an impact with respect to the N400 component. Interestingly though, her results show that all three indefinite

In a subsequent study, Burkhardt (2007) manipulated the degree of inferential demands of the target sentence with respect to the context sentence. As shown in Table 13, the definite determiner was never mentioned explicitly in prior discourse, but the strength of the inferential relationship to the context sentence varied across conditions ranging from necessary – lowest inferential demand – over probable – intermediate inferential demand – to inducible – highest inferential demand. In comparison to the experimental stimuli in Burkhardt (2006), all conditions involve inferring an antecedent from the context sentence and the used definite in the target sentence had no explicit discourse antecedent.

Table 13. *Experimental stimuli used by Burkhardt (2007)*

Condition	Context	Target sentence
Necessary context	Yesterday a Ph.D. student was shot downtown.	The press reported that the pistol was probably from army stocks.
Probable context	Yesterday a Ph.D. student was killed downtown.	
Inducible context	Yesterday a Ph.D. student was found dead downtown.	

Burkhardt's findings reveal that the degree of inferential demands has an impact on the processing of the target sentence. More precisely, the conditions involving a probable or inducible implicit antecedent – probable and inducible context condition – elicit a P600 in comparison to the necessary condition. The verb *shot* in the necessary context implicitly refers to the noun *pistol*; therefore, it does not generate any additional discourse complexity. As a consequence, the noun *pistol* is integrated effortlessly in the discourse model. In contrast, the events *killed* and *found dead* do not automatically generate an association to the noun *pistol*. In

conditions, i.e. given, bridged and new condition differ significantly from the given definite condition with respect to the P600 interval and the three indefinite conditions do not differ significantly from one another. Such a finding is very interesting since it shows at least two things: Concerning the P600 time interval, (1) the discourse antecedent does not have an impact on the processing of the indefinite, and (2) given presuppositions are the only condition that do not introduce an extra processing cost when compared to the other investigated conditions. According to Burkhardt, this finding suggests that in the given definite condition, the content of the context and the target sentence depend on one another. *The conductor* of the target sentence has a direct discourse referent *a conductor* that has been introduced in the context sentence. Such a dependency is missing though when it comes to the given indefinite condition. Given the character of indefinites, that is the introduction of independent entities, there is no dependency between *a conductor* in the context sentence and *a conductor* of the target sentence. In addition, it seems that these extra processing costs are similar to those observed when a presupposition is not explicitly introduced. In conclusion, Burkhardt's (2006, 2009) studies reveal that discourse updating occurs in the absence of a direct discourse referent, which is the case in the bridged and new definite condition or in discourses in which a new discourse referent, an indefinite, is introduced.

order to integrate the noun, the discourse model must be updated, which results in increased processing costs eliciting a P600.

In conclusion, Burkhardt's studies are of paramount importance for the investigation of on-line language understanding. Her findings vividly show that the processing of bridged versus new information impose different cognitive demands. When processing bridged information, the elicited P600 reflects aspects of discourse updating. In contrast, in the course of processing new information, an N400 and a P600 component are sequentially elicited. The elicitation of the N400 was interpreted as evidence that this component also "reflects facilitation effects and is taken as a general index of dependency formation" (Burkhardt, 2006, p. 166).

The studies on definite determiner phrases paved the way for a broader investigation of presupposition processing. In the following, I will first present an event-related potential study by Domaneschi, Canal, Masia, Lombardi Vallauri and Bambini (2018) which used the same methodology as Burkhardt (2006, 2007) before turning to studies using different methodologies.

Measuring event-related potentials (ERPs), Domaneschi et al. (2018) investigated the on-line processing of two presupposition triggers, i.e. definite descriptions and the change-of-state verb *stop*. As presented in Table 14, the target sentences were kept constant across conditions while the availability of the antecedent in the first context sentence was manipulated. In the supportive context condition, there was an explicit discourse antecedent, whereas no explicit discourse antecedent was presented in the neutral context condition¹⁹.

¹⁹ It is noteworthy to mention that the used experimental stories in the supportive and neutral condition did not differ in terms of naturalness and plausibility. It can, thus, be excluded that naturalness and plausibility had an effect on the reported effects.

Table 14. *Experimental stimuli used by Domaneschi et al. (2018)*

Trigger	Condition	Context 1	Context 2	Target sentence
Definite description	Supportive context	In Paolo's office there used to be a bad-tempered graphic designer .	The office needs consultants for several branches of the activity.	Due to overstaffing problems, about a month ago, <i>the graphic designer</i> was made redundant.
	Neutral context	In Paolo's office there are many employees.		
Change-of-state verbs	Supportive context	During his school years, Simone used to deliver pizza .	He often finished work after midnight.	Then he graduated, and so he <i>stopped</i> delivering pizza and took over a small restaurant.
	Neutral context	During his high school years, Simone used to work in his uncle's restaurant.		

For definite descriptions, the region of interest is the noun following the trigger *the*, that is, *graphic designer* and, for the change-of-state verb, the region of interest is the noun *pizza*, which appears two positions after the triggering point, i.e. the change-of-state verb *stopped*²⁰. Domaneschi et al.'s (2018) findings show an N400 and P600 effect for both triggers in the neutral condition compared to the supportive condition. Moreover, the results also show that the size of the N400 and the P600 effect is modulated as a function of trigger type. In other words, the category of the presupposition trigger has an impact on the on-line processing of presupposition accommodation at different processing times: The typical N400 component (centro-parietal activation) was elicited by definite descriptions that need to be accommodated, whereas the effect is more widely distributed and slightly less robust for change-of-state verbs. Concerning the P600 component, presuppositions in neutral contexts conveyed via a change-of-state verb elicit a more pronounced P600 compared to presuppositions in neutral contexts conveyed via a definite description.

The previously mentioned theoretical distinction between definites and change-of-state verbs has a cognitive counterpart. Definite descriptions, that are more anaphoric in nature, are more sensitive to the search of a discourse antecedent. As a consequence, the missing link to an

²⁰ Domaneschi et al.'s (2018) choice of critical regions are based on Tiemann (2014)'s results. Tiemann (2014) investigated the time course of processing distinct presupposition triggers in a self-paced reading paradigm, which will be presented later in this chapter.

explicit discourse antecedent renders the definite in neutral contexts less expected. In these cases, the discourse dependency between the antecedent *there are many employers* and the definite *the graphic designer* is less salient than it is the case in the supportive context condition. Conversely, temporal triggers like change-of-state verbs involve a more demanding representation of temporally displaced events represented by higher costs of the P600 effect (Domaneschi et al., 2018). More precisely, the information that *Simone stopped delivering pizza* does not rely that much on anaphoric information, but heavily relies on the updating of the activity, that is, the activity of *delivering pizza*. Conclusively, Domaneschi et al. (2018) not only extend the findings presented by Burkhardt (2006; 2007) to another presupposition trigger, but also show that the size of the N400 and P600 effect depends on the category of the presupposition trigger. In addition, the results also point out that the on-line processing of presupposition accommodation is characterized by the biphasic N400/P600 pattern.

In what follows, I turn to reviewing the main findings on presupposition processing achieved via behavioral studies, which rely on reading times and acceptability judgement tasks, and discuss their compatibility with the EEG studies presented above. In one of the first studies on presupposition processing, Schwarz (2007) investigated the reading time of the presupposition trigger *also* comparing presuppositions in supportive sentences, as in (7), versus presuppositions in neutral contexts, as in (8)²¹. The region of interest was the segment involving *also*, i.e. *had also written to the mayor*. In sentence (7), the presupposition is supported by *The congressman who wrote to John*, which indicates that the congressman had written to someone, which supports the presupposition of *also*. In contrast, the presupposition is not supported by the context preceding *also* in sentence (8).

7. The congressman/who wrote to John/had also written to the mayor/to schedule a meeting/for the fundraiser.
8. The congressman/who John wrote to/had also written to the mayor/to schedule a meeting/for the fundraiser.

Schwarz's (2007) results indicate that processing the presupposition of *also* in neutral contexts comes with an immediate cost. The segment involving *also* in a supportive context is processed faster compared to a neutral context. In addition, Schwarz reports that there is no spill-over effect in the subsequent region, that is, that there is no difference in reading time in the segment *to schedule a meeting* between the supportive and neutral contexts²². Further evidence of a

²¹ Slashes in examples (7) and (8) indicate segments in the self-paced reading time paradigm.

²² Whether this processing difference is caused by the process of accommodation cannot conclusively be answered by his data. Schwarz argues that the processing difference between the two investigated conditions is caused by the difference in presupposition satisfaction. He points out that *too* is hardly ever accommodated (e.g. Kripke,

processing difference between presuppositions in neutral versus satisfied contexts comes from Tiemann (2014).

Tiemann (2014) compared the acceptability judgments and reading times in supportive versus neutral contexts²³. In the supportive context (9), the presupposed content had an explicit discourse antecedent, whereas there was neither an explicit nor implicit discourse antecedent in the neutral context (10).

- | | |
|--|----------------------|
| 9. Tina's brother owns a taxi. | (Supportive context) |
| a. She borrows his taxi and drives to Potsdam. | |
| 10. Tina's brother owns a bicycle. | (Neutral context) |
| b. She borrows his taxi and drives to Potsdam. | |

Her results point out that sentences with a presupposed content in a neutral context are judged significantly less acceptable compared to sentences with a supported presupposed referent. In addition, the self-paced reading paradigm indicates an overall slow-down in the neutral compared to the supportive context condition. For sentences using definites, longer reading times already occur at the triggering point – *definite article (his)* – and at the noun following the trigger – the critical word (*taxi*). In summary, Tiemann's study is the first experimental evidence that indicates that processing non-satisfied presupposed content comes with an immediate slow-down at the critical word²⁴ and that this processing cost disappears during the continuation of the sentence.

1991; corpus study by Spenader, 2002). Consequently, in contexts in which it is not satisfied “there is no chance to accommodate it, since the presupposition of *too* resists accommodation” (Schwarz, 2007, p. 41). Unfortunately, no presupposed content question or any other relevant test question was asked after the presentation of the stimuli. For this reason, there is no certainty whether *too* was accommodated or not. Contrary to Schwarz, it could also be argued that *too* was accommodated given the experimental evidence provided by other presupposition triggers. For instance, according to Burkhardt (2006) who obtained similar effects for definite descriptions, the presence of an effect on the triggering region suggests that the presupposed content undergoes a process what she calls *discourse update*. Given that no spill-over effects were present in Schwarz' data, it could be argued that the presupposition in neutral contexts is integrated rapidly. Such an interpretation would be similar to the one provided by Domaneschi et al. (2018), who obtained no spill-over effects in an EEG study on definite descriptions and change-of-state verbs in the neutral condition. Furthermore, their near ceiling accuracy score in the neutral condition also suggests that the presupposition was accommodated. Further research should try to shed light onto the underlying mechanism causing this slow-down for *too* in neutral contexts.

²³ The original experiment investigated the processing of five distinct presupposition triggers, i.e. factive verbs, change-of-state verbs, definite descriptions, and the iteratives *too* and *again*. In this section, I will only present the results concerning the definite determiner. The other presupposition triggers will be presented in the following section, in which the processing of distinct presuppositions trigger will be looked at in detail.

²⁴ It is important to note that in comparison to the material used by Haviland and Clark (1974), there is no implicit discourse antecedent in Tiemann's neutral context condition. In Haviland and Clark's experimental material, the target sentence *The beer was warm* had an implicit link to prior discourse *We checked the picnic supplies*. It seems that the definite *the beer* appeared to be more compatible with the context sentence than this is the case in Tiemann's study. In particular, the context sentence in (20) and the beginning of the continuation in (20a) *Tina borrows his* sets up the discourse expectation in such a way that *bicycle* should actually be predicted rendering the noun *taxi* less available. It appears that in Tiemann's study the presupposed content is *new*, whereas the definite

In summary, this section has shown that presuppositions in neutral contexts are processed differently compared to presuppositions in supportive contexts. Investigating the processing of presuppositions in non-supportive contexts is not only interesting with respect to presupposition accommodation (in neutral context), but also with respect to falsified presuppositions. A presupposition can be falsified in two ways. First, when the uniqueness criterion of presuppositions triggered by definite descriptions is not satisfied (ambiguous discourse antecedent). Second, presupposed content can also be inconsistent with respect to information provided earlier in discourse (inconsistent discourse antecedent). In the following sections, I will first present studies on uniqueness violations and then turn to experiments that look at the processing of presuppositions with an inconsistent discourse antecedent.

2.2.2. Uniqueness violations

In cases in which the presupposed content refers to more than one available discourse antecedent, the uniqueness of the presupposition is not met. Altmann and Steedman (1988) investigated uniqueness violations in definite descriptions. Their experimental material contained scenarios in which the uniqueness of the presupposed content is met, as in (11a), and scenarios in which the uniqueness of the presupposed content is violated, as in (11b). In particular, the continuation in (11a) includes a unique identifiable safe that is the one *with the new lock*, while this uniqueness is violated in the discourse continuation in (11b) *The burglar blew open the safe with the dynamite*. The latter continuation does not include enough specificity identifying one of the safes, that is, either the *new safe* or the *old safe*. As control scenarios, the authors used the ones in (12a) and (12b) in which neither of these two includes a uniqueness violation.

11. A burglar broke into a bank carrying some dynamite. He planned to blow open a safe. Once inside he saw that there was a safe with a new lock and a safe with an old lock.
 - a. The burglar / blew open / the safe / with the new lock / and made off / with the loot.
 - b. The burglar / blew open / the safe / with the dynamite / and made off / with the loot.
12. A burglar broke into a bank carrying some dynamite. He planned to blow open a safe. Once inside he saw that there was a safe with a new lock and a strongbox with an old lock.
 - a. The burglar / blew open / the safe / with the new lock / and made off / with the loot.

in Haviland and Clarks study, as presented earlier, is considered as *bridged information*. Such a difference in experimental stimuli is important to mention. In the section *asserted versus presupposed content*, I will present two studies that investigate the impact of plausibility on presupposition accommodation.

- b. The burglar / blew open / the safe / with the dynamite / and made off / with the loot.

The self-paced reading times indicate that the segment *with the new lock* was read faster compared to the segment *with the dynamite* when preceded by the context in (11), whereas no difference in reading time on the two mentioned segments was observed when preceded by the context in (12). Altmann and Steedman's (1988) result suggests that the absence of a unique identifiable discourse antecedent for definite determiner phrases comes with a processing cost in the segment following the noun. Such a result is in line with theories predicting that the search of the direct antecedent for the definite determiner only finishes once the appropriate noun phrase (NP) has been resolved (Britt, Gabrys, & Perfetti, 1993; Perfetti & Britt, 1995). For this reason, the increased reading time in the condition including an ambiguous referent does not appear at the NP *the safe*, but only at the segment following the NP in which the NP could still not be disambiguated. According to Perfetti and Britt (1995), in order to resolve the uniqueness violation of the noun, a more complex noun phrase has to be created which, given the syntactic structure used in the experiment, appears at the position after the noun (Perfetti and Britt, 1995). As a result, in contexts in which the disambiguation is not resolved, as in (11b), the processing is slowed down at the position after the noun. However, when compared to the previous reported literature on the processing of definites in neutral and supportive contexts, an immediate effect should have been observed at the NP itself due to accrued linkage costs caused by the ambiguous reference. Nevertheless, it may have been the case that a habituation effect to the experimental material occurred. As a consequence, participants got used to ambiguity resolutions that, when resolved, always appeared after the NP.

An event-related potential study by van Berkum et al. (1999) investigated the exact time course of uniqueness violations of presuppositions. The experimental material was composed of stories as in (13) and (14). In the first story (13), the uniqueness criterion for the determiner *the girl* in the final sentence is met, while a uniqueness violation is present in the second story (14). In the latter story, two equally salient referents – *girls* – have been introduced in the context, which, consequently, are only disambiguated in the relative clause following the determiner *that had been on the phone*.

13. David had told *the boy and the girl* to clean up their room before lunchtime. But the boy had stayed in bed all morning and the girl had been on the phone all the time. David told **the girl** that had been on the phone to hang up.

14. David had told the *two girls* to clean up their room before lunchtime. But one of the girls had stayed in bed all morning and the other girl had been on the phone all the time. David told **the girl** that had been on the phone to hang up.

Van Berkum et al.'s (1999) results show that the noun *girl* in the two-referent condition (14) versus the one-referent condition (13) elicits an N400. This negative deflection reveals that referential ambiguity has an impact on the processing as soon as the ambiguous referent is encountered. This finding is in contrast with the results by Altman and Steedman (1988) who did not report increased reading times on the noun segment, but only on the segment following the noun. It is possible that the more fine-grained methodology – using event-related potentials – allowed to pinpoint the occurrence of the effect more precisely. Van Berkum et al.'s findings have also been replicated with spoken sentences in a follow-up study (van Berkum, Zwitserland, Hagoort, & Brown., 2003).

Along the lines of van Berkum et al. (1999), Kirsten, Tiemann, Seibold, Beck & Rolke (2014) investigated uniqueness violations not only for definite descriptions, but also for indefinite descriptions in an EEG study. Their experimental stimuli are displayed in examples (15) and (16). The context sentence was composed of either a unique identifiable referent – *a polar bear* – as in (15) or an ambiguous referent – *some polar bears* – as in (16). As shown earlier, there is a uniqueness violation with respect to the presupposition when a context involving ambiguous referents (16) is followed by a determiner as in (16a), whereas there the presupposition is supported in sentence (15a). The authors compared determiner phrases containing a uniqueness violation versus determiner phrases involving no uniqueness violation. In addition, the authors also examined the processing of indefinites comparing a matching (16b) versus a non-matching condition (15b)

15. Antje visited the zoo in Duesseldorf yesterday and saw *a polar bear* in the bear enclosure.
- a. Antje noticed that **the polar bear** was very aggressive.
 - b. Antje noticed that **a polar bear** was very aggressive.
16. Antje visited the zoo in Duesseldorf yesterday and saw *some polar bears* in the bear enclosure.
- a. Antje noticed that **the polar bear** was very aggressive.
 - b. Antje noticed that **a polar bear** was very aggressive.

Kirsten et al.'s results indicate that the noun involving an ambiguous referent elicits an N400 and also a P600. Moreover, the negative deflection in the N400 interval in the ambiguous definite noun phrase is more pronounced compared to the ambiguous indefinite noun phrase.

The results replicate the findings of van Berkum et al. (1999, 2003) showing that uniqueness violations elicit an N400 at the noun position. However, Kirsten et al. also report a P600 effect on the noun, which has not been found in the studies conducted by van Berkum et al. A possible explanation is that the stimuli used in both studies are quite different. In Kirsten et al.'s study the target sentence *Antje noticed that the bear was aggressive* sets up the discourse expectations in such a way that the appearance of the noun *bear* is very likely to be followed by something related to the bear's appearance or activity. In order to resolve the ambiguity of the noun, "the reader interprets the definite noun phrase as referring to a specific example from one domain in order to save the sentence from becoming infelicitous" (Kirsten et al., 2014, p. 1159). This process must occur on the noun position because no additional information later in the sentence will help the reader to resolve the disambiguation. In contrast, the sentences used in van Berkum et al. (1999) allow the reader to resolve the disambiguation later in the sentence as in *David told the girl that had been on the phone*.

Interestingly, Kirsten et al.'s experiment shows that processing ambiguous noun phrases also occurs for indefinites, in which the biphasic N400/P600 pattern is elicited. Nevertheless, it is important to note that the N400 is increased as a function of backgroundedness: Processing ambiguous information involving a presupposition elicits a larger N400 compared to ambiguous information involving an assertion.

Conclusively, the presented results show that the presupposition comes with a processing cost not only when the presupposed content must be accommodated, but also when it cannot be uniquely identified. Let us now turn to contexts in which the presupposed content is inconsistent to the information provided in discourse.

2.2.3. Falsified presuppositions

In a series of studies, Singer (2006) and Ferretti and colleagues (2008, 2013) investigated the processes involved in text verification with respect to the distinction between factive and non-factive verbs. Using a reading-time paradigm, Singer (2006) manipulated the truth of the conveyed information (consistent versus inconsistent) and factivity (factive versus non-factive verbs). As depicted in Table 15, sentence 2 introduced a noun, *oranges* or *apples*, which was either consistent or inconsistent with respect to the information provided in the target sentence. In addition, the conveyed information was either presupposed, that is, via the use of a factive construction (the verb *determine*) or non-presupposed (the verb *figure*) that is, via a non-factive verb.

Table 15. *Sample story used by Ferretti et al. (2008)*

Sample story	
Sentence 1	Ken enjoyed riding his bike to football practice in the afternoon with his brother.
Sentence 2 (True or False introduce information)	Consistent: On this day, it was very hot and Ken and his brother ate oranges while they cycled.
	Inconsistent: On this day, it was very hot and Ken and his brother ate apples while they cycled.
Sentence 3	Since it was about a five mile ride from their house to the practice field, they figured they were getting a better workout than most of the other guys on the team.
Sentence 4	By the time they got to practice, Ken was feeling sick to his stomach.
Target sentence	The coach determined/figured that it was <u>oranges</u> that Ken ate.
Sentence 6	Everyone knew that they were sour at this time of year.
Question	Did Ken ride his bike to football practice? (Yes)

Singer's (2006) results (Experiment 1a, 1b, and 2) reveal a consistency by factivity interaction: Reading time was slower in the inconsistent factive condition versus the consistent factive condition. In contrast, no difference between the consistent and inconsistent condition was observed in the non-factive condition.

In a follow-up study measuring event-related potentials, Ferretti et al. (2008) investigated whether the consistency by factivity interaction occurs (1) at the critical word, that is, *oranges*, which either verifies or falsifies the prior information or (2) at an earlier or even later stage during the sentence. First, their results point out that the difference occurs at the critical noun *oranges*. The event-related potentials are different for congruent narrative text passages than for incongruent ones independently of factivity. Second, the results reveal that the inconsistent condition elicits an N400 independently of factivity. However, the ERPs also reveal an extended N400 for inconsistent factive verbs, that is, that the negativity continues until 1000ms, whereas the inconsistent non-factive condition compared to its consistent counterpart elicits a P600 in the interval between 800 and 1000ms. Ferretti et al. take these findings as evidence that verb factivity influences pragmatic processing. They consider that the presence of the P600 and an absence of an extended N400 in the inconsistent non-factive condition suggest that the inconsistent noun is established as the new referent into the situation model. In other words, the discourse has been updated with the new information. Even though the information is

inconsistent, the coach may mistakenly believe that Ken ate something else than *apples*. Given that non-factive verbs do not entail the truth of their complements, the provided information may be more unexpected compared to the consistent condition, but the information is not completely inconsistent since it only refers to the coach's belief. For this reason, Ferretti et al. (2008) suggest that the elicited P600 in the inconsistent condition may reveal that the discourse model has been updated. In contrast, in the factive condition, the absence of the P600 and the presence of an extended N400 suggests "that people fail to establish the inconsistent nouns as new or independent referents in their situation model" (Ferretti et al., 2008, p. 886). Given that factive verbs entail the truth of their complements, the information is simply false and cannot be saved by the incorrect belief system of the coach. In such a case, the discourse model is not updated. In summary, Singer (2006) and Ferretti and colleagues (2008) results show that factivity has an impact on the verification of text ideas.

In a recent study, Shetreet, Alexander, Romoli, Chierchia & Kuperberg (2019) extended the previously presented findings by Ferretti et al. (2008). Given that the N400 effect is reduced as a function of word repetition (e.g., Rugg, 1985; Van Petten, Kutas, Kluender, Mitchiner & Melsaac, 1991), Shetreet and colleagues used scenarios in which no repetition in the target sentence was present. In addition, they also assessed the naturalness of the used stimuli. As can be seen in Table 16, the bridged information in the target sentence *it was vacant* was either consistent or inconsistent with the conveyed information of the context sentence, *it was unused* vs *it was busy*. In the inconsistent factive condition, the information in the target sentence is not only inconsistent, but it is also false since it contradicts the truth of the factive complement that has been introduced in the context sentence. In contrast, given that non-factive verbs do not entail the truth of their complement, the information provided in the inconsistent condition may be incompatible with the information conveyed in the context sentence, but it is not false.

Table 16. *Stimuli used by Shetreet et al. (2019)*

Trigger	Condition	Context	Target sentence
Factives	Consistent	Calvin needed to meet with his team members in the conference room. He was aware that it was unused.	He checked and it was <u>vacant</u> and dark.
	Inconsistent	Calvin needed to meet with his team members in the conference room. He was aware that it was busy.	
Non-Factives	Consistent	Calvin needed to meet with his team members in the conference room. He presumed that it was unused.	
	Inconsistent	Calvin needed to meet with his team members in the conference room. He presumed that it was busy.	

Shetreet et al.'s behavioural results point out that plausibility in the inconsistent condition is reduced as a function of factivity. Inconsistent information in the factive condition was rated as more implausible compared to inconsistent information in the non-factive condition. In addition, their ERPs reveal that this behavioural difference has a cognitive counterpart. For factives, inconsistent information elicited a P600 during 500 and 700ms compared to consistent information. In contrast, no difference was observed in the inconsistent versus consistent non-factive condition. In addition, there was no evidence of an N400, neither in the factive conditions, nor in the non-factive ones. First, Shetreet et al. suggest that in cases in which a factive verb construction such as *He was aware that it was busy* is used, the factive complement sets up strong discourse expectations to subsequent events. In cases in which this event structure prediction is violated as in *it was vacant*, the detection of the conflict comes with a processing cost, in particular, it elicits a posterior positivity. In contrast, given the nature of non-factive verbs, the predicted upcoming event structure is less contextually constrained since non-factives do not entail the truth of their complements. For this reason, no conflict between the inconsistent information and the information introduced in the non-factive complement must be overcome. Second, the absence of the N400 in Shetreet et al.'s study suggests that the observed N400 effect in Ferretti et al.'s study for the inconsistent condition may have been

driven by word repetition, which was present in the consistent, but absent in the inconsistent condition.

Further evidence that inconsistent presuppositions elicit a P600 effect comes from Jouravlev, Stearns, Bergen, Eddy, Gibson and Fedorenko (2016) who investigated the presupposition trigger *again*. Their results indicate that inconsistent uses of *again* elicit a P600 in comparison to consistent uses of *again*. In summary, Ferretti et al.'s (2009, 2013), Jouravlev et al.'s (2016) and Shetreet et al.'s (2019) results indicate that processing discourse inconsistent content is modulated by the presupposed truth of the information. Inconsistent presupposed information is processed differently compared to inconsistent non-presupposed information. In addition, the three presented EEG studies on factives reveal a presence/absence of the N400 and P600 component as a function of the backgroundedness and consistency of the relevant information.

The reviewed literature in this subsection points out that inconsistent presupposed information incurs higher processing costs when compared to inconsistent non-presupposed information. These findings suggest that information conveyed as a presupposition is checked against the previously communicated information. In cases in which information conveyed as a presupposition clashes with the information that is commonly accepted, a higher processing cost occurs (Ferretti et al., 2009, 2013). The same is true the other way around: Information first conveyed as a presupposition and then contradicted also elicits higher processing costs compared to information that is not conveyed as a presupposition (Shetreet et al., 2019). However, it is also worth mentioning that early research on memory recall indicates that false information conveyed via a presupposition is less likely to be detected²⁵.

In one of the famous studies on memory recall, Loftus (1975) investigated how the wording of questions can influence memory recall of an event one week after being exposed to it. In experiment 4 of her study, the question was either asked using an assertion via an indefinite or a false presupposition via a definite article (see Table 17). After watching a three-minute video clip, participants had to answer questions related to the clip. The questions of interest contained information about the clip that were actually false. Participants were assigned to three different conditions. The first group was exposed to direct questions involving an indefinite article such as *Did you see a school bus in the film?*, the second one was exposed to questions

²⁵ Later in this section (2.2.6), I will also present a study by Wang et al. (2009) who found evidence that the N400 effect is stronger when inconsistent information is conveyed via an assertion. In scenarios in which the same information is conveyed as a presupposition, the N400 amplitude is reduced.

involving a presupposition such as *Did you see the children on the school bus?*, and the third group – a control group – was only exposed to filler questions and did not see any of the target questions. One week after the experiment, the participants answered the same questions again. Loftus’ results indicate that participants of the control group had the lowest incorrect response rate (8.4%) of all three groups, whereas the incorrect response rate rose to 15.6% in the direct question group (i.e. question involving an indefinite) and was highest in the false presupposition group (i.e. question involving a definite). In the latter group, 29.2% gave incorrect responses to the questions. Loftus’ study is one of the first pieces of evidence that the mere exposure to false presuppositions immediately after watching a video clip increases the probability to recall more incorrect information one week later. In general, this study reveals that different information layers do not only have an impact on language processing and comprehension, but also influence other domains such as memory recall.

Table 17. *Experimental stimuli of Loftus’ (1975) experiment 4. Depicted is the percentage of “yes” responses one week after having seen the video sequence. All questions refer to items that were not present in the video sequence.*

Direct questions	Percentage of Yes responses one week later	False presupposition questions	Percentage of Yes responses one week later
Did you see a school bus in the film?	12	Did you see the children on the school bus?	26
Did you see a truck in the beginning of the film?	8	At the beginning of the film, was the truck parked beside the car?	22
Did you see a center line on the country road?	14	Did another car cross the center line on the country road?	26
Did you see a woman pushing the carriage?	36	Did the woman who was pushing the carriage cross into the road?	54
Did you see a barn in the film?	8	Did you see a station wagon parked in front of the barn?	18

Loftus’ study received some criticism with respect to its used stimuli. As Schwarz (2014) points out, participants may have been influenced by some Gricean reasoning. Given that the

information in the false presupposition conditions was conveyed as a presupposition, the presupposed information may have simply been considered as true. A later study by Fiedler, Walther, Armbruster, Fay, and Naumann (1996) addresses this criticism. In their study, the authors used an experimental design in which the participants had to identify correct or incorrect objects after watching a video-taped flat. Participants were told that two videos were recorded, and they should decide whether the statement was related to the video they saw or to another one. This experimental design should increase participants' awareness to false presuppositions in a way that they should not take them for granted by default. Nevertheless, the results by Fiedler et al. are similar to the ones obtained by Loftus. Incorrect recognition of objects is higher in statements using a presupposition – definites – than using an assertion – non-definites – (see their results of experiment 3).

Loftus (1975) and Fiedler et al.'s (1996) results provide evidence that different layers of meaning incur different rates of intrusion errors on the hearer. Even if the hearer has been provided with correct information in a video clip, when false information is presupposed by follow-up questions, this is more likely to be considered as true in comparison to the same information not being presupposed.

In a similar vein, Bredart and Modolo's (1988) study shows that inadequacies are less likely to be detected when they are part of the presupposition than when they are part of the asserted content. The authors compared sentences as in (17) and (18). Sentences in which the false information was conveyed as an assertion (17) received higher correct response rates compared to false information that was conveyed as a presupposition (18).

17. It was President Luther King that was killed in Dallas in 1963.

18. It was in Dallas that President Luther King was killed in 1963.

In summary, the presented studies in this section show that false information conveyed via a presupposition incurs an immediate processing cost when embedded in contexts that make its falsity salient and relevant. Moreover, the last two presented studies also indicate that (i) false information conveyed as a presupposition incurs higher memory intrusion errors (Loftus, 1975) and (ii) detecting false information is more difficult when this information is conveyed via a presupposition than via an assertion (Bredart & Modolo's, 1988).

2.2.4. Presupposition Triggers

As discussed in Section 1.8, there are different theoretical proposals that group presupposition triggers into different classes (e.g., Abusch, 2002, 2010; Glanzberg, 2003, 2005; Zeevat, 1992,

2002). Domaneschi et al. (2013) experimentally investigated whether the distinction between ‘weak’ and ‘strong’ triggers as proposed by Glanzberg (2003, 2005) would elicit different processing patterns. The distinction between ‘weak’ and ‘strong’ triggers is drawn on the basis of the outcome of presupposition failure. Strong presupposition triggers require an obligatory repair, whereas repair is only optional in the case of weak presupposition triggers. For instance, definite descriptions are considered as strong presupposition triggers and lead, in case of failure, to an obligatory repair of the context. For instance, when uttering *Pass me the cup of coffee* and there is no salient cup of coffee in reach, the utterance fails to pick up an available discourse antecedent (*a cup of coffee*), which is directly linked to the asserted content of the utterance (*the cup of coffee*). Without an existing *cup of coffee*, the sentence lacks a truth-value. Hence, it must be corrected immediately, which in turn triggers, according to Glanzberg, an obligatory repair. In contrast, there are presupposition triggers such as focus sensitive particles like *even* that do not require an obligatory, but only an optional repair. For instance, the asserted content in an utterance with a focus sensitive particle *Even John passed the exam* can still be processed, and truth-evaluated, even when the presupposition fails. More precisely, even if the associated presuppositions (19b and 19c) of utterance (19) are false, the asserted content can still be considered as true.

19. Even John passed the exam.

- | | | |
|----|--|--------------------|
| a. | John passed the exam. | (Asserted content) |
| b. | Someone other than John passed the exam. | (Presupposition) |
| c. | It was unexpected that John passed the exam. | (Presupposition) |

In their study, Domaneschi et al. (2013) empirically investigated Glanzberg’s distinction between weak and strong triggers (see Table 18). In addition, the authors also manipulated the level of interference by comparing a low versus high interference condition in a dual-task paradigm with two levels of cognitive demand.

Table 18. *Experimental design used in Domaneschi et al. (2013)*

Sample Story (Audio story)			
The Barcelona Aquarium hosts 20 different kinds of sharks. The tour guide explains to the visitors that [<i>Factive Verb</i>] all the sharks are female; therefore, there is no possibility of procreation within the tanks. However, recently, the re-introduction [<i>Iterative</i>] of a male shark into the main tank has been discussed. The zambezi sharks [<i>Definite Description</i>] are the main attraction since the operators feed them by hand. Most of the sharks can only feed on cod. In fact, sharks gave up [<i>Change of State Verb</i>] feeding on other fish a long time ago. All the animals in this aquarium are being continuously cared for: sometimes, even [<i>Focus-Sensitive Particle</i>] the zambezi sharks are taken out of their tanks.			
Presupposition trigger	Question	Mean correct responses (SD) Condition A (low interference)	Mean correct responses (SD) Condition B (high interference)
Definite description	Are there zambezi sharks in the Barcelona Aquarium?	86 % (12%)	90 % (10%)
Factive Verb	Are all the sharks in the aquarium female specimens?	86% (20%)	89 % (10%)
Change-of-state verbs	Did the aquarium sharks feed on fish other than cod in the past?	83% (12%)	65 % (18%)
Iteratives	Has a male specimen been introduced into the main tank in the past?	65% (17%)	49 % (12%)
Focus sensitive particles	Are the other animals in the aquarium sometimes taken out of their tanks?	58% (16%)	60 % (12%)

Their results show that (i) the category of presupposition trigger has an impact on the processing of the respective presupposed content and (ii) the level of interference does not impact the distinct triggers in the same way. More precisely, with respect to the low interference condition, the following pattern emerged: The presupposed content of definite descriptions, factive verbs and change of state verbs is processed more frequently than the presupposed content of iteratives and focus sensitive particles. This finding indicates that processing the presupposed content depends heavily on the distinction between the mentioned theoretical distinction of ‘weak’ and ‘strong’ triggers. Furthermore, their results point out that the processing of the presupposed content does not only depend on the presupposition trigger, but also on the level of interference. A high level of interference – increase of the so-called cognitive demand – significantly decreases the processing of the presupposed content within the categories of change of state verbs and iteratives, whereas there is no evidence that a different level of interference has an impact on the processing of definite descriptions, factive verb constructions and focus sensitive particles.

In order to better understand the acceptability and the precise time course of distinct presupposition triggers, Tiemann et al. (2011) and Tiemann (2014) investigated five different presupposition triggers. In the former, Tiemann et al. (2011) compared information introduced via a presupposition to information introduced via an assertion. In a follow-up study (Tiemann, 2014), she extended her investigations by comparing presuppositions in neutral contexts to presuppositions in supportive contexts.

Early studies on presuppositions examined their acceptability in contexts in which the content of the presupposition represents new information (i.e. when the presupposition is *informative*). Tiemann et al. (2011) compared the acceptability judgments of different sentence conditions using five distinct presupposition triggers, i.e. *again*, *to know* (factive verb), definite descriptions, *too* (iterative) and change of state verbs. In their experiment (Trigger Study) a context sentence as in (20) was used, which was followed by one of three conditions, i.e. an asserted condition as in (20a), a presupposition without a discourse antecedent as in (20b), or a semantically anomalous condition as in (20c).

- | | |
|--|--|
| 20. Tina is shopping with a good friend. | |
| a. | She buys red gloves today. (Asserted Information) |
| b. | She buys red gloves again. (Presupposed Information) |
| c. | She buys red gloves friendly. (Semantically anomalous) |

Their results indicate that the asserted and semantically anomalous conditions are at the opposing ends of the scale, i.e. the asserted condition received a *very good* acceptability rating whereas the semantically anomalous one ranges between *very bad* and *bad*. The condition containing the presupposition (20b) received an intermediate acceptability rating, which is significantly different from the acceptable and the semantically anomalous condition. This result points out that, on the one hand, taking something for granted that has not yet been introduced in prior discourse is judged less acceptable compared to information that involves no presupposed content, and on the other, a sentence containing a presupposition that has not been introduced in previous discourse is judged more acceptable than unacceptable semantically anomalous sentence. Furthermore, the results also show that the type of trigger has a significant impact on the acceptability judgment. The presupposition triggers of *again* and *know* received a higher acceptability rating compared to the presupposition triggers of definite descriptions, *too*, and change-of-state verbs.

In a follow-up study using an acceptability rating and a self-paced reading paradigm, Tiemann (2014) investigated the acceptability and the precise time course of presuppositions in

neutral contexts compared to supportive contexts. As depicted in Table 19, five distinct presupposition triggers were used, i.e. *again*, *too*, the change-of-state verb *stop*, definite descriptions, and the factive verb *know*.

Table 19. *Stimuli used in Tiemann (2014)*

Presupposition Trigger	Condition	Context sentence	Target sentence
Again	Supportive condition	Susanne had already bought red gloves before.	Today, Susanne bought red gloves again and put them on the right away.
	Neutral condition	Inge had never bought red gloves until now.	
Too	Supportive condition	Fritz cooks today a soup with Tina today.	She hopes that Susanne will cook a soup with her, too, and buys for it ingredients.
	Neutral condition	Nobody is eating today a soup with Tina.	
Change-of-state verbs (to stop)	Supportive condition	Karl is doing honorary work in a home for the elderly.	Karl will stop doing honorary work in a home for the elderly.
	Neutral condition	Susanne is doing honorary work in a home for the elderly.	
Definite descriptions	Supportive condition	Tina's brother has a taxi.	She borrows herself his taxi and drives to Potsdam.
	Neutral condition	Tina's brother has a bicycle.	
Factive verbs (to know)	Supportive condition	Tina is not in love with Fritz.	He knows that Tina is not in love with him and gets drunk.
	Neutral condition	Inge is not in love with Fritz.	

The overall results show that the presuppositions are judged more acceptable in supportive contexts compared to neutral ones (Table 20).

Table 20. Acceptability judgment using a Likert scale from 1 (very bad) to 4 (very good). DD = Definite Descriptions.

	too	again	stop	know	DD
Supportive condition	3.7	3.4	3.8	3.8	3.8
Neutral condition	1.7	2.4	2.4	2.3	1.8

In addition, the self-paced reading time indicated the exact time course of the increase in the neutral condition versus the supportive condition: As depicted in Table 21, (i) for *too*, reading time was slower in the region following the trigger and on the critical word (= the verb that has not been mentioned in prior discourse - *cook*); (ii) for *again*, the slow-down occurred only on the trigger itself; (iii) for *know*, the slow-down occurred on the critical word (= *know*) and on the verb of the presupposed content (critical word + 1 - *in love*); (iv) for definites, the slow-down occurred on the trigger itself - *his* - and on the noun following the trigger - *taxi* - and (v) for the change-of-state verb *stop*, the slow-down occurred on the critical word; however, this slow-down did occur in the supportive condition and not in the hypothesized neutral condition.

Table 21. Significant differences in self-paced reading paradigm. * indicates significant differences, whereas ns indicates non-significant differences. In general, the neutral condition is read slower than the presupposed one. The only exception is the presupposition trigger of change-of-state verbs, the critical section is read faster in the neutral condition compared to the supportive one). DD = Definite Descriptions.

	too	again	stop	know	DD
Trigger	ns	*	ns	ns	*
Trigger+1	*	ns	ns	ns	/
Critical word	*	ns	*	*	*
Critical word + 1	ns	ns	ns	*	ns

Tiemann's (2014) findings extend the results by Tiemann et al. (2011) and indicate that (i) sentences involving a presupposition without a discourse antecedent are rated as less acceptable compared to supported presuppositions, (ii) the category of the presupposition trigger has an impact on the acceptability rating in neutral contexts, and (iii) the time-course of processing presuppositions in neutral contexts depends on the presupposition trigger. More specifically, the results show that the acceptability ratings involving the presupposition triggers *again*, *stop*, and *know* are higher than those for the triggers *too* and definite descriptions. This highlights once more that the linguistic heterogeneity of presupposition triggers also has a cognitive

counterpart. However, it is not clear how the different theoretical proposals may explain the acceptability ratings. For instance, Abusch's (2002; 2010) distinction between soft and hard presupposition triggers cannot entirely explain the observed pattern, nor can Glanzberg's proposal distinguishing weak from strong triggers (2003, 2005).

Using Abusch's terminology, soft triggers can be suspended, whereas hard triggers cannot. Definite descriptions, *again* and the iterative *too* are usually considered as hard triggers, whereas change-of-state verbs and factives are classified as soft triggers. When linking Tiemann's results to this distinction, the only presupposition trigger that behaves differently is the hard trigger *again*, which shows a pattern similar to the soft triggers *stop* and factive verbs. Even though this finding does not correspond to Abusch's distinction, it is in line with Schwarz' results (2014). When comparing *stop* and *again* in a visual world paradigm, Schwarz (2014) also did not find any evidence that *again* and *stop* are processed differently.

With respect to the reading times, a remarkable finding is the increase in reading time in the supportive condition of the change-of-state verb *stop* in comparison to the neutral one. Tiemann argues that this finding could either suggest that (i) "there is an effect of presupposition failure in the neutral condition that we do not see" (Tiemann, 2014, p. 90) or (ii) that accommodating the presupposition of a change-of-state verb may not be that demanding. Given that the presupposition cannot be found in the previous context, it could, thus, be integrated more effortlessly. Tiemann suggests that in the supportive condition the context must be checked in order to verify the presupposed content. It should be noted that her finding and her explanation differs from the more recent experimental findings with respect to change-of-state verbs, which reveal that processing change-of-state verbs in neutral contexts comes with a processing cost (Domaneschi et al., 2018; Domaneschi and Di Paola, 2019). A possible interpretation explaining Tiemann's results is that her experimental stimuli are (i) quite different from the stimuli used in Domaneschi et al. (2018) and in Domaneschi and Di Paola (2019) and (ii) that the topic shift in her stimuli from *Susanne is doing honorary work* to *Karl will stop doing honorary work* does not resemble the typical process of presupposition accommodation since there may not be a direct link between both sentences. As a consequence, the discourse model needs neither be linked to an antecedent nor updated since Karl has been mentioned for the first time. In contrast, the processing is different for the antecedent in the supportive condition *Karl is doing honorary work*. In order to process the presupposition *Karl will stop*

doing honorary work, the context must be verified, which may be costlier in comparison to a context which must not undergo this process of verification²⁶.

In summary, the presented experimental studies have indicated that distinct presupposition triggers are processed differently. First, Domaneschi et al.'s (2013) study provide evidence that the presupposed content of factives, definite description and change-of-state verbs is processed more frequently compared to iteratives and focus sensitive particles. Second, Tiemann et al.'s (2011) and Tiemann's (2014) results reveal that (i) the acceptability ratings are reduced as a function of information backgroundedness and that (ii) the time course of presupposition accommodation depends on the presupposition trigger. Third, the presented studies have also shown that the different theoretical classifications of presupposition triggers are only partially able to capture the processing patterns identified in the experimental literature.

In the first presented study in this subsection, Tiemann et al.'s (2011) results indicated that presupposed content is judged less acceptable compared to asserted content. In their study, the authors compared the distinction between presupposed versus asserted content in plausible contexts. I will now present a study that investigates the processing of asserted versus presupposed content in plausible as well as implausible contexts. Afterwards, I will present an EEG study that compares the processing of asserted versus presupposed information by using the distinction between indefinites and definites.

2.2.5. Presupposed versus asserted content

Further evidence that the preceding context has an effect on the processing of presuppositions comes from Singh, Fedorenko, Mahowald, and Gibson (2016). In their study, the authors not only manipulated the way in which the new information was introduced (new information was either asserted or presupposed), but also the appropriateness of the preceding context (the context was either plausible or implausible). In their first study²⁷, the authors investigated the processing of a definite (e.g. *the bouncer*) versus an indefinite (e.g. *a bouncer*), which was preceded by a plausible context, as in (21), or an implausible context, as in (22). In their second

²⁶ In general, it should be noted that Tiemann's (2014) stimuli appear to be problematic, in particular with respect to the neutral condition. The used condition introduced either a topic shift, i.e. for *again*, *stop*, *know* and *too* or an unexpected continuation as it is the case for definites, in which a bicycle was introduced in the discourse antecedent, which was followed by *taxi* in the target sentence. As a consequence, her results should be interpreted with care, but they represent, nevertheless, a good starting point for discussing the time course of presupposition processing.

²⁷ Singh et al. (2016) used a stop-making-sense self-paced reading paradigm, in which the participants were asked to continue the sentence as long as the sentence makes sense to them. This paradigm has the advantage that it allows to measure two dependent variables at the same time, that is, (1) the reading time for each region and (2) the proportion of continue responses at each region.

study, the investigation was extended to another presupposition trigger, the iterative *too*, as in (23) and (24), which was compared to an adverbial, e.g. tomorrow.

21. Bill went to a club last night.
 - a. A bouncer argued with him for a while.
 - b. The bouncer argued with him for a while.
22. Bill went to a circus last night.
 - a. A bouncer argued with him for a while.
 - b. The bouncer argued with him for a while.
23. John will go to the pool this morning.
 - a. Peter will go swimming too after he gets back from school.
 - b. Peter will go swimming tomorrow after he gets back from school.
24. John will go to the mall this morning.
 - a. Peter will go swimming too after he gets back from school.
 - b. Peter will go swimming tomorrow after he gets back from school.

Their results show that (i) plausibility has an impact on the processing of the presupposition, (ii) in general, implausible presupposed content is accommodated less frequently compared to implausible asserted content and, more specifically, it also depends on the trigger type, (iii) the type of the trigger modulates the reading time in the implausible condition, and (iv) plausibility has an impact on the processing of new information independently from the way in which this information is introduced (asserted versus presupposed).

First, plausible presuppositions that must be accommodated are judged more acceptable than implausible ones. With respect to plausible contexts, accommodating the presupposed content even if it has not yet been assumed appears to be unproblematic. This result supports the theoretical analysis of the phenomenon of accommodation discussed in the first part of this chapter. As Lewis (1979) puts it “something that requires a missing presupposition, and straightaway that presupposition springs into existence, making what you said acceptable after all” (p. 172). However, Lewis also points out that adding new information to the common ground occurs “*ceteris paribus and within certain limits*”, which indicates that accommodating the presupposed content is not a straightforward process but depends on some constraints. Sing et al.’s results reveal that plausibility is an important constraint: Implausible presuppositions make less sense than plausible ones.

Second, the new information introduced via both presupposition triggers in the implausible condition is judged less acceptable in comparison to the asserted condition. Moreover, the results show that the acceptability depends on the category of the presupposition trigger. For definites in the implausible condition, 13% judged the sentence as not making sense

at the triggering point *the bouncer*, which increased to 52% at the end of the sentence. In contrast, for the presupposition trigger *too*, 36% judged the sentence as not making sense at the triggering point *too*, which increased to 60% at the end of the sentence.

Third, for *too*, the results indicate an increase in reading time for the presupposed content versus the asserted content in the implausible condition. In particular, this difference arises at the region following the presupposition trigger. In contrast, there was no reading time difference for definites versus indefinites in the implausible condition.

Fourth, Singh et al.'s results also show that there is neither a difference in acceptability nor in reading time between asserted and presupposed content in plausible contexts. This finding holds for both investigated presupposition triggers. In the following, I will elaborate on the absence of the effect with respect to the presupposition trigger of definite descriptions. The absence of an effect may be due to the fact that the inferential demand of processing asserted versus presupposed information in highly plausible contexts does not differ. As shown earlier in this chapter, O'Brien et al. (1988) also did not find a difference in reading time processing bridged versus new information in highly constraining contexts. For instance, in context (21), the noun *club* introduces entities that are not explicitly specified. These contexts activate more easily the noun *bouncer*. In these cases, it may be irrelevant whether this information is new (*a bouncer*) or given (*the bouncer*) because the noun, even in the presupposed condition, can easily be inferred. If there is a difference between processing/accepting the asserted versus presupposed information in highly plausible contexts, then this difference should arise at the position of the indefinite *a* versus the definite article *the*. Given that the indefinite and the definite article appeared simultaneously with the noun *a bouncer* versus *the bouncer*, a possible difference between the two conditions may have been more difficult to be detected using the chosen paradigm. For this reason, the high temporal resolution of the EEG method may be more sensitive to detect possible differences. This is exactly what Masia, Canal, Ricci, Vallauri and Bambini (2017) did in their experiment.

Measuring event-related potentials, Masia and colleagues (2017) investigated the difference between presupposed and asserted content using the two presupposition triggers depicted in Table 22²⁸.

²⁸ The used stimuli were pretested in a naturalness study, which indicated that the conditions did not differ in terms of naturalness. As mentioned before, this measure is quite important given that differences in reading time or event-related potentials can be driven by differences in acceptability ratings (e.g. Burkhardt, 2006; 2007; Singh et al., 2016; Tiemann, 2014).

Table 22. *Experimental stimuli used by Masia et al. (2017)*

Trigger	Condition	Context	Target sentence
Definite description	Presupposed content	It is by now well established that the humankind is not pure. In fact, our DNA contains genetic information belonging to Neanderthals, who soon peopled Europe.	The migration was confirmed by a very recent article published by Italian and foreign researchers.
	Asserted content		There was a migration , confirmed by a very recent article published by Italian and foreign researchers.
Subordinate clause set	Presupposed content	Ye Weibin, in art Antonio, has been living in Italy for 12 years. After several jobs, he now runs a bar in the suburb.	When he became a father , he used to bring his little daughter to the bar keeping her with him all day.
	Asserted content		He has become a father and now he always brings his little daughter to the bar, and keeps her with him all day.

Masia et al.'s (2017) findings indicate that the presupposed content of both presupposition triggers elicit an N400 component compared to their asserted counterparts, but no P600 was found. The presence of an N400 and the absence of a P600 effect for the presupposed content versus the asserted content was interpreted in the following way: as both presupposition triggers do not contain an explicit discourse reference, linkage costs accrue, which may be responsible for the triggering of the N400. Masia et al.'s results are very much in line with the earlier described model by Schumacher (2009). However, the absence of a P600 is in contrast with the results obtained by Burkhardt (2006). In Burkhardt's study, the bridged context condition, which is similar to the presupposed content condition in Masia et al.'s study, elicited a P600 and not the reported N400. For Masia et al., the absence of the P600 between the presupposed and the asserted condition in their experiment may be due to the fact that both stories did not

differ in the prior assessed naturalness rating, which in turn may make the process of discourse updating equally relevant for both conditions. For this reason, the only difference that emerged is the fact that the presupposed content must be accommodated, creating an unexpected discourse continuation, whereas the asserted content is a more likely discourse continuation because it only introduces new information without linking it to previously introduced information as it is the case in the presupposed condition. In summary, Masia et al.'s findings extend the results of Singh et al. (2016) and show that event-related potentials are more sensitive to capture a processing difference between asserted and presupposed contents in plausible contexts. In addition, the emergence of an N400, but absence of a P600 component, when naturalness is controlled for, shows that the N400 is sensitive to the integration of presupposed versus asserted information for the presupposition triggers of definite descriptions and subordinate clauses.

Until now, I have focused on one key property of presuppositions, namely their backgroundedness, which makes the recognition of the truth of the presupposition a precondition for a felicitous utterance. In the previous section, I showed that in cases in which (i) the presupposition must be accommodated (neutral versus supportive contexts and asserted versus presupposed content) and (ii) when the presupposition is falsified by the context (uniqueness violation of presuppositions and falsified presuppositions), interpretation comes with a processing cost. The reviewed literature indicates that this increased processing cost has been detected via several distinct experimental methods.

In the theoretical overview of the discursive properties of presupposition, I showed that presuppositions are usually not considered as the main point of the utterance and do not move the discourse forward. First, presuppositions are subject to discourse attachment constraints, that is, there are usually excluded from any discourse attachment (Ducrot, 1972). Second, presuppositions are considered not-at-issue and it is usually infelicitous to target the content that has already been taken for granted in discourse continuations. In the next section I will review the experimental literature on this topic in order to examine if these well-established theoretical observations also have an experimental counterpart.

2.2.6. Discourse Attachment properties

Presuppositions do not typically provide natural answers to questions (Grimshaw, 1979). For instance, the answers in (25a) and (25b) presuppose the truth of the presupposition that Bill left without asserting it. According to Grimshaw, the content of the information provided in (25a) does not per se pose a problem – a hearer can easily infer that *Bill left* –, but answering a

question with a presupposition instead of an assertion appears to violate an underlying discourse principle, that is, that “one cannot reply to a question with a response which presupposes the answer” (Grimshaw, p. 322). If instead, the answer is asserted as in (25c), a perfectly well-formed exchange unfolds.

25. Did Bill leave?
- a. It is odd that he did.
 - b. I’d forgotten that he did.
 - c. Yes, he did.

Grimshaw (1979) claims that a similar observation can be made with the question-answer pair in (26). Given the reply in (26a), it can be inferred that B *did have a lot of fun*; however, the deviance of such an answer stems from the fact that the exclamation does not assert, but only presupposes that the speaker had fun. In summary, Grimshaw’s observations indicate that answering a question with a presupposition is considered as a violation, which leads to what she calls an *ill-formedness in discourse*.

26. Did you have fun?
- a. What fun we had!

As shown above, presuppositions provide neither natural answers to questions nor are central in discourse. Due to its backgroundedness, the presupposed content is considered less addressable than the asserted one. Let us consider the dialogue in (27). While it is possible to directly deny or reject what has been asserted by speaker A (as in 27b), it is not possible to directly refute a presupposition without giving rise to an infelicity (27c) (Cummins, Amaral & Katsos, 2012).

27. a. A: Paul stopped smoking.
 b. B: No, Paul didn’t stop smoking.
 c. B: # No, Paul didn’t used to smoke.
 d. B: Hey, wait a minute! Paul didn’t used to smoke.

Crucially, as suggested by Shanon (1976) and von Stechow (2004, 2008) challenging a presupposition requires a particular discourse move that is metalinguistic in nature (and that has been described as the ‘*Hey, wait a minute!*’ test). In order to reject the presupposition of (27a) that Paul used to smoke, B must disrupt the normal flow of discourse by uttering a sentence as in (27d). In cases in which the non-at-issue content is addressed as in (29c), the speaker is abandoning the current QUD, which leads to the impression of a non sequitur (Jaye, 2010). Continuations which target the presupposition are typically considered infelicitous. Typically,

the asserted content is *at-issue* and addresses the QUD, whereas the presupposed content is *non-at-issue*.

A recent empirical investigation targeting the acceptance or rejection of presuppositions in discourse comes from Cummins et al. (2012). The authors examined whether responses to a question are judged less acceptable when the presupposition is rejected than when the presupposition is accepted. In their experiment, four experimental conditions were used: Responding “yes” or “no” when either accepting the presupposition as in (28a and 28b) or rejecting the presupposition as in (28c and 28d). Their overall results show that acceptance ratings of answers that did not reject the presupposition were significantly higher compared to acceptance ratings of those which challenged the presupposition. More interestingly, even when the at-issue content is directly denied, as in (28b), significantly higher ratings are still observed than when the non-at-issue content is denied, as in (28c). In a follow-up study, Amaral and Cummins (2015) show that their results also hold for Spanish. In conclusion, these two studies present empirical evidence that answering a question with a presupposition is less acceptable than answering a question with the asserted content.

28. Did Brian lose his wallet again?

- | | | |
|----|--|--------------------------------|
| a. | Yes, he did lose his wallet again. | (Positive asserted content) |
| b. | No, he didn't lose his wallet this time. | (Negative asserted content) |
| c. | Yes, although he never lost it before | (Positive presupposed content) |
| d. | No, because he never lost it before. | (Negative presupposed content) |

Theoretical observations suggest that it is not only infelicitous to answer a question with a presupposition, but it is also infelicitous to target the presupposition in discourse attachment scenarios. According to Ducrot (1972), discourse continuations are infelicitous if they only address the presupposition. This is exactly what Jayez (2010) empirically investigated when focusing on consequence discourse markers (the French *alors* and *donc*, respectively equivalent to so and therefore) and causal justification subordinating conjunctions (*parce que* and *puisque*, respectively equivalent to because and since). Using an acceptability-rating task, his results are in line with the theoretical prediction. Discourse continuations as the ones in (29c) and (29d) received lower acceptability ratings than discourse continuations that target the asserted content (29a and 29b).

29. a. Paul stopped quivering, so he went outside.
b. Paul stopped quivering because he went inside.
c. Paul stopped quivering, so he was cold.

d. Paul stopped quivering because he went outside.

2.2.6.1. Discourse Attachment properties: EEG evidence

In the previous section, acceptability judgment ratings indicated that answering a question with a presupposition received lower acceptability ratings than answering a question with an assertion. As pointed out in the first part of the literature review on presupposition processing, acceptability ratings are a good starting point in order to provide important insights about language phenomena but they do allow us to investigate the precise time course of language processing. For this reason, I will now turn to the studies that use the EEG to address similar research questions.

Cowles et al. (2007) investigated the discourse level restrictions during online sentence processing. The authors present evidence that information packaging using it-cleft constructions sets up certain expectations for the hearer. For instance, *Wh-questions* set up the discourse in such a way that the expected answer of (30) must be a lettuce-eating agent.

30. What ate the lettuce in your garden, the deer or the rabbits?
- a. It was the rabbits that the lettuce ate.
 - b. # It was the lettuce that the rabbits ate.

Consequently, an expected answer could either be the deer, the rabbits or any other not yet introduced animal which plausibly eats lettuce, as in (30a). In this case, the new information that answers the wh-question have focus status and represents the at-issue content, whereas the shared information, that is, that the lettuce was eaten is appropriately conveyed as part of the presupposed content. This appropriate information packaging, which characterizes the answer in (30a), is reversed in (30b).

Even if the correct information can be derived from both sentences, the current question under discussion is expected to be addressed via an appropriate structuring of the it-cleft construction. Using an information packaging as in (30b) violates this discourse expectedness. This is exactly what Cowles et al. found. Their results indicate that answers with a focus misalignment elicit an N400 in comparison to answers where such a misalignment is absent, which in turn suggests that informational structural constraints have an impact on the expectation of upcoming words.

A study by Wang et al. (2009) extends these findings by Cowles et al. (2007). In their study, the authors used a 2x2 factorial design in which they manipulated not only the semantic appropriateness – semantically appropriate versus semantically inappropriate – but also the focus alignment – in focus or not in focus. Their results show that the N400 component is

modulated by focus. Inappropriate semantic information that is in focus (31b) in comparison to appropriate information (31a) elicits the usually observed N400 effect. In contrast, the N400 component is sharply reduced when the inappropriate information is not in focus (32b). According to the authors, processing resources may be allocated to the focus position of an utterance in order to facilitate semantic integration. In contrast, non-focused information requires less resources; consequently, a violation of semantic appropriateness leads to lower processing costs. Similar results were obtained by Li et al. (2008) with auditory stimuli.

31. What kind of vegetable did Xiao Min buy for cooking today?

- a. Today Xiao Ming bought eggplant to cook.
- b. Today Xiao Ming bought beef to cook.

32. Who bought the vegetables for cooking today?

- a. Today Xiao Ming bought eggplant to cook.
- b. Today Xia Ming bought beef to cook.

2.2.7. Summary: Judging and processing presuppositions and their discourse attachment properties

The main findings of the experimental literature reviewed so far can be summarized as follows:

- (i) Processing presuppositions in neutral contexts in comparison to supportive contexts comes with an immediate processing cost.
- (ii) Processing presuppositions in neutral contexts compared to assertions also comes with an immediate processing cost.
- (iii) Ambiguous information involving a presupposition is treated differently compared to ambiguous information involving an assertion.
- (iv) Contextually inconsistent presupposed information is processed differently than contextually inconsistent non-presupposed information.
- (v) Answering a question with a presupposition is not only less acceptable but also comes with an immediate processing cost.

Overall, the empirical findings show evidence that the theoretical distinction between presuppositions and other layers of meaning also has an experimental counterpart. Processing information that is considered as backgrounded knowledge, or at least presented as such, is processed differently compared to asserted information or information that has already been introduced. Moreover, the presented empirical findings are in line with the theoretical framework in which presuppositions are considered marginal in discourse since they do not move the discourse in the desired direction. Discourse moves that address the presupposition without deliberately challenging it are judged less acceptable and also trigger a different processing pattern than asserted content that follows the current discourse goal.

So far, the presented empirical evidence investigated backgroundedness and discourse attachment properties independently of each other. Recent research though has attempted to investigate them simultaneously. In the remaining part of this chapter, I will turn to those studies in order to elaborate on the third question asked in the beginning of the experimental section:

(3) Is there a relationship between projectivity and non-at-issueness?

2.2.8. Projectivity and non-at-issueness

The first experimental evidence concerning the existence of a relation between the backgroundedness of presuppositions – more specifically, their projectivity – and their non-at-issueness comes from Xue and Onea (2011), who investigated the factive constructions *know* and *find out* as well as the iteratives *again* and *too*. A sample stimulus of the factive construction *know* and the findings for all used presupposition triggers are depicted in Table 23.

Table 23. *Experimental stimuli used by Xue and Onea (2011) and their findings. Top: experimental design for projectivity. Middle: Experimental design for at-issueness. Bottom: results for both experiments.*

Projectivity (<i>in bold is the answer in which the presupposition is taken for granted</i>)				
Context	Question	Likelihood of the question (Forced-choice)		
If Paul knows that Christine likes tea, he will give her a teapot as a present.	Is it possible that that Christine doesn't like tea?	Yes, it is possible.	No, it is not possible.	
		I don't know.		

At-issueness (<i>in bold are the answers in which the presupposed content is not-at-issue</i>)	
Context	Continuation (Forced-choice)
Tina knows that Max is on vacation.	Yes, and Max is not on vacation at all. Yes, but Max is not on vacation at all.²⁹ No, Max is not on vacation

Results				
	know	find out	too	again
Projectivity	38.24%	51.96%	87.25%	99.02%
Not-at-issueness³⁰	27.59%	50%	74.15%	77.59%

²⁹ Since “*Yes, but*” and “*Yes, and*” are indirect denials of the presupposed content, Xue and Onea consider these two continuations as indications measuring the non-at-issueness of the presupposition.

³⁰ The answer possibility “*Yes, and*” was only preferred by a minority. *To know, to find out, too, and again* received 0%, 5.7%, 18.97%, and 6.9%, respectively.

Xue and Onea’s results suggest that there is a relationship between projectivity and non-at-issueness with respect to the investigated four presupposition triggers. Projectivity correlates positively with non at-issueness. The higher the score of projectivity, the higher is the probability of the presupposed content to be non at-issue. In their study, the complement of the factive verb *know* is less projective (e.g. on the projective variability of the complement of *know*, see Domaneschi & Di Paola, 2018) compared to the presuppositions of *too* and *again* and the complement of the factive *find out* received an intermediate rating³¹.

Further evidence of the relationship between projectivity and non at-issueness is provided by Tonhauser, Beaver and Degen (2018), who investigated a broader range of projective contents (for a sample stimulus see Table 24)³².

Table 24. *Experimental stimuli used by Tonhauser et al. (2018)*

Experiment 1a and 1b		Experiment 2a and 2b	
Context	Michelle asks: “Does Jane know that Mark visited Alcatraz?”	Amy (context)	“Jane knows that Mark visited Alcatraz.”
Projectivity (Question)	Is Michelle certain that Mark visited Alcatraz?	Dennis	“Are you sure?”
At-issueness (Question)	Is Michelle asking whether Mark visited Alcatraz?	Amy	“Yes, Mark visited Alcatraz.”
		At-issueness (Questions)	Did Amy answer Dennis’ question?

Their overall results are similar to Xue and Onea’s finding: In experiments 1a, 1b and 2a, a linear relationship between projectivity and non-at-issueness is observed. In addition, their

³¹ In a study investigating the projectivity of four distinct presupposition triggers, Smith and Hall (2011) found that definite articles were the most projective. Surprisingly though, cleft constructions, which are considered as hard trigger projected less than the soft triggers *win* or the complement of the factive construction *know*.

³² Tonhauser et al. (2018) investigated non-restrictive relative clauses (NRRCs), sentence-medial nominal appositives, possessive noun phrases, *be annoyed*, *discover*, *know*, *only*, *stop*, *be stupid to* (experiment 1a) and emotive predicates *be amused* and *be annoyed*, cognitive predicates such as *be aware*, *discover*, *find out*, *notice*, *realise*, *learn*, and *establish*, the sensory predicate *see*, and the communication predicates *confess* and *reveal* (experiment 1b).

In experiment 1a, the lowest mean non-at-issueness ratings were the ones of *stop* and *only* (.71 and .72, respectively). The other 7 projective contents obtained a non-at-issueness rating higher than .85 and a their corresponding projectivity rating was higher than .83). In experiment 1b, the lowest mean non-at-issueness rating was the one for *establish* (.61) and the two lowest projectivity ratings were obtained for *establish* and *confess* (.41 and .69, respectively). The remaining 10 projective contents received non-at-issueness scores higher than .8 and projectivity scores higher than .75.

The stimuli used in experiment 1a were also used in experiment 2a. The same holds for the stimuli of 1b.

study reveals that this relationship is modulated by the variation of the at-issueness diagnostic. More precisely, in Experiment 1a and 1b a polar question such as “*Does Jane know that Mark visited Alcatraz?*” was used as a minimal context. Using a polar question, the expression of interest *Mark visited Alcatraz* was therefore embedded under an entailment-canceling operator. An ‘asking whether’ question, such as *Is Michelle asking whether Mark visited Alcatraz?*, was used in order to assess the at-issueness of the target expression. In contrast, the at-issueness diagnostic in Experiment 2a and 2b was quite different (see Table 24) since it relied “on the assumption that at-issue and not-at-issue content differ in the extent to which it is up for debate and can be directly assented/dissented” (Tonhauser et al., p. 520). Using such a diagnostic, the target expression *Mark visited Alcatraz* is no longer embedded under an entailment-canceling operator (see Amy’s response to Dennis’ ‘*Are you sure?*’ question) since it is uttered in an indicative sentence.

Interestingly, the non at-issueness rating for nearly all used presupposition triggers decreases in the second experiment³³. For instance, the complement of the factive verb *know* received a non at-issue rating of nearly 90% when using the ‘asking whether’ diagnostic, whereas this rating dropped to nearly 60% when using the ‘are you sure’ diagnostic. Even though there is a substantial drop in the non-at-issueness rating between both experiments, both reported percentages are superior to the one observed by Xue & Onea (for *know*, the non at-issueness rating was 27.59%).

In summary, Xue and Onea’s (2011) and Tonhauser et al.’s (2018) results have provided important insights about the relationship between projectivity and non-at-issueness. In addition, these two studies reveal once more that the choice of the experimental material and the selected non at-issueness diagnostic substantially impacts participants’ judgment. In Xue and Onea’s experiment, non at-issueness was assessed using a forced-choice continuation scenario, whereas it was assessed using a ‘asking whether’ or ‘are you sure’ diagnostic in Tonhauser et al.’s (2018) studies.

2.2.9. Summary

The review of the experimental literature on presuppositions focused on two of the key properties of presuppositions that are (i) the backgroundedness of presuppositions and (ii) their

³³ It is important that the linear relationship between projectivity and at-issueness remains unaltered despite the decrease regarding the non-at-issueness in the second experiment.

non-at-issueness. Several questions were initially asked which have been addressed in the course of the literature review. I report the main questions and summarize the results below.

(1) Does presupposition accommodation come with a processing cost?

- Presuppositions in neutral contexts in comparison to supportive contexts are judged less acceptable and come with an immediate processing cost.
- Ambiguous information involving a presupposition is processed differently compared to ambiguous information involving an assertion.
- Contextually inconsistent presupposed information is processed differently than contextually inconsistent non-presupposed information.
- Presuppositions in neutral contexts in comparison to assertions are judged less acceptable and come with an immediate processing cost.
- Acceptability ratings and processing patterns are moderated by the class of the presupposition trigger.

(2) Are presuppositions part of the normal flow of discourse?

- Answering a question with a presupposition is judged less acceptable compared to answering a question with an assertion and elicits an immediate processing cost.
- The distinction between at-issueness versus non at-issueness moderates the detection of inappropriate information. Inappropriate at-issue information incurs higher processing costs than inappropriate non at-issue information.

(3) Is there a relationship between projectivity and non-at-issueness?

- There is a linear relationship between projectivity and non at-issueness. Contents receiving higher projective ratings also receive higher non at-issueness ratings.
- The degree of non at-issueness depends on the non at-issueness diagnostic.

Altogether, the reviewed empirical research on presuppositions points out that presupposed content is not only judged, but also processed differently with respect to many aspects. Even though recent research has provided important insights to better understand the processing of presuppositions, there are still many open questions. In the remainder of this chapter I will discuss some of them and outline how I will address them in the current dissertation.

3. Open Questions and Study Overview

3.1. Study 1: How do different layers of meaning influence speaker's commitment?

3.1.1. What we know

In the first part of this chapter, I showed that presuppositions typically project and cannot be cancelled when unembedded. The former characteristic clearly distinguishes presuppositions from entailments and the latter distinguishes presuppositions from implicatures (Geurts & Beaver, 2011). Furthermore, I also pointed out that there is an emerging literature in pragmatics that aims to understand better how different levels of meaning convey varying degrees of speaker commitment. It has been shown that several linguistic markers convey different degrees of commitment, for instance (1) modal auxiliaries (*must* versus *might*), (2) adverbials (*certainly* versus *maybe*), and (3) evidentials (*I saw* versus *I guess* versus *people say*; for a more exhaustive list, see Boulat & Maillat, 2017). However, little is known about how different levels of meaning impact speaker commitment.

In his theoretically-motivated proposal, Moeschler (2013) suggest that distinct levels of meaning commit the speaker differently. He points out that the notion of commitment is related to the notion of strength and depends on two factors: (1) the nature of the inference – semantic versus pragmatic – and (2) the accessibility of the inferred content. Based on the notion of strength, Moeschler suggests that distinct levels of meaning commit the speaker differently. Concerning the nature of inference, entailments are more committal than presuppositions, which are more committal than explicatures and the least committal are implicatures (34). However, when taking accessibility into account, the ordering changes: explicatures are more committal than implicatures, which are more committal than entailments and presuppositions (35).

(34) Ordering based on the nature of the inference
entailments > presupposition > explicature > implicature

(35) Ordering based on the accessibility of the resulting content
explicature > implicature > entailments = presupposition

Moeschler acknowledges that the hearer may evaluate the speaker's commitment on both factors; however, he does not make any clear prediction about the strength of each factor.

In order to investigate the issue of commitment and meaning-relations, Study 1 will focus on the social and interactional dimension of commitment, as well as the speaker's liability to criticism and blame, which goes hand in hand with any commitment violation (Harnish, 2005; Haugh, 2013).

To investigate speaker commitment within this perspective, an interesting study by Vullioud et al. (2017) manipulated the confidence of the speaker by using confidence expressions such as *I'm sure it's him* versus *I'm really not sure*, which are taken to be 'commitment signals' (for a sample story, see Table 25). As can be seen in the sample stimulus, participants are presented with the testimony of two speakers, a confident one versus an unconfident one. Afterwards, it is revealed that the information of both informants is wrong (see Experiment 1 by Vullioud et al., 2017, Table 25). Participants then have to decide which one of the two informants they will punish and trust.

Table 25. *Experimental design by Vullioud et al. (2017)*

	Context story	Confidence manipulation	Feedback	Punishment	Trust
Confident speaker	"Hello, I'm trying to reach the Swiss manager for international coordination. Do you know who he is and where I can find him?"	"Hi! International coordination, I know him! It's Mr. Descloux, in building L, for Lausanne. You can believe me, I'm sure it's him."	<i>Participants are told that both speakers were wrong</i>	The first project is a project that has no interest or importance. Taking part in this project is demeaning and can be seen as a kind of punishment . Whom do you give the task to?	The second project is an important and interesting project for a big client. Taking part in this project is gratifying and can be seen as a kind of reward . Whom do you give the task to?
Un-confident speaker		"Hi, hmm, I don't know but I think that for the international coordination, it's Mr. Grandjean, in building B, for Bern. But I'm really not sure".	<i>and then they are told the following:</i> You are the team leader of the two colleagues you saw during the coffee break. You are about to start two new projects.		

Vullioud et al.'s findings (Experiment 1) reveal that when both speakers were proven wrong, the unconfident speaker was trusted more and punished less when compared to the confident speaker. In different words, this study reveals that an overconfident speaker incurs higher direct costs and reputational damage when it turns out that her testimony is incorrect. Such a finding opens up the question of whether and how different layer of meaning modulate speaker commitment, and as a result contribute to managing the reputation of a speaker.

3.1.2. What we do not know yet

Currently, we do not know what the impact of different levels of meaning, or meaning-relation, is on the acceptability of the conveyed information and the reputation of its sender as a reliable source of information. As pointed out before, to better understand this relationship, Study 1 will focus on the notion of commitment.

The linguistic literature on commitment modulation via meaning-relations is theoretically and experimentally lacking. On the theory side, we lack any well-established criteria for classification, and the ordering relying on distinct criteria differ from one another (see (34) and (35) above). Furthermore, this issue has not yet received the attention of experimental pragmaticists.

More specifically, concerning speaker commitment and presuppositions, the theoretical literature does not show a unified account. On the one hand, scholars like Peters (2016) note that the speakers are strongly committed when presupposing something. Moreover, the information conveyed by presuppositions is usually uncontroversial (Simons, 2005) and not under discussion (e.g., Tonhauser et al., 2013). Consequently, it is possible that presuppositions have an impact on the degree of speaker commitment, which might be stronger compared to foregrounded information such as content that is asserted and implicated. In that case, the reputation of a presupposing speaker should be more severely compromised if the conveyed information was found out to be unreliable. Lombardi Vallauri (2016), on the other hand, argues that a speaker can more easily distance herself from a presupposition. Since the presupposed content has already been put forward by another source (or at least assumed to be shared among interlocutors), the speaker should not be held accountable for the falsity of the presupposed content. Such a reasoning may suggest that the speaker does not take direct responsibility for the conveyed presupposed content (e.g., Ducrot, 1984; Lombardi Vallauri, 2016). If this is true, using a presupposition should be less committal compared to saying or implicating the same piece of information.

As pointed out before, the commitment carried by different levels of meaning has not yet been under the scope of empirical investigation. So, we do not yet know what happens to the reputation of a speaker when the piece of information conveyed via a presupposition turns out to be false: Are presupposing speakers considered more accountable for the unreliability of the content that they have conveyed or are they held less accountable than saying or implicating speakers?

3.1.3. What the present study will tell us

The first study of this thesis will empirically investigate whether different levels of meaning convey varying degrees of speaker commitment. More precisely, we will examine whether false information conveyed via a presupposition incurs a higher or lower reputational cost compared to assertions and implicatures. This study will answer to the question of whether the theoretical distinction between different levels of meaning has important social consequences with respect to the way in which interlocutors monitor each other's trustworthiness as sources of information and adjust their reputation in communication. By answering to this question, Study 1 will contribute to a better understanding of how trust is negotiated in interaction and build a new interesting bridge with the literature in evolutionary and cognitive psychology on human alertness to misinformation and the possibility of deception.

3.2. Study 2: How are presuppositions processed in felicitous discourse continuations?

3.2.1. What we know

Many scholars have pointed out that presuppositions are usually subtracted from the main flow of discourse. First, Ducrot (1972) maintains that the presupposed content of an utterance is not available to discourse attachment. In his seminal work, he shows that only the asserted content is available for discourse continuations³⁴. Second, Grimshaw (1979) claims that answering a question with a presupposition leads to an ill-formedness in discourse. According to her, presuppositions do not provide natural answers to questions since doing so would violate an underlying discourse principle that is that questions cannot be answered with a response that takes its answer for granted before this having been established. Third, in her *QUD* framework, Roberts (1996) highlights that discursive moves must address the *current question under discussion* in order to be felicitous. Since the very nature of presuppositions is that they are considered as information that has been taken for granted, they are marginal in discourse, therefore they often do not contribute to the main point of the utterance. For this reason, presuppositions are considered less addressable than asserted content. In many cases, discourse continuations that address the presupposition without directly denying it are considered infelicitous.

As we have seen in the experimental chapter on the processing of presuppositions, these linguistic observations have found empirical support from experimental data. Cummins et al.'s (2012) and Amaral and Cummins' (2015) results show that answering a question with a

³⁴ As pointed out in detail in section 1.5, Ducrot also indicates that discourse continuations can, in certain cases, target both contents. However, the presupposed content can never be the only one that is addressed.

presupposition is judged less acceptable than answering a question with an assertion. In a similar vein, Cowles et al. (2007) show that answering a question with a presupposition elicits a different processing pattern than answering a question with an assertion. More precisely, answering a question with a presupposition elicited an N400 compared to answering a question with at-issue information. Furthermore, Wang et al.'s (2009) findings suggest that inappropriate information is processed differently when it is conveyed as at-issue information than when the same information has a non-at-issue status. Such a finding indicates that information that contributes to the current question under discussion is under closer scrutiny than information that is only considered marginal to the main flow of discourse.

Presuppositions are not only judged less acceptable or processed differently when they provide answers to questions, but also when a discourse continuation targets the presupposed content in causal justification scenarios. Jayez' (2010) results highlight that continuations targeting the presupposed content in consequence discourse scenarios using the French equivalent markers of *so* and *therefore* are judged less acceptable than their asserted counterparts.

So far, the experimental literature has only investigated cases in which addressing the presupposed information in discourse continuations is considered infelicitous. However, discourse continuations in which the presupposed content does not give rise to an infelicity have not yet been the target of an investigation.

3.2.2. What we do not know yet

As shown in detail in the first part of this chapter, attaching a discourse constituent to the presupposed content is usually considered infelicitous. However, there are also discourse continuation scenarios in which targeting the presupposed content does not represent a pragmatic violation. The linguistic observation proposed by Winterstein (2009) reveals that discourse continuations containing the trigger *too* represent a notable exception to the more general observation that discourse continuations cannot target the presupposed content. For instance, the continuation in (30a) *Robert is proud too* is intuitively as felicitous as the continuation in (30b) *Robert plays bass too*. In the former case, the discourse continuation targets the asserted content, whereas in the latter case the presupposed content is addressed.

- (30) a. Lemmy is proud to be a bass player, Roberto is proud too.
- b. Lemmy is proud to be a bass player, Roberto plays bass too, [although he is not proud of it].

For Winterstein, the additive particle *too* can refer to any prior proposition independently of the expressed level of meaning if the same strength between *too* and its antecedents exists. This is exactly the case in the discourse continuation scenarios in (30a) and (30b). According to his proposal, both continuations are considered felicitous. To our knowledge, no research has looked at these discourse continuations from an experimental perspective. For this reason, the second study of this dissertation aims to provide an answer to the following research question:

Are felicitous discourse continuations which address the presupposed content cognitively more demanding than discourse continuations addressing the asserted content?

3.2.3. What this research question will tell us

Until now, experimental research has investigated the judgment and processing of presuppositions with respect to the answerhood to questions or in discourse continuation scenarios in which such a continuation is considered infelicitous. This is the reason why it is difficult to tell whether the different judgment ratings and processing pattern of presuppositions in comparison to asserted contents is due to the pragmatic infelicity or due to the very nature of presuppositions since they do not contribute to the main flow of discourse. In order to better understand the underlying impact of pragmatic felicity/ infelicity and layer of meaning, it is worth investigating cases in which discourse attachment to the presupposed content is not considered infelicitous. Such an experimental investigation will yield important insights about the processing of presuppositions in felicitous discourse continuations. It seems reasonable to assume that despite being felicitous, the presupposed content is processed differently since its conveyed information is peripheral and does not move the discourse in the desired direction. If this is the case, such a finding will tell us that the processing cost is directly linked to the presupposition and not to pragmatic or discourse infelicity.

In order to better understanding the underlying role of the presupposition in felicitous discourse continuations, the event-related potential method will be used since it allows to better understand the cognitive correlates of presuppositions and avoids tapping into metacognitive processes. The majority of studies investigating discourse continuations and the non-at-issueness of presuppositions used judgment ratings (e.g., Amarel & Cummins, 2015, Cummins et al., 2012; Jayez, 2010, Tonhauser et al., 2018). In order to avoid any role of metalinguistic considerations, we used the same design as the one used by Cowles et al. (2007) who investigated ERPs of the answerhood to questions using it-clefts. This method allows to study the immediate cognitive correlates of processing presuppositions in felicitous discourse attachments.

3.3. Study 3: What are the cognitive correlates of different layers of meaning in decontextualized sentences?

3.3.1. What we know

Over the past nearly fifty years, research has increased our understanding of presupposition projectivity and the non-at-issueness of presuppositions and investigated these properties experimentally. Thanks to this work, we now have many insights on presupposition processing. First, neutral, contextually inconsistent, and ambiguous presuppositions are treated differently when compared to their experimental controls, i.e. presuppositions in supportive contexts, contextually consistent presuppositions, and ambiguous information involving an assertion, respectively. Second, presuppositions are, in most of the cases, subtracted from the main flow of discourse and as a consequence less addressable than the asserted content.

The last study of this dissertation aims to better understand the cognitive underpinnings of presupposition processing by focusing on its sensori-motor correlates. Within the field of cognitive neuroscience, the impact of language processing on motor activation has been the subject of a series of studies in the last couple of decades (see for a review Pulvermüller, 2005; Willems & Casasanto, 2011; Kiefer & Pulvermüller, 2012). This body of work has led to important discoveries on the processing of action-related language. For instance, we now know that hand-related action verbs (e.g. to write) in simple affirmative assertive sentences trigger a response in the sensori-motor structures of the brain implicated in the execution of the corresponding action (e.g., Aziz-Zadeh, Wilson, Rizzolatti, & Iacobini, 2006; Hauk, Johnsrude & Pulvermüller, 2004; Tettamanti et al., 2005). Crucially for our purposes, it has been shown that this activation is modulated by the linguistic environment, and appears to be reduced in the presence of negation or volitional verbs (*want*, *desire*), (e.g., Aravena et al., 2012, 2014; Zwaan, Taylor, & de Boer, 2010; Papeo, Hochmann, & Batelli, 2016; Tettamanti et al., 2008).

A few studies in this field have looked at the pragmatics of language use. For instance, Lauro, Mattavelli, Papagno and Tettamanti (2013) found evidence that sensori-motor cortex activation is modulated by figurative uses of language. In their study, they show that literal and idiomatic uses of action verbs elicit a sensori-motor response whereas such a response is absent when it comes to action verbs that convey a metaphoric meaning. Furthermore, an interesting study by van Ackeren et al. (2012) extends the previous findings by Lauro et al. (2013) by showing that the communicative potential of a sentence enriched by contextual factors can also modulate sensori-motor activation. As discussed at length in the beginning of this chapter, speaker meaning often goes beyond what is linguistically encoded. For instance, a sentence *It*

is hot here can convey the literal meaning that it is hot. However, the same sentence uttered in a context in which people are sitting in a hot room and addressed to someone close to the window could also mean that the speaker intends to convey an indirect request to open the window. This is exactly what van Ackeren manipulated and their results show an effect of this contextual manipulations on the activation of the sensori-motor cortex. Utterances conveying an indirect request which invites the addressee to perform an action elicit sensori-motor activation, whereas the same utterances in a context which does not give rise to this interpretation do not. In their study, the sentence *It is very hot here* was shown either with a background picture of a desert or with the background picture of a closed window. In the former example, the sentence was interpreted literally, whereas in the latter the hearer goes beyond the literal meaning in order to infer the conveyed meaning (the indirect request of opening the window). Only when the sentence *It is hot here* involved an indirect request, this elicited a sensori-motor activation. To our knowledge, this is the first evidence that pragmatic inference contributes to modulating the engagement of the motor system in language processing. The question that naturally arises is whether different layers of pragmatic meaning play a distinctive role in modulating the sensori-motor activation of action verbs. It seems thus important to examine other pragmatic phenomena, beyond figurative uses of language and indirect request, in order to better understand the place of pragmatics in the sensori-motor activation of action verbs. For this reason, Study 3 contributes to this literature by investigating the linguistic phenomenon of presuppositions.

The method chosen for Study 3 is the grip force sensor method, which will be discussed in detail in Chapter 4. This is a promising new method allowing to indirectly measure sensori-motor activation of brain areas involved in hand-related action planning and execution. Recent evidence shows that this fine-grained method allows measuring subtle grip-force variations when listening to isolated hand-related action verbs or action-verbs occurring in affirmative sentences. First, Frak, Nazir, Goyette, Cohen and Jeannerod (2010) showed that hand-related action verbs elicit a grip force activation whereas nouns unrelated to manual actions do not. Second, Aravena et al.'s (2012) results point out that hand-related action verbs trigger a grip force response when they are part of affirmative sentences such as *Paul writes a letter*, whereas negated sentences like *Paul does not write a letter* do not trigger such a response. In a follow-up study, Aravena et al. (2014) extended these findings to volitional verbs showing that the presence of a hand-related action verb does not suffice to trigger a grip force response. More precisely, volitional contexts like *Paul wants to sign the contract* do not trigger a grip force

response. Third, Nazir et al. (2017) highlight that the grip-force sensor method is a reliable method that is able to assess the localization of the source of language-induced activity with respect to the motor brain structures and has a high temporal resolution since it allows to measure the grip force variation in milliseconds as soon as the action verb is encountered.

3.3.2. What we do not know yet

To our knowledge, this is the very first grip force study that investigates the cognitive correlates of presuppositions. For this reason, it will not only yield important insights in the processing of presuppositions, but also extend our current understanding of which linguistic contexts modulate motor brain structures.

In the previous section, we pointed out that affirmative linguistic environments such as *Paul writes a letter* elicit a grip force activation, whereas negated action verbs like *Paul does not write a letter* or volitional sentence like *Paul wants to write a letter* do not elicit such an activation. A possible interpretation of these findings is that grip force activations are only elicited when the discourse or situation model (cf. Zwaan and Radvansky, 1998) of the sentence includes the event. In cases, in which the event does not take place, a grip force activation does also not take place. For instance, a negated action verb like in *Paul does not write a letter* leaves no possibility that an activity takes place. Similarly, an event does also not take place in volitional contexts such as *Paul wants to write a letter*.

A presupposition is information that is taken for granted, but not the main part of the utterance. If the sensori-motor system is activated by actions that involve the event, then also presupposed action verbs should elicit an activation since the event certainly has taken place. However, it is also plausible that the backgroundedness of the presupposition has an impact on the processing of presupposed action verbs. Given its peripheral status, one could also expect that presupposed action verbs will not elicit the same response as asserted action verbs. This study will allow us to better understand how presuppositions are processed in the motor brain structures. In order to do so, we investigate the processing of action verbs which are part of factive complements such as *Peter knows that Paul writes a letter*. In these constructions, the tense of the action is the same as in its assertive counterpart like in *Paul writes a letter*. Factive verbs will also be compared to non-factive verbs, like *suspect*, *imagine*, *thinks*, which do not assume the truth of their complements. For instance, the truth of the conveyed action in non-factive complements such as *Peter suspects that Paul writes a letter* is not guaranteed. In order to better understand whether this linguistic distinction is reflected in a differential activation of relevant sensori-motor areas, we will investigate the grip force activations of both structures.

We know that the distinction between factive and non-factive predicates maps onto different processing patterns, as revealed by studies that looked at the cognitive costs of processing inconsistent information. Ferretti et al. (2008, 2013) and Shetreet et al. (2019) found evidence that processing discourse inconsistent information is modulated by the presupposed truth of the information. In these studies, the authors compared factive verb constructions and non-factive verb constructions. The former type presupposes the truth of the complement, whereas the latter does not. Even though the experimental set up between Ferretti et al. and Shetreet et al.'s experiments was different, their results reveal that inconsistent presupposed information comes with a processing cost. More precisely, Ferretti et al. used scenarios in which the information of interest was first conveyed via an assertion and then, in the target sentence, this information was embedded under a factive or non-factive verb, which was either consistent or inconsistent to the prior information. In contrast, Shetreet et al.'s experimental stimuli were set up the other way around. The information was first introduced in a context sentence via a factive or non-factive construction, which was either consistent or inconsistent (for a detailed description of the stimuli, see Table 9 in chapter 2) with respect to the used target sentence. Overall, both studies provide evidence that the factive verb sets up strong discourse expectations to subsequent events. In cases in which the information is introduced via a factive verb construction and later contradicted, the detection of this conflict comes with a processing cost, i.e. a higher positive deflection during the P600 interval (Shetreet et al., 2019), whereas such an effect is absent in the non-factive condition. Processing costs also occur when using an inversed set-up, that is, when the information is first introduced via an assertion and then contradicted in the factive complement (Ferretti et al., 2008).

Based on these findings, it is worth investigating whether the distinction between factive and non-factive complements also has a counterpart with respect to cognitive motor activation.

3.3.3. What the present study will tell us

This research will shed new light on the involvement of the sensori-motor system when processing information which is conveyed at distinct levels of meaning. For this reason, this research will first broaden our knowledge of the array of contexts in which a sensori-motor response can be evoked. Second, it will contribute to a better understanding of the cognitive status of presuppositional information. In particular, if, as the theoretical literature suggests, presuppositions are not the main piece of information in the communicated message, it is possible that this secondary or peripheral status is reflected in a difference of impact on the sensori-motor system. Furthermore, the investigation of factive versus non-factive

constructions will yield important insights into whether this theoretical distinction, which is supported by empirical evidence obtained via ERP studies, is also relevant at the level of language-related sensori-motor activation.

Chapter 2

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Saying, presupposing and implicating: How pragmatics modulates commitment

Abstract Commitment plays a crucial role in the stabilization of communication. While commitment increases the acceptance of the message communicated, it comes with a price: the greater the commitment, the greater the cost (direct or reputational) the speakers incur if the message is found unreliable (Vullioud, Clément, Scott-Phillips & Mercier, 2017). This opens up the question of which linguistic cues hearers deploy in order to infer speaker commitment in communication. We present a series of empirical studies to test the hypothesis that distinct meaning-relations – *saying*, *presupposing* and *implicating* – act as pragmatic cues of speaker commitment. Our results demonstrate that, after a message *p* is found to be false, speakers incur different reputational costs as a function of whether *p* had been explicitly stated, presupposed, or implicated. All else being equal, participants are significantly more likely to selectively trust the speaker who implicated *p* than the speaker who asserted or presupposed *p*. These results provide the first empirical evidence that commitment is modulated by different meaning-relations, and shed a new light on the strategic advantages of implicit communication. Speakers can decrease the reputational damages they incur by conveying unreliable messages when these are implicitly communicated.

Keywords Commitment, Implicature, Presupposition, Experimental pragmatics

1. Introduction

On June 1st, 2016, during a rally in Sacramento, Donald Trump accused his Democratic rival, Hilary Clinton, of telling “such lies about his foreign policy.” The issue at stake concerned his position on nuclear weapons and Japan, and he forcefully denied having claimed that Japan should obtain nuclear power. In fact, Trump had expressed his opinion in two distinct interviews. In a first interview at a CNN town hall in March, he had said that “At some point we have to say, you know what, we’re better off if Japan protects itself against this maniac in North Korea”. Clearly, while he had not explicitly stated it, Trump had (strongly) suggested the idea of Japan getting nuclear power. However, in a second interview with Fox News Sunday a few days later, he claimed: “Maybe they would in fact be better off if they defend themselves from North Korea [...] Maybe they would be better off - including with nukes, yes, including with nukes.” The difference between Trump’s statements relies on the fact that while the former merely implicates that Japan should get nuclear power, the latter explicitly states it (Grice, 1989). The intuition here is that Trump’s *commitment* to what he communicated - and his accountability for it – increased from the first to the second interview. Consequently, his denial appeared not only implausible but also illegitimate.

The notion of commitment, widely employed in the linguistic literature, aims at capturing the fact that senders can endorse or distance themselves to differing degrees from what they communicate (for a review see Boulat & Maillat, 2017; Brabanter & Dendale, 2008). The study of commitment has traditionally focused on a variety of linguistic devices - evidentials, epistemic modals, verbal expressions of confidence, as well as reported speech - whose semantics constrains the attribution of speaker commitment (e.g., see Lyons, 1977; Ifantidou, 2001; Noveck, Ho & Sera, 1996; Palmer, 1986; Papafragou, 2000, 2006; among many others). More recently, however, linguists have started investigating the ways in which commitment can be pragmatically modulated (Moeschler, 2013; Morency, Oswald & Saussure, 2008; Saussure & Oswald, 2009). This research has opened up the question of whether a communicated assumption carries distinct degrees of speaker’s commitment depending on its relation to the semantic content of the utterance as well as on the role it plays in the overall interpretation of the speaker meaning.

In what follows, we address the question of whether the meaning relations of *saying*, *presupposing*, and *implicating* are pragmatic cues of the degree to which a speaker is committed to the proposition conveyed. Our goal is two-fold: on the one hand, we aim to provide a theoretical framework in which one can investigate the pragmatic modulation of commitment;

on the other hand, we explore this modulation in a series of empirical studies. We approach this linguistic endeavour by borrowing theoretical and methodological tools from evolutionary and cognitive psychology (Vullioud, Clément, Scott-Phillips & Mercier, 2017, see also, e.g., Anderson, Brion, Moore, & Kennedy, 2012; Fusaroli *et al.*, 2012; Tenney, MacCoun, Spellman, & Hastie, 2007; Tenney, Spellman, & MacCoun, 2008)).

2. Commitment across meaning-relations

In this section, we introduce the notion of *saying*, *implicating*, and *presupposing* and discuss different theoretical proposals regarding their relative degree of commitment. The obvious starting point of this investigation is the Gricean distinction between ‘what is said’ and ‘what is implicated’ (Grice, 1989). Grice argued that speakers typically communicate more than they linguistically encode. That is, a speaker can *say* something while *implicating* further propositional contents. Crucially, implicatures are by definition cancellable, either explicitly or implicitly:

[...] a putative conversational implicature that *p* is explicitly cancelable if, to the form of words the utterance of which putatively implicates that *p*, it is admissible to add *but not p*, or *I do not mean to imply that p*, and it is contextually cancelable if one can find situations in which the utterance of the form of words would simply not carry the implicature. (Grice, 1989, p. 44)

Several authors maintain that, because of the cancellability of ‘what is implicated,’ *implicating* is non-committal, or at least less committal than *saying*. Cancellability is described as closely intertwined with the following notions: (i) non truth-conditionality, (ii) deniability, and (iii) certainty about the intended interpretation. All these are relevant to the study of commitment. Implicatures are non truth-conditional content, that is, their truth-value has no bearing on the truth of the utterance that carries them: if they are false, the utterance is odd, but not necessarily false (Carston, 2004). According to Moeschler (2013), this makes *implicating* a weak meaning-relation, “which means that the commitment of the speaker is not as strong as with the other relations” (Moeschler, 2013, p. 96), such as *saying*.

Furthermore, the cancellability of ‘what is implicated’ opens the door to its deniability (Pinker, 2007; Lee & Pinker, 2010). A content is deniable if the speaker can deny (when openly challenged) to have had the intention to communicate it in the first place. Deniability and cancellability do not overlap: what is deniable is cancellable, but what is cancellable is not

necessarily deniable (at least not plausibly). Consider the following example adapted from Grice (1989). Mary is worried that her husband might be having an extra-marital affair and asks her friend Susy what she thinks about it. Susy replies:

- a. I saw your husband with a woman the other day at the cinema.

Mary interprets Susy's utterance as implicating that her husband is indeed likely to be having an affair. It turns out that Mary's husband was at the cinema, but in the company of his sister, whom Susy knows very well. When confronted with this, Susy defends herself by claiming: "I didn't mean to suggest that he had an affair. In fact, the woman he was with was his sister." In this case, the implicature is cancellable but hardly deniable, as suggested by the fact that Susy's defense is very much unlikely to convince Mary. While cancellability is a binary category (cancelable/non-cancelable), deniability is a matter of degree and it is a function of the discourse-related properties of the context of utterance (see, e.g., Sternau, Ariel, Giora & Fein, 2015, 2016, 2017). Importantly, Pinker (2007) suggests that the deniability of 'what is implicated' allows a speaker to convey some content (sexual innuendos, bribes, threats, etc.), without running into the risk of paying its potential cost (direct and/or reputational). For instance, by implicating a bribe to a police officer ("So maybe the best thing would be to take care of it here"), a speaker can avoid the risk of being arrested for bribery by an honest cop or a speaker can avoid the embarrassment of having a sexual advance turned down, if it had been merely implicated. That is, in social interactions, *implicating* is reputationally less costly for the speaker than *saying*.

Finally, the cancellability of 'what is implicated' depends on its context-dependency: 'what is implicated' is cancellable because it is possible to find contexts in which the speaker could use the same utterance without conveying the same set of implicatures. Implicatures are the result of an inferential process that takes 'what is said' as a premise, and together with available contextual assumptions, leads to an implicated conclusion or implicature (Sperber & Wilson, 1995). The selection (or construction) of the intended contextual assumption introduces an additional risk of misunderstanding. Because of this, Morency *et al.* (2008) maintain that *implicating* involves a more risky interpretative process than *saying*, which typically generates a lower degree of confidence in the hearer. This in turn leads to a weaker attribution of commitment towards the implicated content.

The picture that emerges is clear: *implicating* is taken to be less committal than *saying*. This conclusion is further echoed by work in the philosophy of language and epistemology of testimony. For instance, the philosopher Elizabeth Fricker has argued that insinuation and hints allow a message to be conveyed while being disavowable by its sender. The distinction between *saying* and *implicating* is conceived as a “*socially* entrenched distinction” to the extent that social norms make speakers accountable for the former, but not for the latter. She writes:

It is only what a speaker explicitly states that she incurs overt, full and undeniable responsibility for the truth of. Things she leaves it to her audience to figure out, even if she fully expects and intends the audience to figure them out, and this is part of the perlocutionary point of her utterance, are not committed to by her – not, at any rate, to the same full and undeniable extent.

(Fricker 2012, p. 85)

In spite of the wide consensus that the *saying/implicating* distinction is relevant to the domain of speaker’s commitment, some scholars have recently challenged this conclusion. For instance, Meibauer (2014) argues that speakers are committed to the truth of an implicature in the same way as they are committed to the truth of what they explicitly say. This is because – according to Meibauer – a deliberately false implicature qualifies as a genuine *lie*, that is, a content that the speaker believes to be false and puts forth with the intention of creating a false belief in the audience.

Let us now develop our discussion beyond the Gricean categories of *saying* and *implicating*, and include the meaning-relation of *presupposing* (Ducrot, 1984; Stalnaker, 1974). In fact, while it is uncontroversially assumed that a speaker is committed to the truth of what her utterance presupposes, less attention has been devoted to the relative degree of commitment with regard to other meaning-relations. The question of whether *presupposing* is more or less committal than *saying* or *implicating* has not received a univocal answer. For instance, Moeschler (2013) has suggested that the implicit nature of presupposed content – typically what is presupposed is not explicitly articulated in discourse – should lower the degree of speaker commitment (as it does with *implicating*). On the other hand, he argues that the strength of the inference drawn to recover the presupposed content (linguistically triggered and semantic in nature) should make *presupposing* more committal than *saying*. Unfortunately, no principled way to establish the relative weight of these conflicting determinants of speaker commitment is provided, and the issue remains open.

Intuitions about the relative degree of commitment of *presupposing* with respect to *saying* and *implicating* are not clear-cut. ‘What is presupposed’ is typically background information, that is, information which is old, previous, or given (van der Sandt, 1992) or presented as such (Saussure, 2013). It is information that “the hearer will not want to dispute” (von Stechow, 2000), and that the speaker puts forth as uncontroversial. As Simons (2005) points out, presuppositions tend to be non-controversial, independently of whether they are assumed to be shared prior the time of the utterance. This is due to the role they play in the interpretation of the utterance. Presuppositions are meant to ‘establish’ the relevance of the utterance. As a result, if presuppositions were not to be accepted by the addressee, the utterance would not provide any relevant contribution to the conversation. This suggests that the degree of commitment associated to ‘what is presupposed’ might be stronger than that associated with foreground contents, like ‘what is said’ and ‘what is implicated.’

However, the backgrounded nature of presupposed content – it being typically presented as part of the common ground (Stalnaker, 1974, 2002) or as likely to be accepted uncontroversially by the interlocutors (Simons, 2005) – may also indicate that interlocutors share the responsibility for ‘what is presupposed’ in the conversation. In line with this intuition, Lombardi Vallauri (2016a, p. 3) argues that “messages containing presuppositions [...] conceal the very act of proposing it [*their content*] as true, as if the speaker has *no commitment* to transferring it” (my emphasis). In the same vein, Ducrot (1984) conceives of presuppositions as echoing a “collective voice” and, as a result, the speaker is assumed not to take direct responsibility for the presupposed content.

To sum up, the linguistic literature on commitment modulation via meaning-relations is theoretically and experimentally lacking. On the theory side, the apparent consensus that commitment is a graded notion is not grounded on any well-established criteria for classification. That is, there is no unanimously accepted criterion to determine the degree of speaker commitment that pertains to each meaning-relation. The notions of ‘truth-conditionality,’ ‘deniability,’ ‘hearer’s certainty,’ ‘explicitness,’ ‘accessibility,’ ‘inferential strength’ have all been employed to investigate the gradedness of commitment, generating orderings which are often in conflict with one another. Critically, we find no studies that address this issue experimentally. These two shortcomings are clearly linked to one another: the lack of a systematic treatment of commitment in the theoretical literature has arguably prevented any sound empirical investigation.

This state of affairs calls for new approaches to the study of commitment. To move the field forward we suggest turning one's attention to the social and interactional dimension of commitment, as well as the sender's liability to criticism and blame, which goes hand in hand with any commitment violation (Harnish, 2005; Haugh, 2013). As already discussed in the literature, this approach has important consequences for linguistic theorizing. For instance, it allows one to overcome some problems with defining commitment in terms of the speaker's mental states or propositional attitudes (e.g. as the strength of the speaker's belief towards a proposition). Among these we find the issue of the 'inscrutability' of commitment, as well as the possibility of a mismatch between the speaker's mental states (her beliefs) and the degree of commitment that she intends to communicate in interaction (see, e.g., Saussure & Oswald, 2009). In the following section, we examine how recent insights from psychology can provide us with methodological tools to help investigate commitment experimentally.

3. The role of commitment in the evolution of communication

Reputation plays a crucial role in our daily interactions, as it shapes the beliefs that others hold about one's worth as a potential cooperator (Heintz, Karabegovic & Molnar, 2016; Sperber & Baumard, 2012). This is also true for communicative interactions. Communication creates a complex variety of cooperative opportunities, but it amplifies the risk of deception too. For this reason, it requires interlocutors to select vigilantly which conversational partners are worth their trust, and to punish – at least reputationally – those who are not (Sperber *et al.*, 2010). This calls for a better understanding of the linguistic devices that allow to manage one's reputation as a trustworthy conversational partner.

In a recent contribution, Vullioud, Clément, Scott-Phillips and Mercier (2017) have suggested that commitment plays a crucial role in reputation management, and have focused their attention on strategic concerns in the understanding of the dynamics of commitment. They maintain that one of the effects of commitment is to moderate the acceptance of the information communicated (see also Anderson *et al.*, 2012). Specifically, they argue that people tend to be more accepting of statements to which the speaker is more committed (e.g. statements that are expressed more confidently). However, as Vullioud *et al.* (2017) emphasize, there has to be a potential downside to commitment, otherwise the equilibrium would be for everyone to commit maximally to any statement they want the interlocutor to accept. This would render commitment a useless cue, and interlocutors would stop paying attention to cues to commitment. In line with this, a review of the literature suggests that commitment comes at a price. Several experiments

have shown that among speakers whose statements have been found to be false, speakers who had expressed more commitment suffered more reputational damage than those who had expressed less commitment (Tenney *et al.*, 2007; Tenney, Small, Kondrad, Jaswal, & Spellman, 2011; Tenney *et al.*, 2008; Vullioud, Clément, Scott-Phillips, & Mercier, 2017).

By focusing on the use of confidence expressions as commitment signals, Vullioud *et al.* (2017) ran a series of studies in which they showed that a confident speaker incurs a greater reputational damage than an unconfident speaker when her testimony turns out to be unreliable. Crucially, they also show that this damage is more severe when the message is accepted based on the speaker's commitment than for reasons other than that (such as the speaker's competence). Their studies share the following template: participants are presented the testimonies of two senders, which differ from each other with respect to their degree of confidence. It is then revealed that they are both wrong and participants are asked to decide which of the two senders they would like to punish and which one they would like to trust in the future, in a different domain from that in which he was found to be wrong. That is, their dependent measures are represented by participants' answers to a 'punishment question' and a 'trust question.' While the first aims at capturing the direct cost of commitment violation, the second is a measure of reputational damage. Both the punishment and the trust question provide an indication of the blameworthiness and the liability of a committed sender.

Drawing on this research, we can operationalize commitment as a function of the direct and reputational costs the senders incurs when her message is found to be false. This provides us with an empirically tractable notion of commitment, one that capitalizes on its interpersonal nature and that does not require any metalinguistic judgement from the participant's side. In the following sections we present a series of studies that aims at investigating the relative degree of speaker commitment towards a message when this is explicitly communicated, implicated or presupposed.

4. Experiment 1

By adopting Vullioud *et al.*'s (2017) paradigm, we aim at empirically investigating the way in which meaning-relations modulate speaker commitment. With regard to this, our investigation is genuinely explorative, as it does not rely on widely shared predictions. As noted above, the strongest prediction which we can draw from the existing literature concerns the relationship between what is said and what is implicated, and goes in the direction of attributing a stronger commitment to the former than to the latter (but see Meibauer, 2014). The picture is far less

clear when it comes to presuppositions, and no clear prediction is available with regard to whether *presupposing* would be more or less committal than *saying* and *implicating*. By subjecting the literature to empirical testing, we aim at moving this debate forward and at providing data on which to build new, potentially finer-grained, theoretical contributions.

4.1. Methods

Participants

We recruited 291 participants through Amazon Mechanical Turk (163 men, 127 women, 1 others, $M_{age} = 34.94$, $SD = 10.08$).

Materials and procedure

We created four stories each describing a professional context in which the participant receives the testimonies of two speakers. Both speakers convey the same piece of information, varying in their degree of confidence (condition 1) or with respect to the level of meaning at which the information is conveyed (condition 2-4). In light of the information received, the participant is asked to type in a message to a third story character. The participant then receives additional information which falsifies the two testimonies. Finally, the participant answers two forced-choice test questions: a ‘punishment question’ and a ‘trust question’. In Conditions 3 and 4, the participant is also asked a third ‘implicature question’. Question order for the punishment question and the trust question as well as order of presentation of the speakers were counterbalanced across participants. The implicature question – when present – was always displayed at the end. The implicature question served as a criterion to ensure that we would only retain the data of those participants that had indeed derived the relevant implicature on the basis of the available contextual information.

The experiment was comprised of the following four conditions:

Condition 1: confident speaker vs. unconfident speaker

Condition 2: *presupposing* speaker vs. *saying* speaker

Condition 3: *saying* speaker vs. *implicating* speaker

Condition 4: *implicating* speaker vs. *presupposing* speaker

Each story contained a different presupposition trigger belonging to the following four categories: it-clefts, iteratives (*too*), change of state verbs (*repair*) and emotive factives (*be relieved that*). This selection involves both syntactic constructions and lexical items and it crosscuts alternative classifications proposed in the literature (‘soft’/‘hard’ triggers (Abusch, 2010), ‘weak’/‘strong’ triggers (Glanzberg, 2005)). Furthermore, all the intended implicatures

were ‘particularized’ conversational implicature.³⁵ Tables 1 and 2 illustrate a sample story. The complete list of stimuli used in the experiment is reported in the Appendix A.

Each participant read a single story and was assigned to one of the four conditions described above.

³⁵ As the ‘implicature’ status of Gricean ‘generalized’ conversational implicatures is vigorously debated in the pragmatics literature (see, e.g., Carston, 2002), we purposefully excluded this category from our investigation.

Table 1. *A sample story in Condition 3 (saying speaker vs. implicating speaker). Horizontal lines indicate where participants were asked to advance the text.*

<p>You are the new supervisor of a team of creative designers. After having been away for a one-week business trip, you are back at the office. This morning you have to hold a presentation in front of an important costumer. When you arrive at the office you notice that the conference room is not ready yet. So, you send an email to your team members and ask them why the projector has not been set up yet.</p>	[background story]
<p>The replies come back as follows:³⁶ Adam: The projector is not here. Louis removed it. It is at the central office. Joe: Louis gave a presentation at the central office yesterday.</p>	[saying speaker]
<p>In light of this you write the following message to Louis: [typing box]</p>	[implicating speaker]
<p>In the end, you give the presentation without the projector. Later on, you find out that the projector was simply misplaced and that Louis used a different projector for his presentation.</p>	[feedback]
<p>Remember what Adam and Joe told you:</p> <p>Adam: The projector is not here. Louis removed it. It is at the central office. Joe: Louis gave a presentation at the central office yesterday.</p> <p>The following week you have to assign a new project to either Adam or Joe. The project is of little interest or importance. Taking on this project is demeaning and can be seen as a sort of punishment. Who would you give the project to?</p> <ul style="list-style-type: none"> ○ Adam ○ Joe 	[punishment question]
<p>Since you are new in town, you are looking for a good kindergarten for your kids. Whom do you ask for advice?</p> <ul style="list-style-type: none"> ○ Adam ○ Joe 	[trust question]
<p>Remember what happened. You had an important presentation to give, and were looking for the projector that is supposed to be in the conference room. You asked your colleagues about it, and Joe said:</p> <p>Joe: Louis gave a presentation at the central office yesterday evening.</p> <p>Does Joe mean that the projector was removed from the conference room?</p> <ul style="list-style-type: none"> ○ Yes ○ No ○ I don't know 	[implicature question]

³⁶ See Table 2 for examples of the testimonies in all the conditions.

Table 2. *Examples of speakers' testimonies for each condition.*

Condition 1	Peter: The projector is not here. I'm sure Louis removed it yesterday and brought it to the central office. [confident speaker] Adam: The projector is not here. I think Louis removed it yesterday and brought it to the central office, but I'm not sure. [unconfident speaker]
Condition 2	Peter: It was Louis who removed the projector. It is at the central office. [<i>presupposing</i> speaker] Adam: The projector is not here. Louis removed it. It is at the central office. [<i>saying</i> speaker]
Condition 3	Adam: The projector is not here. Louis removed it. It is at the central office. [<i>saying</i> speaker] Joe: Louis gave a presentation at the central office yesterday evening. [<i>implicating</i> speaker]
Condition 4	Joe: Louis gave a presentation at the central office yesterday evening. [<i>implicating</i> speaker] Peter: It was Louis who removed the projector. It is at the central office. [<i>presupposing</i> speaker]

Analysis

We removed from our analysis participants who answered either “No” or “I don’t know” to the implicature question in Conditions 3 and 4 (130 participants). Furthermore, we excluded 1 non-native English speaker. Our final sample included 160 participants. Participants were equally distributed across the four conditions. In order to have comparable samples for each condition, we had anticipated the exclusion rate for Condition 3 and Condition 4 (based on a pilot), and recruited proportionately more participants for these conditions. The writing task, i.e. typing a message, was meant to increase the engagement of the participant in the fictional story. As it was not directly relevant to our concerns, we did not perform any qualitative analysis on the participants’ answers.

4.2. Results

Condition 1 (confident vs. unconfident speaker). The results replicated Vullioud *et al.* (2017). Participants were significantly more likely to punish the confident speaker (73%, 27/37, binomial $p = .008$) and to trust the unconfident one (84%, 31/37, binomial $p < .001$).³⁷

Condition 2 (presupposing vs. saying speaker). Participants were as likely to punish the *presupposing* speaker as they were to punish the *saying* speaker (49%, 21/43, binomial $p = 1$). Similarly, there was no significant difference with regard to the trust question: 42% of the

³⁷ All the binomial tests here report two-sided p -values.

participants trusted the *saying* speaker and 58% trusted the *presupposing* speaker (25/43, binomial $p = .36$)

Condition 3 (saying vs. implicating speaker). The punishment question did not show any significant difference, with 63% of participants punishing the *saying* speaker and 37% the *implicating* speaker (26/41, binomial $p = .12$). By contrast, participants were significantly more likely to trust the *implicating* speaker than the *saying* speaker (73%, 30/41, binomial $p = .004$).

Condition 4 (implicating vs. presupposing speaker). Participants were as likely to punish the *implicating* speaker as they were to punish the *presupposing* speaker (51%, 20/39, binomial $p = 1$). However, a clear difference emerged with regard to the trust question: only 23% of the participants trusted the *presupposing* speaker, while 77% preferred to trust the *implicating* one (30/39, binomial $p = .001$).³⁸

4.3 Discussion

A first important result of our experiment is the replication of Vullioud *et al.* (2017). It not only established the reliability of our adapted paradigm, but it also provided us with a way to compare the behaviour of explicit commitment signals (confidence expressions) with tacit cues of commitment (meaning-relations). The comparison between explicit and implicit cues suggests that the former leads to a stronger modulation of speaker commitment (as evidenced by the fact that both the punishment and the trust questions showed a significance difference in Condition 1). While the participants are inclined to impose direct costs (punishment question) as well as reputational ones (trust question) to a confident but mistaken speaker, when it comes to meaning-relations the speaker's damage is only reputational. Crucially, our results show that interlocutors are sensitive to the way in which content is communicated – whether it is presupposed, said or implicated. This provides the first empirical evidence that participants modulate the degree of speaker commitment as a function of a provided meaning-relation.

Our data show that *implicating* is taken to be less committal than *saying* and *presupposing*. This result suggests that the relative degree of commitment attributed to a message does not entirely depend on its degree of explicitness. While implicatures and presuppositions are contents typically left implicit (with the exception of some presupposition

³⁸ The pattern of results for Conditions 3 and 4 does not change if we include in the analysis all participants (independently of their answer to the implicature question). Participants were significantly more likely to trust the *implicating* speaker than the *saying* speaker (Condition 3: 86/104, binomial $p < .001$) and the *presupposing* speaker (Condition 4: 88/106, binomial $p < .001$). Furthermore, a statistical significance difference also emerges with respect to the Punishment question: participants were significantly less likely to punish the *implicating* speaker than the *saying* speaker (Condition 3: 27/104, binomial $p < .001$) and the *presupposing* speaker (Condition 4: 38/106, binomial $p = .005$).

triggers), they clearly commit the speaker to different degrees. *Implicating* allows speaker to get their message across without incurring the same reputational damage as *saying* and *presupposing*, and it thus represents a powerful way to minimize drops of trust that result from unreliable testimony.

5. Experiment 2 (a and b)

Experiment 1 did not provide evidence of a difference in terms of the reputational damage incurred by a speaker who presupposes false information compared to a speaker who explicitly communicates it. To assess the robustness of this result, in Experiment 2 (a and b) we include new stimuli covering a broader range of presupposition triggers (Karttunen, 1969; Levinson, 1983). Along with the stimuli used in Experiment 1, we use items from the following categories: definite descriptions, temporal clauses, counterfactual conditionals and *only* (Experiment 2a), as well as new iteratives and focus-sensitive particles (Experiment 2b).

5.1 Methods (Experiment 2a)

Participants

We recruited 151 participants through Amazon Mechanical Turk (79 men, 72 women, $M_{age} = 35.11$, $SD = 9.98$).

Materials and procedure

Our stimuli comprised the set of stories used in Experiment 1 (Condition 2) and 4 additional new stories which included the following presupposition triggers: the definite description *the*, the temporal clause *after*, a counterfactual conditional and *only*. See Appendix B for a detailed list. The procedure was the same as Experiment 1's. Participants were presented with the testimonies of a *presupposing* speaker and a *saying* speaker and they were asked to select which of the two they wished to punish or trust after receiving negative feedback about the information transmitted.

5.2 Results (Experiment 2a)

The results confirmed the null finding of Experiment 1 (Condition 2). Participants were equally likely to punish the *presupposing* speaker and the *saying* speaker (50%, 76/151, binomial $p = 1$), and equally likely to trust them (50%, 75/151, binomial $p = 1$).

We then looked at each presupposition trigger individually in order to detect any potential difference in behaviour. The only presupposition trigger that stood out was the iterative *again*: participants were more likely to punish the *saying* speaker than the *presupposing* one. However,

this result is only significant if we do not correct for multiple comparisons (76%, 16/21, binomial $p = .03$).

5.3 Discussion (Experiment 2a)

Overall, data from Experiments 1 and 2 are consistent with each other. Participants do not seem to be more prone to attribute different reputational costs to a speaker that has presupposed a message which turns out to be false than to a speaker who has explicitly stated it. This in turn suggests that to the extent that *presupposing* and *saying* are taken as cues to attribute a certain degree of commitment towards the message conveyed, they behave very similarly to each other.

However, given the suggesting that the presupposition trigger *again* might differ from others, it leaves open the question of whether different presupposition triggers might yield different degrees of speaker commitment. With regard to this, it is worth noting that *again* belongs to a class of presupposition triggers that Glanzberg (2003, 2005) has called ‘weak presupposition triggers.’ This class includes iteratives and focus-sensitive particles and it is characterised by the fact that in case of presupposition failure, repair is typically optional. That is, even if the presupposition is false or not part of the common ground, the utterance explicitly communicates a proposition whose truth-value can be independently evaluated. Take the following example from our set of stimuli: “He is late again”. Even if the presupposition fails, the proposition that *He is late (today)* can be coherently assessed as true or false. Because of this feature of weak presupposition triggers, it is plausible to hypothesize that, in these linguistic contexts, the speaker might commit more to what is said than to what is presupposed. This hypothesis sets the ground for our Experiment 2b.

5.4 Methods (Experiment 2b)

Participants We recruited 77 participants through Amazon Mechanical Turk (48 men, 29 women, $M_{age} = 33.02$, $SD = 10.21$). We excluded 3 participants as they were not English native speakers.

Materials and procedure Our stimuli comprised 4 stories which included the following presupposition triggers: the iteratives *again*, *also*, *too* and the focus-sensitive particle *even*. See Appendix B for a detailed list. The procedure was the same of Experiment 2a.

5.5 Results (Experiment 2b)

The results did not confirm our hypothesis. Overall, participants were equally likely to punish the *presupposing* speaker and the *saying* speaker (57%, 32/74, binomial $p = .30$), and trusted them to the same extent (51%, 38/74, binomial $p = .91$).

5.6 Discussion (Experiment 2b)

The results of Experiment 2b confirm that participants do not treat *presupposing* and *saying* as fundamentally different with respect to degrees of speaker commitment. This holds even when looking at more subtle distinctions within the heterogeneous class of presuppositions triggers, such as the distinction between weak and strong triggers (Glanzberg, 2003, 2005). This suggests that *presupposing* and *saying* expose the speaker to the same reputational damage if the message conveyed is found to be unreliable.

6. Experiment 3

In line with the predictions of most of the linguistic and philosophical literature on the distinction between what is said and what is implicated, Experiment 1 shows that *implicating* is less committal than *saying*. Specifically, it reveals that senders can safeguard (at least partially) the trust receivers grant them by communicating unreliable messages by means of implicatures. To confirm the robustness of our results, we conducted a replication study.

6.1 Methods

We recruited 85 participants through Amazon Mechanical Turk (50 men, 34 women, 1 other, $M_{age} = 34.48$, $SD = 10.60$). The material, procedure and criteria for data cleaning were the same as Experiment 1 (Condition 3). Our final sample included 50 participants.

6.2 Results

The results confirmed our data from Experiment 1. While participants were as likely to punish the *saying* speaker as the *implicating* one (50%, 25/50, binomial $p = 1$), they clearly prefer to trust the *implicating* speaker over the *saying* one (70%, 35/50, binomial $p = .007$).

7. General discussion

In this article, we provide the first - to the best of our knowledge - empirical evidence that the meaning-relation through which the speaker conveys her message affects the degree of speaker commitment to its truth. Specifically, we show that, holding everything else equal, the meaning-relation of implicating is taken to be less committal than both saying and presupposing (which appear to be on a par). We compared speakers *implicating*, *saying*, or *presupposing* the same piece of information, and assessed the extent to which receivers adjusted their trust towards the sender after her testimony was revealed to have been misguided. Speakers are judged as less blameworthy when they implicate rather than explicitly communicate or presuppose a false piece of information. This result cannot be attributed to receivers believing that the message was only accidentally conveyed, that is, that speakers did not *intend* to implicate it. Thanks to

the presence of the ‘implicature question,’ our studies assessed what participants took to be the speaker’s intended meaning. By restricting our analysis to participants who recognized the implicature as part of what the speaker intended to communicate with her utterance, we show that trustworthiness is less damaged even when false information is taken to be intentionally implicated (and not the result of accidental misunderstanding). Meaning-relations act as cues for the addressee to infer the speaker’s degree of commitment towards the information communicated (Moeschler, 2013), and are thus relevant to establishing the social implications of an act of communication. These implications include speakers’ liability to criticism and blame. As a result, speakers can strategically deploy these cues with the aim of managing their reputation.

To conclude, we would like to discuss our results in light of recent proposals concerning the evolution of implicit communication. Implicit communication raises a *prima facie* puzzle, which is the following: why is implicit communication pervasive despite it being costly and open to misunderstandings. It has been well documented that implicit communication is costly, as implicature derivation typically imposes extra processing costs to the receiver (see, e.g., Bott & Noveck, 2004; Tomlinson, Bailey, & Bott, 2013). Furthermore, because the recovery of implicatures exclusively relies on contextual cues, implicit communication is more prone to misunderstandings and, as a result, it reduces the likelihood that the sender will get her message across. To solve this puzzle, Reboul (2017a, 2017b) proposes what she calls the “manipulation hypothesis,” that is, the hypothesis that implicit communication would have emerged in order to facilitate manipulation. Specifically, Reboul suggests an explicit link between commitment and manipulation. The argument goes as follows. First, *implicating* does not commit the speaker to the truth of the message conveyed. Second, a message on the truth of which the speaker does not commit is less likely to be critically evaluated by the receiver. It follows that *implicating* increases the chance of the receiver accepting the speaker’s message without further scrutiny.

Our results offer a different perspective on the relation between commitment and manipulation, which enriches and complements the discussion above. Meaning-relations are linguistic tools that can modulate the degree of speaker commitment and thus be used to influence interlocutors. By lowering her commitment, a speaker can attempt to get her message across while reducing social sanctions. Our results show that implicating is taken to be less committal than saying and presupposing. As a result, the advantage of implicating relies on the fact that the speaker can reduce the costs associated with the transmission of false information, and preserve some of her reputation as a reliable source of information. This requires calibrating

one's commitment towards the unreliable pieces of information that are part of the overall communicated message. It is worth noting, though, that one's reputation is affected by, not only the outcomes of his or her actions but also by his or her underlying intentions, preferences and task specific capabilities (Heintz *et al.*, 2016). While our studies do not explicitly distinguish between deceptive and honest but mistaken communicators, future research should look at the effect of intentional or accidental misinformation on the relation between commitment and reputation.

Reputation managing is an essential component of our social life and helps us navigate the intricate dynamics of social interactions. This work ultimately contributes to advance our understanding of how reputation is managed in a market of potential communicative partners and opens up an interesting new line of research at the interface between pragmatics and social psychology.

Chapter 3

Felicitous Discourse Attachment to Presupposed Content: When backgrounded information is as expected as foregrounded information – An EEG study of factive verb constructions

Abstract Presuppositions are typically not the main flow of discourse and discourse attachments targeting the presupposition are considered infelicitous. In his theoretical proposal Winterstein (2009) showed that additive discourse particles can be considered as an exception. Discourse attachments in additive discourse relations that target the presupposed content are not considered infelicitous. To better understand the underlying impact of pragmatic felicity/infelicity and layer of meaning and its cognitive processing pattern, we present two EEG experiments. The presupposition trigger of interest are factive verb constructions. The findings of our two studies indicate the following: Despite its peripheral and not-at-issue status, discourse continuations to the presupposed content do not elicit a distinct processing pattern compared to attachments to the asserted content. Our results will be discussed and related to the recently presented framework proposed by Beaver et al. (2017) that challenge the at-issue status of factive work constructions.

Keywords: language processing, presupposition, factivity, discourse, question under discussion

1. Introduction

Linguistic presupposition is information which is triggered by the presence of certain linguistic expressions (*presupposition triggers*) and is conveyed as background information of a conversation. A variety of distinct linguistic forms such as definite descriptions as in (1), change of state verbs as in (2), iterative adverbs as in (3), wh-question as in (4) and constructions like temporal clauses as in (5) trigger presuppositions (for an extensive list see Levinson, 1983).

1. I have to pick up my sister at the airport.
I have a sister. (Presupposition)
2. Peter stopped smoking.
Peter used to smoke. (Presupposition)
3. Barack Obama was elected again.
Barack Obama was elected before. (Presupposition)
4. When did Michael leave the house?
Michael left the house. (Presupposition)
5. Before Strawson was even born, Frege noticed presuppositions.
Somebody named Strawson was born. (Presupposition)

Presupposition triggers are ubiquitous in discourse and, for this reason, they have been the object of extensive investigation in philosophy and linguistics. Presupposition is information which is old, previous, or given, or at least presented as such (Stalnaker, 1974). One main recurrent feature in the literature of presuppositions, viewed from different perspectives, is the fact that presuppositions are usually subtracted from the main flow of discourse. First, presuppositions do not provide natural answers to questions (Grimshaw, 1979). Second, the presupposed content is considered less addressable than the asserted one as it does not contribute to the current question under discussion (Roberts, Beaver, Simons, & Tonhauser, 2009). Lastly, presuppositions generally resist discourse connections (Ducrot, 1972). It is typically infelicitous to link a discourse connective (such as *because*) to the presupposed content, while this is not the case when the link targets the asserted content.

In the current research, we are particularly interested in the real-time processing of attachments that represent a significant exception to this established picture: that is, *felicitous* discourse continuations targeting the asserted or the presupposed content in additive contexts. To this end, before presenting our study, we turn to a more detailed discussion of why presuppositions are generally considered marginal in discourse and describe the way in which this claim finds empirical support by recent experimental data. Second, we show in which cases

discourse attachment to the presupposed content can be pragmatically felicitous. Third, we outline how the distinction between asserted versus presupposed content relates to neurocognitive findings on felicitous and infelicitous information packaging. Lastly, we give an overview of the experimental study presented in this paper.

Non-Answerhood to questions

Presuppositions do not in general provide natural answers to questions (Grimshaw, 1979). For instance, the answers in (6b) and (6c) presuppose the truth of the proposition that *Bill left* without asserting it. According to Grimshaw, the infelicity of these exchanges does not depend on the content of the conveyed information as the hearer can easily retrieve the answer to this question (i.e. that *Bill left*). However, by answering a question with a presupposition instead of an assertion, the speaker appears to violate an underlying discourse principle: “one cannot reply to a question with a response which presupposes the answer” (Grimshaw, p. 322). In contrast with this, answering a question with an assertion, as in (6d), results in a perfectly appropriate exchange.

- 6. a. A: Did Bill leave?
- b. B: It is odd that he did.
- c. B: I’d forgotten that he did.
- d. B: Yes; He did.

Grimshaw (1979) claims that a similar observation can be made with the question-answer pair in (7). Given the reply in (7b), it can be deduced that B *did have a lot of fun*; however, the deviance of such an answer stems from the fact that this content is not asserted, but only presupposed. According to Grimshaw, answering a question with a presupposition is considered as a violation, which leads to what she calls an *ill-formedness in discourse*. Therefore, presuppositions do not provide natural answers to questions.

- 7. a. Did you have fun?
- b. What fun we had!

Presupposed content and the question under discussion

Not only are presuppositions considered as inappropriate answers to questions, but they also appear to play a relatively marginal role in discourse. As shown before, presuppositions are typically described as backgrounded contents, that is, contents that do not contribute to the main point of the utterance. Due to its backgroundedness, the presupposed content is considered less addressable than the asserted one. Let us consider the dialogue in (8). While it is possible to

directly deny or reject what has been asserted by speaker A (as in 8b), it is not possible to directly refute a presupposition without giving rise to an infelicity, as in (8c) (example taken from Cummins, Amaral & Katsos, 2012).

8. a. A: Paul stopped smoking.
- b. B: No, Paul didn't stop smoking.
- c. B: # No, Paul didn't used to smoke.
- d. B: Hey, wait a minute! Paul didn't used to smoke.

Crucially, as suggested by Shanon (1976) and von Fintel, (2004, 2008), challenging a presupposition requires a particular discourse move that is metalinguistic in nature (and that has been described in the literature as the '*Hey, wait a minute!*' test). In order to reject the presupposition of (8a) that *Paul used to smoke*, B must disrupt the normal flow of discourse by uttering a sentence like (8d).

The infelicity of (8d) can be analyzed through the model of discourse information flow proposed by Roberts (1996). According to her model, discursive moves must address the so-called *current question under discussion* (QUD), that is, whatever question addresses the most recent accepted discourse goal. Roberts distinguishes between two distinct types of content that are introduced by a discourse move: *at-issue* content and *non-at-issue* content. While the former represents the direct contribution to the QUD, the latter does not move the conversation forward in the established direction. Typically, the asserted content is considered as *at-issue* and addresses the QUD, whereas the presupposed content is considered part of the *non-at-issue content*. For instance, the discourse move of B in (8c) is considered infelicitous as it targets the non-at-issue content of A's utterance. Such a discourse move signals that the speaker is abandoning the current QUD and leads to the impression of a non sequitur (Jayez, 2010).

Using an acceptability rating study, Cummins et al. (2012) investigated how discourse continuations targeting the presupposed versus asserted content are judged. In their experiment, four experimental conditions were created by manipulating the affirmative or negative nature of the answer as well as by manipulating the level of meaning that was targeted by the answer. Dialogues included "yes" or "no" responses including discourse continuations targeting the asserted content (9a and 9b) or the presupposed content (9c or 9d). Their overall results show that acceptance ratings are higher for answers addressing the asserted content than for answers refuting the presupposition (for similar findings on Spanish, see Amaral & Cummins, 2015).

9. Did Brian lose his wallet again?
- a. Yes, he did lose his wallet again.
 - b. No, he didn't lose his wallet this time.
 - c. Yes, although he never lost it before.
 - d. No, because he never lost it before.

The at-issueness versus non-at-issueness was directly tested using acceptability ratings in the study by Cummins et al. (2012), and Amaral and Cummins (2015). An interesting, and quite different, approach is put forward by Schwarz (2014). Instead of using acceptability ratings, he measured the reaction times for false judgments by comparing cases in which either the at-issue content or the non-at-issue content is falsified. The two conditions are comparable to the conditions used by Cummins et al. (2012), which challenged either the asserted content (9b) or the presupposed one (9c). Schwarz compared definites like *the boy*, as in (10a), which are referential in nature with indefinites like *a boy*, as in (10b), which are non-referential. The former is considered as presupposition trigger, whereas the latter is not.

10. a. **The boy** with an outing on Tuesday is going to play golf.
b. There's **a boy** with an outing on Tuesday who's going to play golf.

After showing participants pictures depicting boys and girls and their weekly activities, target sentences like the ones in (10a) and (10b) had to be judged. Schwarz' results show that reaction times to 'false' responses in the presupposition condition (10a) are slower than 'false' responses in the assertion condition (10b). For him, this shows that presuppositions and assertions, which represent theoretically distinct levels of meaning, are also processed differently. In summary, Schwarz' results point out that falsified presuppositions come with a higher processing cost when compared to falsified assertions.

Further evidence showing that inconsistent information conveyed via a presupposition disrupts the normal flow of discourse comes from studies examining the brain signature of factive verb constructions and the presupposition trigger *again*. Factive verbs presuppose that their complement clause expresses a true proposition (Egre, 2008; Kiparsky & Kiparsky, 1970). Ferretti, Singer, and Patterson's (2009) and Ferretti, Singer, and Harwood's (2013) results point out that processing inconsistent information conveyed via a factive complement comes with an extra processing cost compared to consistent information. Shetreet, Alexander, Romoli, Chierchia and Kuperberg (2019) extended these findings by comparing consistent presupposed information in bridged contexts versus inconsistent presupposed information. In the bridged scenarios, the presupposition has a discourse antecedent without having been explicitly

introduced. For instance, the target sentence *He checked and it was vacant* was either consistent – *Calvin was aware that it [the room] was unused* – or inconsistent – *Calvin was aware that it [the room] was busy* – with information that has been introduced by a factive sentence. Shetreet et al.’s results indicate that inconsistent information in the factive condition elicits a P600 compared to consistent information. More interestingly, their results point out that the difference of the experimental material with respect to the Ferretti et al. studies (2009, 2013) has an impact on the processing pattern of inconsistent information of factive verb constructions.

Further evidence that inconsistent presupposed content elicits a P600 effect comes from Jouravlev, Stearns, Bergen, Eddy, Gibson & Fedorenko (2016) who investigated the presupposition trigger *again*. Their results indicate that inconsistent uses of *again* elicit a P600 in comparison to consistent uses of *again*. In summary, Ferretti et al.’s (2009, 2013), Jouravlev et al.’s (2016), and Shetreet et al.’s (2019) results indicate that processing discourse inconsistent content is modulated by the presupposed truth of the information. Inconsistent presupposed information is processed differently compared to inconsistent non-presupposed information. In addition, the three presented EEG studies also point out that the used stimuli are sensitive to the observed presence/absence of the N400 and P600 component (see also Burkhardt, 2006; 2007).

Until now, we presented empirical data indicating that inconsistent presuppositions come with an extra processing cost. We will now look at empirical research that examine the processing of presuppositions without a discourse antecedent. In these cases, the presupposed content is not yet part of the common ground and must be considered as new and not backgrounded information. Generally, this would lead to presupposition failure (Stalnaker, 2002). In order to repair the failure, the speaker must accommodate the presupposition, that is, accept it as at least provisionally true (Heim, 1983; Lewis, 1979).

Let us consider the following example used in a recent experimental research by Domaneschi, Canal, Masia, Vallauri and Bambini (2018). The definite description in (11c) refers to an explicit discourse antecedent when preceded by a context sentence like (11a), but has no explicit discourse antecedent in an alternative context set up by (11b). In the latter case, the existence of a graphic designer is taken for granted, as the person has never explicitly been introduced. In such a case, the existential presupposition triggered by the definite description must be accommodated.

11. a. In Paolo’s office, there used to be **a very bad-tempered graphic designer**.
- b. In Paolo’s office there are **many employees**.

c. Due to overstaffing problems, about a month ago **the graphic designer** was made redundant.

Domaneschi et al.'s findings indicate that the accommodation of presuppositions is associated with a biphasic N400-P600 pattern at the processing point of both definite descriptions and change-of-state verbs. Moreover, their results indicate that the N400 is more prominent with definite descriptions, while for change-of-state verbs the costs of accommodation were associated with a more pronounced P600³⁹. Further evidence comes from another ERP study by Masia, Canal, Ricci, Vallauri, and Bambini (2017). Their event-related potential results show that information packaging has an impact on language processing: New information introduced via a presupposition, e.g. a definite description such as *the migration*, triggers an N400 compared to new information introduced via an assertion containing the indefinite *a migration*. In conclusion, information that is considered as presupposed, but newly introduced in discourse, comes with a higher processing cost (see also self-paced reading time study by Tiemann et al., 2011; an eye-tracking study by Tiemann & Schwarz, 2012).

The previous section not only introduced the QUD model, which states that presupposed content is less addressable than asserted content, but also presents empirical evidence revealing that presupposed content is processed differently compared to asserted content. This leads to the conclusion that when the current question under discuss is not addressed, a different processing pattern is observed (as compared to typical instances of QUD addressing). In the next section, we present an interesting proposal that addresses the discourse attachment properties of presuppositions.

Discourse attachment

In his seminal work, Ducrot (1972) provides an analysis of discourse attachment properties of presuppositions by examining the linguistic behavior of discourse connectives such as *therefore* (*donc*) and *because* (*parce que*). According to Ducrot, this behavior is captured by the following generalization, that he calls the 'linking law' ('*loi d'enchaînement*')⁴⁰:

³⁹ It is not the scope of this paper to discuss why different presupposition triggers may be processed differently; however, it is important to acknowledge that the presupposed content is not only judged differently and has a different processing pattern when its content is falsified compared to the at-issue content, but presupposed content is also processed differently when its information has no prior discourse antecedent (e.g. for a review see Schwarzs, 2015; Burkhardt; 2006; Romoli, Khan, Sudo, & Snedeker., 2014; Schwarz, 2012; Schwarz, 2014a; Schwarz, 2014b; Singh et al., 2015; Singh, Fedorenko, & Gibbs, 2013; Tiemann et al., 2011; Tiemann & Schwarz, 2012).

⁴⁰ According to Ducrot discourse connectives such as *et* (and) and *si* (if) do not fall under the generalization of the *linking law*.

Linking law

“When an utterance A is linked to another utterance B by means of a coordinating or a subordinating conjunction, or by means of an implicit logical link, the link which is established between A and B never concerns what is presupposed by A and B, but only what is asserted by A and B.”

(Ducrot, 1972; p. 81; my translation from French)

According to this generalization, the presupposition of an utterance is never available to discourse attachment. Consider the example in (12) which conveys the asserted information that *Paul does not smoke* (12a) and the presupposition that *Paul used to smoke* (12b). Let us assume that the reason why Paul used to smoke is that he liked the taste of tobacco in his mouth. Crucially, though, if we utter (12) followed by (12c), this continuation will be interpreted as the reason why Paul no longer smokes (thus its infelicity). According to Ducrot, a discourse continuation like (12c) can only target the content which is asserted by the means of an utterance of (12) and not its presupposed content. This is the reason why (12c) is infelicitous, whereas (12d) is a perfectly felicitous discourse continuation. Consistently with our world-knowledge, being afraid of lung cancer is a typical reason for stopping smoking, while liking the taste of tobacco is not.

12. Paul stopped smoking.

- a. Paul does not smoke.
- b. Paul smoked before.
- c. # *because* he liked the taste of tobacco in his mouth.
- d. *because* he is afraid of lung cancer.
- e. Therefore, he will now be able to live a healthier lifestyle.
- f. # Therefore, his lungs are not in a good state.

In the same vein, in a consequence scenario as in (12e) and (12f), the conjunct introduced by *Therefore* can only be interpreted as a conclusion derived from the asserted content, and not from the presupposed content. As a consequence, (12e) is felicitous, whereas (12f) is not.

In support of his linking law, Ducrot points out that the link established between two utterances by means of a discourse connective like *because* cannot involve the presuppositions of the two utterances. For instance, consider example (13), which does not establish any causal link between the fact that Paul used to smoke and the fact that Marie used to drink. In contrast, the utterance conveys the existence of a causal link between the change of behavior of Paul

(Paul no longer smokes) and that of Mary (Mary no longer drinks) according to which the former is to be interpreted as the result of the latter.

13. Paul stopped smoking because Marie stopped drinking.

- a. Paul used to smoke and Marie used to drink. No causal link
- b. Paul does not smoke because Marie does not drink. Causal link

Ducrot's linking law has been empirically corroborated by Jayez (2010). By means of an acceptability rating task, Jayez (2010) assessed whether discourse continuations which target a presupposition are judged less acceptable than discourse continuations which target a previously asserted content. His study focuses on consequence discourse markers (the French *alors* and *donc*, respectively equivalent to *so* and *therefore*) and a causal justification subordinating conjunction (*parce que* and *puisque*, respectively equivalent to *because* and *since*). Example (14) illustrates two pairs of stimuli (translated from French) involving *so* and *because*. While (14a) and (14b) exemplify a discourse continuation to the asserted content, (14c) and (14d) represent a discourse continuation targeting the presupposition.

- 14.
- a. Paul stopped quivering, so he went outside.
 - b. Paul stopped quivering because he went inside.
 - c. Paul stopped quivering, so he was cold.
 - d. Paul stopped quivering because he went outside.

In line with with Ducrot's linking law, Jayez' results indicate that continuations targeting the asserted content are significantly more acceptable than continuations targeting the presupposition⁴¹. The latter were judged consistently as poorly acceptable by the participants.

Discourse attachment to the presupposition: Felicity in the case of *too*

In the previous section we have shown that it is typically infelicitous to attach a discourse constituent to a presupposition. However, the *discourse linking law* does not generalize to all discourse relations. Winterstein (2009) points out that the additive particle *aussi* (*too* in English) can target either the asserted or the presupposed content. The continuation in (15a) is as felicitous as the continuation in (15b). The only difference between the two sentences is that its discourse attachment addresses the at-issue content in (15a), whereas it addresses the non-at-issue content in (15b). Winterstein restricts his claim to cases (i) when "the antecedent can be

⁴¹ Jayez reports that this pattern was found with respect to 10 out of the 13 presupposition triggers deployed in his study.

accessed in any layer of meaning of the preceding discourse” (p. 328), and (ii) when the same strength between *too* and its antecedent exists.

15. a. Lemmy is proud to be a bass player, Roberto is proud too.
b. Lemmy is proud to be a bass player, Roberto plays bass too, [although he is not proud of it].

The present study aims to experimentally investigate the phenomenon of felicitous discourse attachments targeting a presupposition via the EEG method. For this reason, in what follows we discuss the way in which neurocognitive data can be brought to bear in the investigation of information packaging.

Neurocognitive processing of information packaging

The recording of event-related brain potentials does not only allow identifying multiple neurocognitive processes at the same time, but also provides a fine grained characterisation of the online time course of language processing (e.g., Friederici, 2011). From a neurocognitive view, rich expectations about the upcoming semantic word are quickly computed. Information that mismatches the computed expectations elicit a different processing pattern than information that matches our expectations. It has been shown that unexpected information elicits a more pronounced negative potential between 300 and 500ms peaking around 400ms after onset of the critical word (e.g., Chow, Lau, Wang & Philips, 2018; DeLong, Urbach & Federmeier, 2005; Federmeier & Kutas, 1999; Kutas & Federmeier, 2000; Laszlo & Federmeier, 2009; Nieuwland & Kuperberg, 2008; van Berkum, Brown, Zwitserlood, Kooijman & Hagoort, 2005; predictability effects: Kutas & Hillyard, 1984; Lau, Namyst, Fogel & Delgado, 2016). The so-called N400 depends, among other factors, (i) on the expectancy of the upcoming word, the lower the expectancy, the higher the amplitude of the N400 (Kutas & Federmeier, 2011 for a review) and (ii) on previous discourse, the less available a discourse referent is, the higher is the amplitude of the N400 (e.g., Burkhardt, 2006; 2007).

Previous neurophysiological studies examining the effect of discourse information structuring on online sentence processing also reported the triggering of the N400 component. For instance, Cowles, Kluender, Kutas and Polinsky (2007) present evidence that information packaging using *it-cleft* constructions sets up certain expectations for the hearer. The authors examined the pairing of a *Wh-question* and the corresponding answer involving an *it-cleft* construction. The *it-cleft* answer in (16b) sets up the discourse in such a way that the expected answer of (16) must be a lettuce-eating agent. Consequently, an expected answer could either be the deer, the rabbits or any other not yet introduced animal which plausibly eats lettuce. This

expectation is satisfied by the answer given in (16a): this answer conveys new information that has focus status and represents the at-issue content, whereas the shared information, that is information that *the lettuce was eaten*, is presented as part of the presupposed content. This information packaging is reversed in (16b). Even if the same information can be retrieved from both answers, in (16b), the current question under discussion is not answered by an expected structure of the it-cleft construction. The information structure in (16b) violates the hearer's expectation. Cowles et al.'s results indicate that answers with a focus misalignment elicit an N400 (as in 16b) in comparison to answers where such a misalignment is absent (as in 16a).

16. What ate the lettuce in your garden, the deer or the rabbits?

- a. It was the rabbits that ate the lettuce.
- b. # It was the lettuce that the rabbits ate.

Information structure can also serve to reduce the effect of focus misalignment. An interesting study by Wang, Hagoort and Yang (2009) extends the previous findings by Cowles et al. (2007). In their study, the authors manipulated the focus and the semantic appropriateness of an utterance. The inappropriate answer to a question was either conveyed as the at-issue content or as the non-at-issue content. Wang et al.'s results show that an N400 is elicited when the semantic entry is inappropriate, but only when the information is considered at-issue as in (17b). In cases in which the semantic inappropriateness is part of the non-at-issue content (18b), only a very reduced N400 occurs in comparison to the semantic appropriate answer (18a). According to the authors, processing resources may be allocated to the at-issue content of an utterance in order to facilitate semantic integration. In contrast, non-at-issue information requires less resources; consequently, a violation of semantic appropriateness leads to lower processing costs resulting in a reduced N400 for the incongruent information.

17. What kind of vegetable did Xiao Min buy for cooking today?

- a. Today Xiao Ming bought eggplant to cook.
- b. Today Xiao Ming bought beef to cook.

18. Who bought the vegetables for cooking today?

- a. Today **Xiao Ming** bought eggplant to cook.
- b. Today **Xiao Ming** bought beef to cook.

As shown in the previous section, ERP research investigating at-issue versus non-at-issue content has usually used a question mismatch paradigm in which answers addressing the at-issue content were compared to answers addressing the non-at-issue content (e.g; Cowles et al., 2007; Wang et al., 2009). In the present study, we do not investigate question-answer pairs, but

are interested in the processing of discourse attachments addressing either the at-issue or non-at-issue content in additive discourse scenarios. This will allow us to establish whether, despite being pragmatically felicitous, additive discourse continuations which target the non-at-issue content are processed differently than at-issue continuations.

The present research

Given the outlined theoretical and empirical evidence supporting the distinction between the asserted and presupposed content of a presupposition trigger, it is possible that a processing difference between the asserted and presupposed content would arise even when there is no blatant violation of focus congruence or the linking law. If the asserted content is more addressable or activated than the presupposed one, referring to the presupposed content should always be less expected than referring to the asserted content. Moreover, a sentence that requires the non-preferred reference in order to be interpreted should trigger higher cognitive processing costs than a sentence compatible with the preferred reference. Given the heterogeneity of presupposition triggers, not all triggers are suited for this experimental endeavour. The following considerations are relevant for our investigation from a methodological point of view. First, the variety of triggers creates possible confounds. For instance, with respect to aspectual verbs such as *start* or *stop*, the asserted content coincides with the final stage of the transition. Several experimental studies suggest that there is a cognitive advantage for the endpoint of a transition. Nuthmann & van der Meer (2005) observe a stronger pupillary response and longer response times for pairs like *shrinking-small* than for pairs like *shrinking-large*, which suggests that the final stage is cognitively dominant in the representation of transitions. In addition, expectancy-based selection processes favor succeeding over preceding events (Van der Meer, Krueger & Nuthmann, 2005). If this is true, this confound could seriously bias a study comparing the asserted and the presupposed content of aspectual verbs, since the asserted content could inherit some cognitive priority from its final status in the transition. Second, one should compare the asserted and the presupposed content for the same trigger. Although comparing the on-line processing of different triggers can provide useful information as to the processing speed (Schwarz 2015), it is more difficult to draw conclusions than in the unique trigger configuration.

In order to address both methodological concerns, in the present study we will focus on factive verb constructions. Factive verbs not only entail, but also presuppose their complement clause (Egre, 2008; Kiparsky & Kiparsky, 1970). With factives, the asserted and presupposed contents are explicitly expressed at the sentential level, which is a unique characteristic when

compared to other presupposition triggers. This explicitness allows one to directly compare a discourse attachment targeting either the asserted content as in (19a) or the presupposed content as in (19b) to the sentence in (19) without making an effort to infer the implicit presupposed content as it is the case with other presupposition triggers. In the present study, we use an additive discourse relation marked by the French adverb *aussi* (too, also), in order to observe if, despite being pragmatically felicitous, additive discourse continuations which target the non-at-issue content are processed differently than at-issue continuations. The two basic configurations are shown in (19a) and (19b). (19a) uses the masculine clitic pronoun *le* in French to refer either to the proposition corresponding to the complement clause of the first sentence (Peter takes the bus) or to the complement noun (the bus).

19. Mary sait que Lola prend le bus.

[Mary knows that Lola takes the bus.]

a. Elliot aussi le sait.

[Elliot also it knows]

b. Elliot aussi le prend.

[Elliot also takes it.]

The present experiment in which event-related potentials are measured, is used to monitor the time-locked processing of the asserted and presupposed content in pragmatically felicitous discourse attachment scenarios.

Research Question: Are felicitous discourse continuations which address the presupposed content cognitively more demanding than discourse continuations addressing the asserted content?

As highlighted before, the presupposed content does not contribute to the current *question under discussion*. It is well known that discourse continuations targeting the presupposed content are considered less natural (e.g., Cummins et al., 2012) and falsifying the presupposed content is processed differently than falsified asserted content (Schwarz, 2014). It is plausible to assume that the presupposed content, in general, is less addressable than the asserted content. Despite being pragmatically felicitous, we hypothesise that additive discourse continuations which target the presupposition as in (19b) are less expected than those which target the asserted content as in (19a). It is hypothesized that the presupposed content, the less expected content elicits an N400 compared to the continuation addressing the asserted content.

2. Experiment 1

2.1. Method

Development of stimuli

In order to develop the plausibility of our stimuli and to investigate whether the ones used in the experiment showed default discourse continuation preferences, we carried out two pretests.

Plausibility ratings

Using a questionnaire study, 130 pre-selected sentences were rated on a 5-point Likert scale with respect to their plausibility by twenty French native speakers, who did not take part in the subsequent ERP experiment. Sentences which received a rating higher than 4 were chosen for the ERP experiment (4 = an often used sentence, and 5 = a sentence, which can always be used). In total, twenty-two factive verbs amounting to 88 sentences were selected for the EEG experiment (a sample experimental stimulus is shown in Table 1). Each factive verb was used in four different constructions, of which an equal amount of trials targeted either the asserted or presupposed content. More precisely for each factive verb, the final word in the *RSWP* targeted twice the verb of the asserted content and twice the verb of the presupposed content. Mean written frequency of the asserted and presupposed verb for each factive verb construction was always aligned to the frequency criteria of the *Lexique 3* database (New, Pallier, Brysbaert, & Ferrand, 2004) for French lexical words (very rare < 5; 5 < rare < 10; 10 < frequent < 50; highly frequent > 50). In total, 52 highly frequent, 24 frequent, 8 rarely frequent, and 4 very rarely frequent verb pairs were chosen. Moreover, the number of letters and syllables for each pair, i.e. verb of the asserted content and verb of its presupposed counterpart did not differ on average by more than 1 (± 1). No verb pair was either a morphological or a phonological competitor.

Table 1. *Example of stimuli used and their approximate English translation (Target word in bold)*

	Asserted Content	Presupposed content
Context Sentence (Factive Verb Construction) – Self-paced reading	Paul sait que Jean parle l’anglais [<i>Paul knows that Jean speaks English</i>]	
Target Sentence (Rapid Serial Word Paradigm)	Éric aussi le sait [<i>Eric also it knows</i>]	Éric aussi le parle [<i>Eric also it speaks</i>]
Verification question (after 25% of all experimental items)	Est-ce que Jean parle l’anglais ? [<i>Does Jean speak English ?</i>]	

Testing the non at-issueness of factive verb constructions

Given that the main focus of the current experiment investigated the processing of factive complements in pragmatically felicitous additive discourse continuations, it was therefore important to investigate whether factive complements are by default less addressable in discourse continuations. Recent theoretical evidence challenges traditional accounts considering factive complements in some contexts as at-issue (Beaver et al., 2017; Simons et al., 2017). Furthermore, empirical data by Xue and Onea (2011) suggests that the factive complement of *know* is considered in most of the cases as at-issue – in 72.41% of the cases and the complement of *find out* in exactly half of the cases. In order to avoid that an absence of an effect in the ERP study is simply due to a default absence, we pretested a selection of the used stimuli in a forced choice experiment examining the answerhood to questions. We created scenarios, in which the participant overheard a conversation on the train between two other passengers, who are identified as A and B (see Table 2). The participant was told that she has heard very well what A said but has not completely understood B’s answer. After having read the question, the participant pressed the space bar and B’s answer unfolded. The participant was asked to choose the one she thinks is most likely and to do so as quickly as possible. In total, the pre-test contained ten factive verb constructions and twenty fillers.

Table 2. *Example of stimuli used and their approximate English translation of the pretest forced-choice stimuli*

	Asserted Content	Presupposed content
Question	A: Est-ce que Christel a remarqué que son père a retrouvé son appétit ? <i>[Did Christel notice that her father regained his appetite?]</i>	
Target Sentence (Force Choice design)	B: Oui, elle l’a remarqué. <i>[Yes, she noticed it.]</i>	B : Oui, il a retrouvé son appétit. <i>[Yes, he regained his appetite.]</i>

39 French-native speaking participants (23 men, $M_{age} = 28.46$, $SD_{age} = 8.64$) were recruited on the online recruitment platform *Prolific* and received monetary compensation.

The results show that answering a question containing a factive verb construction with a presupposition is significantly less preferred than answering a question with the asserted content. In 92.82% of the cases the asserted content is chosen over the presupposed one (7.18%). The results support not only Grinshaw’s (1979) observation that answering a question with a presupposition is considered as a violation, but also provide empirical evidence that presuppositions are considered not-at issue in scenarios involving the answerhood to questions.

Setup for the ERP experiment

The final list of experimental materials was composed of a set of 88 experimental items. Each item contained a context sentence that was a factive verb construction and a target sentence. Each target sentence contained a discourse attachment referring either to the asserted content or to the presupposed content (see Table 1). The target verb always appeared on the fourth position of the target sentence, which always coincided with the final position of the sentence. A self-paced reading task was used for the context sentence, which was followed by a *rapid serial word paradigm (RSWP)* to unmask anticipation processes (Figure 1). We also added 44 filler sentences. Like the experimental items, the fillers included a context sentence followed by a subsequent sentence that involved new information and did thus not repeat any information of the context sentence. The presentation order of the stimuli was pseudo-randomised. No more than two items of the same category appeared consecutively. In order to control for order effects, we independently generated random orders for each participant. One quarter of the sentences were followed by a yes/no comprehension question in order to keep participants attentive in this silent reading task. In total, twenty-four questions were presented after the stimuli. Equal amounts of twelve questions referred to the asserted and presupposed content.

For both contents the amount of yes and no questions was balanced, six questions triggered a yes answer and six questions triggered a no answer. Additionally, twelve questions were related to the filler material.

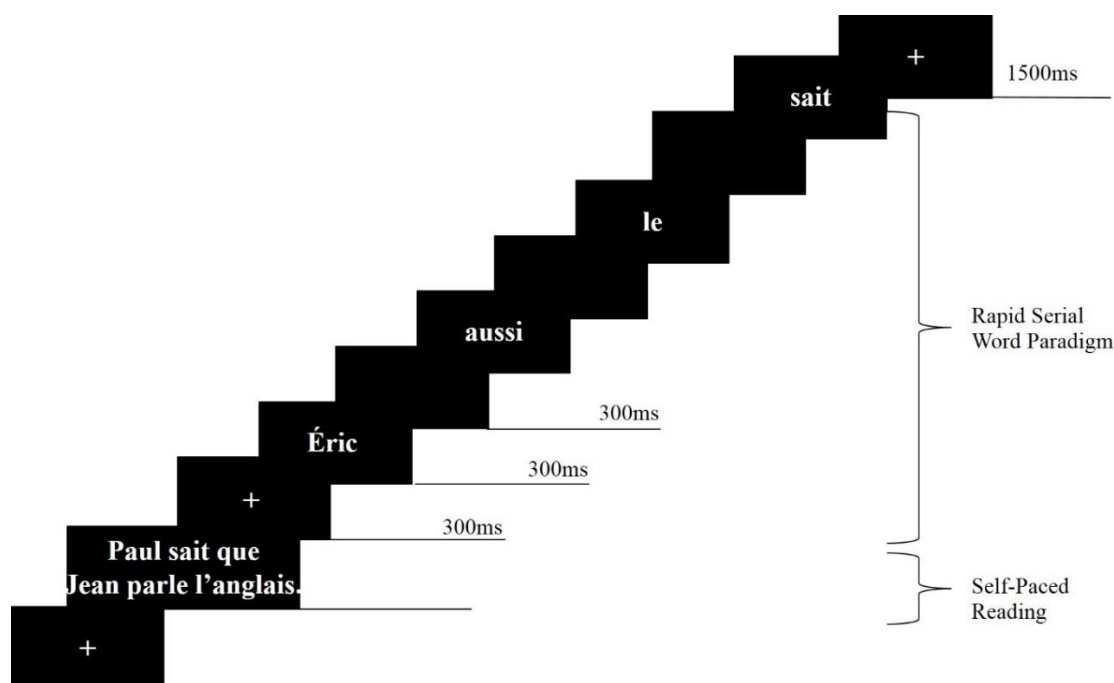


Figure 1. Experimental research design of Experiment 1. Depicted is the asserted content condition.

ERP experiment

Participants

Thirty French native speakers, aged from 18 to 26 years participated in this research (16 women; $M = 20.67$, $SD = 2.06$). Participants were undergraduate students from the University of Lyon 1, none followed a program in linguistics, and all had normal or corrected-to-normal vision. All participants gave written consent to participate in the study and received monetary compensation. The present study was approved by the ethics committee responsible for the *National Scientific Research Center* of South-East France (CPP Sud-Est II).

Procedure

Each experimental phase started with a training session in which instructions about the experiment were presented. In total eight examples were given. Participants were presented with the first sentence on a computer screen. After having understood the first sentence, participants were instructed to press either the “L” or “S” button to start reading the second part. The second sentence was presented using the *RSWP*: One word at a time was presented (300ms

duration and 300ms blank screen, in total a stimulus onset asynchrony of 600ms was chosen) in the centre of the screen (see Figure 1). The instruction was to read each sequence silently and to answer yes or no when a comprehension question appeared on the screen by pressing either a red button (S) which corresponded to no or a green button (L) which corresponded to yes. 25% of all trials contained questions. Either after the last word of the RSWP or after the question, a fixation cross appeared in the centre of the screen to mark the end of each sequence.

The total 132 sequences were divided into two blocks. After the first 66 sequences, a short break of 5 minutes was initiated, which was followed by the remaining 66 sequences. In total, the experiment lasted about 1 hour and 30 minutes. The beginning of each experimental block began with a filler. Participants were debriefed after the end of the experiment.

Electrophysiological Recording and Data Analyses

Presentation of stimuli was controlled by a computer running the experimental software application *Presentation* (version 17.0) on a running standard Windows 7 computer. A 13-inch flat screen TFT running at 1280 by 1024-pixel resolution in 16-bit colour and refreshing at 100 Hz was used during the entire experiment. The viewing distance was approximately 50cm. A probe, in the center of the screen (“+”; Font: 62pt Courier New) was used as the fixation point at the beginning of each trial. In 25% of all trials, a question concerning the content of the sequence appeared on the screen, the participants had to assess its correctness, either confirming the question by pressing the “L” key or denying it by pressing the “S” key. All phrases appeared in Courier New Font, Size 30 in white on a black background.

Electrophysiological data were recorded from 128 channel dense array EEG using the Geodesic Sensor Net with the vertex electrode (electrode Cz) as the on-line reference and re-referenced off-line to a global reference. The electrode impedance was set below 50k Ω . EEG activity was continuously digitised at a sampling rate of 500 Hz, and re-filtered off-line between 0.1 Hz (order 8) and 30 Hz (order 8), and a notch filter was set at 50Hz. Ocular channels were created offline, electrodes E25 and E127 served as VEOG, and electrodes E17 and E127 served as HEOG. Afterwards, we created the two segments of our data representing the two conditions. The time interval before ICA correction ranged from -600 to 1500ms, baseline was corrected 200ms prior stimuli onset. In order to detect eye-blinks, an ocular correction with independent component analysis was used. After the ocular correction, a semi-automatic artifact rejection was used using the following criteria: (i) interval range -300 – 1000ms, (ii) maximal allowed voltage step: 50 μ V, (iii) maximal allowed difference of values in intervals: 100 μ V for an interval length of 100ms, (iv) allowed amplitude \pm 200 μ V, (v) lowest allowed activity in

intervals: 0.5 μ V in interval length of 100ms. Finally, a second baseline correction (-200ms) was used following the recommendations by Luck (2005). As a final step, the segmented conditions were averaged for each participant and data was exported for the analysis in R.

The mean voltage of the ERP data was quantified by calculating mean voltage amplitudes. As stated previously, the main component of interest was the time region associated with the N400 for language processing that is the time interval between 350-500ms. After visual inspection, the P600 time interval, that is the time interval between 500 and 900ms was exploratorily analysed.

The electrode array was divided into a number of regions. In total, 78 electrodes were used for the analysis (see Table 3 and Figure 2).

Table 3. *Electrodes used for the analysis*

Left	Midline	Right
FRONTAL		
22 (FP1), 26, 33 (F7), 18, 23, 27, 34, 28, 24 (F3), 19, 12, 20	15, 16, 11 (Fz)	9 (FP2), 2, 122 (F8), 116, 117, 118, 5, 4, 10, 3, 123, 124 (F4)
CENTRAL		
13, 7, 31, 30, 37, 29, 36 (C3), 42, 47, 41, 35, 40, 46	6, CZ, 55	112, 106, 80, 87, 93, 98, 102, 109, 103, 104 (C4), 105, 111, 110
PARIETAL		
54, 61, 67, 71, 66, 60, 53, 52, 59, 58 (P7), 51	62, 72	79, 77, 78, 76, 86, 85, 84, 92, 91, 97, 96 (P8)

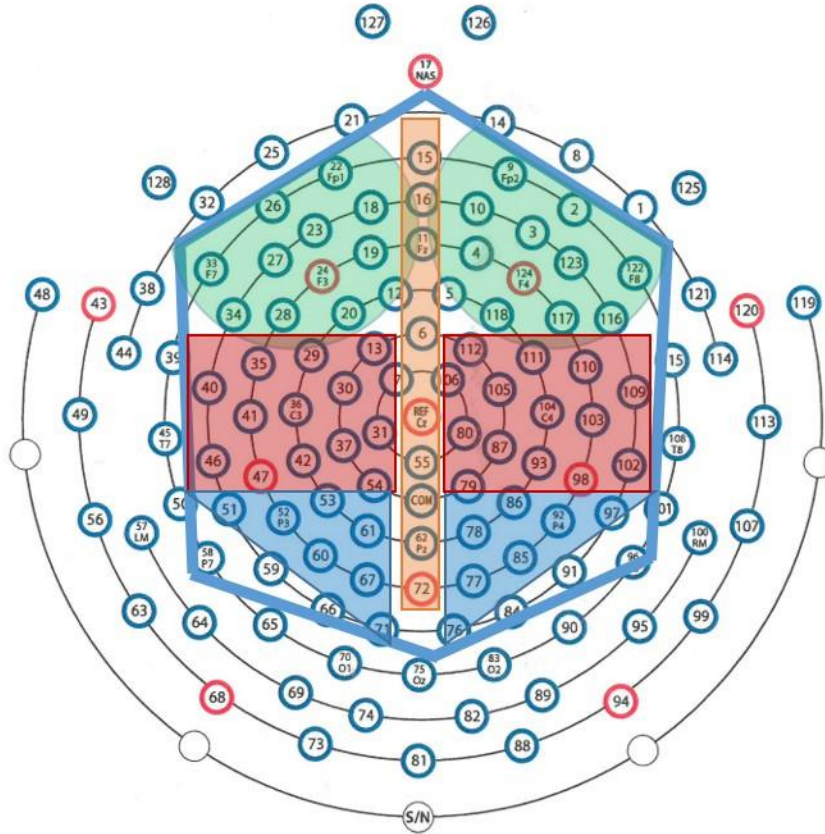


Figure 2. Electrode map for the analysis. Green represents frontal electrodes, red represents central electrodes, blue represents parietal electrodes, and orange are midline electrodes.

In order to keep participants attentive in the task, 36 questions were included. Participants who had more than 30% of their data removed after artifact rejection were not included in the analysis. Four participants were excluded from the analysis because of too many artifacts (> 30%). For the remaining twenty-six participants (14 women, $M_{age} = 20.92$, $SD_{Age} = 1.97$), on average 5.88 trials (13.37%) for the asserted condition and 6.00 trials (13.64%) for the presupposed condition were removed. Results showed that discarded trials did not differ between conditions ($t(25) = .170$; $p = .867$).

Data analysis

The ERP data were analyzed using an RM ANOVA. The dependent variable was the single participant average voltage amplitude for the N400 time interval (350ms – 500ms) and for the P600 time interval (500ms – 900ms). To examine possible topographic differences, the hemisphere (i.e. left, midline; and right) as well as the brain region (i.e. frontal, central and parietal) were entered in the analysis as within participant factors (for the corresponding electrodes see Table 3 and Figure 2). In total, for both time windows, a three-way RM ANOVA was carried out with Content (asserted vs presupposed content), Hemisphere (left, midline and

right), and Brain location (frontal, central, and parietal) as within-subject factors. In case the sphericity assumption was violated, the Greenhouse Geiger correction was adopted.

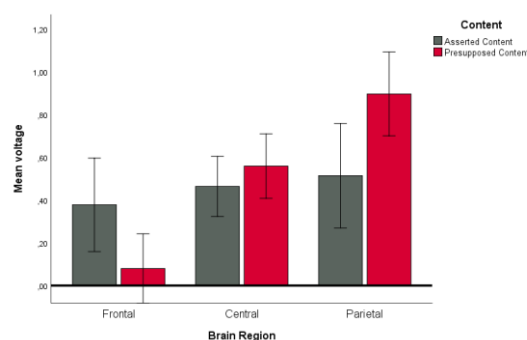
2.2. Results

N400

The RM ANOVA shows that the asserted versus presupposed content do not differ significantly ($F(1, 25) = .205, p = .654$). Furthermore, no significant differences are observed with respect to (i) the interaction Content X Hemisphere ($F(2,50) = 1.380, p = .261$), (ii) the interaction Content X Hemisphere ($F(1.181, 29.519) = 2.914, p = .093$), and (iii) the three-way interaction Content X Hemisphere X Brain region ($F(2.894, 72.347) = .578, p = .625$, see Figure 3).

Figure 3. RM ANOVA on the N400 component (left) and mean voltage of the asserted and presupposed content for each brain region. Error bars represent ± 1 SE.

N400	df	F	P	Partial eta square
Content	1, 25	.205	.654	.008
Content X Hemisphere	2, 50	1.380	.261	.052
Content X Brain Region	1.181, 29.519	2.914	.093	.104
Content X Hemisphere X Brain Region	2.894, 72.347	.578	.625	.023



P600

The exploratory analysis of the P600 shows that there is a significant main effect of content ($F(1, 25) = 19.170, p < .001$). In addition, the two-way interaction Content X Brain region is also significant ($F(1.329, 33.216) = 3.837, p < .05$). The results reveal that the mean voltage of the asserted content is significantly higher compared to the presupposed content for central electrodes ($M_{central_asserted.content} = 1.304, CI: .991 - 1.616$; $M_{central_presupposed.content} = .692, CI: .423 - .961$). The results indicate a significant trend for the interaction Content X Hemisphere ($F(2, 50) = 2.975, p = .06$). Mean voltages for the right hemisphere are higher for the asserted content ($M_{right.hemisphere_asserted.content} = 1.505, CI: 1.153 - 1.857$) than for the presupposed content ($M_{right.hemisphere_presupposed.content} = .886, CI: .583 - 1.189$).

The ERP grand averages for the entire time intervals are depicted in Figure 5.

Figure 4. RM ANOVA on the P600 component (left) and mean voltage of the asserted and presupposed content for each brain region (right). Error bars represent ± 1 SE.

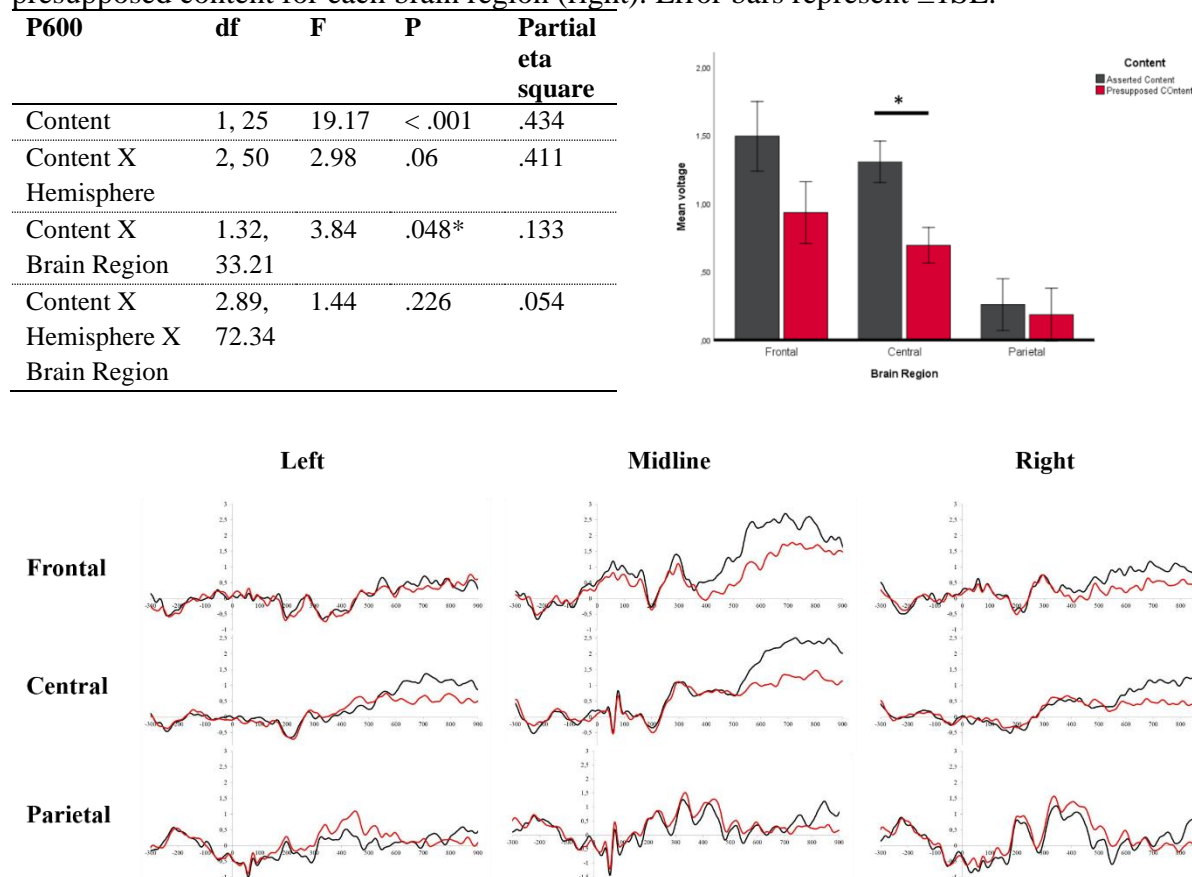


Figure 5. ERP Grand averages for all three brain regions and hemispheres of experiment 1.

2.3. Discussion

The present study investigates felicitous discourse continuations to the asserted and presupposed content in factive verb constructions. It is hypothesized that the non-at-issue content that is the presupposed content elicits an N400 compared to the at-issue-content that is the asserted content. Our results indicate that the event-related potentials between the asserted and presupposed content do not differ significantly in the N400 time interval. On the contrary, a significant fronto-central P600 emerged for the asserted content, which was not predicted a priori. In the following, we will discuss the P600 brain wave for the at-issue-content.

Our results show a fronto-central positivity (P600) for the at-issue content. In general, the P600 is elicited by various syntactic anomalies caused by ungrammaticality or by so-called garden path sentences where a temporal misanalysis must be resolved (for a review see Frierderici, 2011; Friederici, Pfeifer, & Hahne, 1993; Hagoort, Brown, & Groothusen, 1993; Neville, Nicol, Barss, Forster, & Garrett, 1991; Osterhout, & Holcomb, 1992; Osterhout, Holcomb, & Swinney, 1994). Given that this waveform was not predicted by our initial hypothesis, the most plausible explanation is that a temporal ambiguity may have emerged in

the asserted content condition due to the French anaphoric reference *le* which can serve as the link either to the abstract propositional object – asserted content – or to the direct object – presupposed content *le bus* (see Figure 6) (for an overview on the semantics of abstract objects see Moltmann, 2013).

It has been shown that referentially ambiguous anaphors, which inhibit the integration of antecedent information combined with increased WM demands elicit a late positivity (for a detailed review on processing anaphors see Callahan, 2007). An ERP study by Kaan and Swaab (2003) shows that a more complex ambiguous sentence structure preceding the critical verb elicits a P600. The verb *are* as in (20) only has one possible discourse referent, whereas the verb *were* as in (21) has two possible referents that could either be the cake or the pizzas. Kaan and Swaab’s result reveal that sentences with an ambiguous discourse referent as in (21) elicit a P600. Its localization is more frontally distributed than the more frequently reported posterior P600 (for a review see Friederici, 2011). In our current study, we found the same pattern as reported in Kaan and Swaab’s study, that is, a fronto-central P600. Tentatively, the fronto-central P600 found in the current study may have been caused by resolving the ambiguity linking the anaphoric reference *le* to the abstract proposition that is the asserted content.

20. The man in the restaurant doesn’t like the hamburgers that are on his plate.

21. I cut the cake beside the pizzas that were brought by Jill.

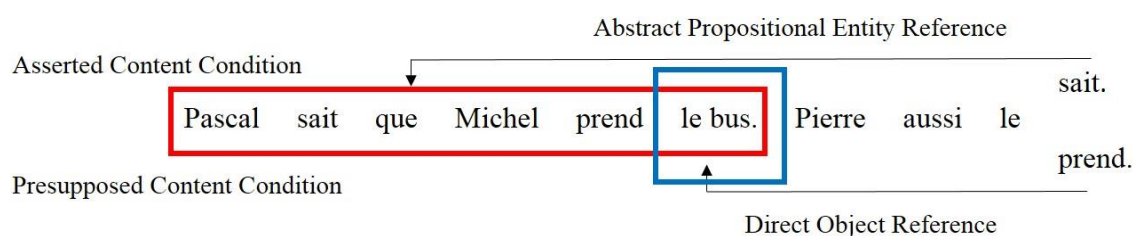


Figure 6. Abstract propositional entity reference vs direct object reference

Consequently, it is important to test whether the higher processing cost during the P600 interval may have overridden any possible processing differences in the N400 interval. For this reason, we designed a follow-up experiment to investigate whether the higher processing cost for the P600 remains present in the absence of an ambiguity. We replaced the anaphora with a more explicit reference. The target verbs are no longer at the end of the sentence; however, its position in the *RSWP* always appeared at the third position as exemplified in (22a) and (22b).

22. Mary sait que Lola prend le bus.

[Mary knows that Lola takes the bus.]

a. Elliot aussi **sait** que Lola prend le bus.

[Elliot also **knows** that Lola takes the bus.]

b. Elliot aussi **prend** le bus.

[Elliot also **takes** the bus.]

3. Experiment 2

3.1. Method

Participants

Thirty French native speakers, aged from 18 to 39 years participated in this research (18 women; $M = 21.8$, $SD = 4.17$). Participants were undergraduate students from the University of Lyon 1, none followed a program in linguistics, and all had normal or corrected-to-normal vision. All participants gave written consent to participate in the study and received monetary compensation. The present study was approved by the ethics committee responsible for the *National Scientific Research Center* of South-East France (CPP Sud-Est II).

Experimental design and Materials

The same stimuli sentences as in Experiment 1 were used. Only the target sentences were modified (see Table 5).

Table 5. Example of an experimental stimulus used and their approximate English translation (Target word in bold)

	Asserted Content	Presupposed content
Context Sentence (Factive Verb Construction) – Self-paced reading	Paul sait que Jean parle l’anglais [Paul knows that Jean speaks English]	
Target Sentence (Rapid Serial Word Paradigm)	Éric aussi sait que Jean parle l’anglais [Eric also it knows that Jean speaks English]	Éric aussi parle l’anglais [Eric also speaks English]
Verification question (after 25% of all experimental items)	Est-ce que Jean parle l’anglais ? [Does Jean speak English ?]	

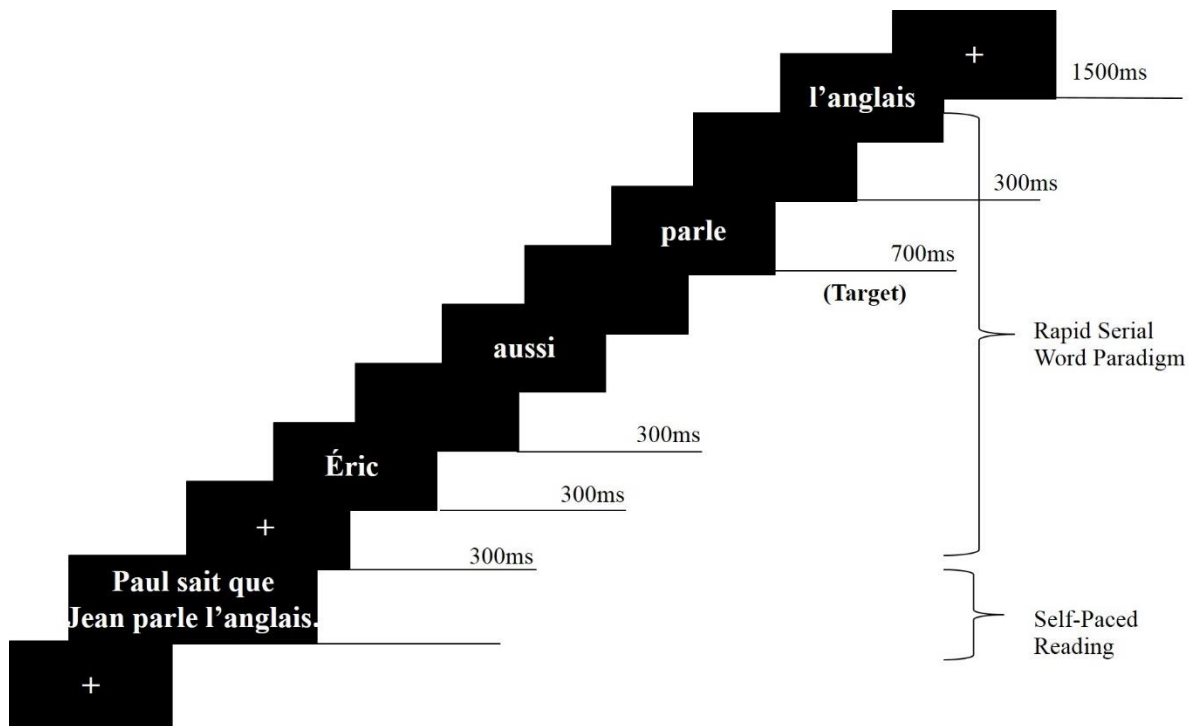


Figure 7. Experimental research design of Experiment 2. Depicted is the presupposed content condition.

Equipment, data acquisition, and procedure were exactly the same as presented in Experiment.

Data analysis

Data analysis was the same as presented in Experiment 1.

In order to keep participants attentive during the task, 36 questions were included. Participants who had more than 30% of their data removed after artifact rejection were not included in the analysis. Seven participants were excluded from the analysis because of too many artifacts (> 30%). For the remaining twenty-three participants ($M_{age} = 22.17$, $SD = 4.67$), on average 5.52 trials (13.37%) for the asserted condition and 6.13 trials (13.64%) for the presupposed condition were removed. Results showed that discarded trials did not differ between conditions ($t(22) = .701$, $p = .491$).

3.2. Results

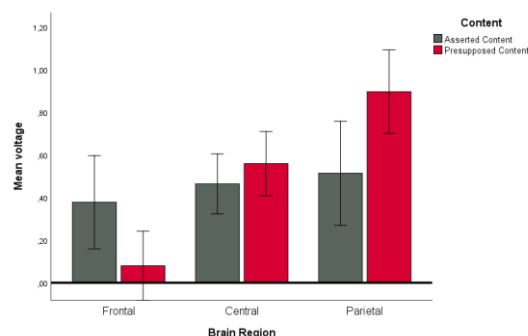
N400

The RM ANOVA shows that the amplitude of the asserted versus presupposed content shows a significant trend ($F(1, 22) = 4.256$, $p > .05$) with respect to the N400 time interval. Furthermore, no significant differences are observed with respect to (i) the two-way interaction Content X Hemisphere ($F(1.182, 25.995) = 3.495$, $p = .067$), (ii) the two-way interaction Content X Hemisphere ($F(2,44) = 1.380$, $p = .261$), and (iii) the three-way interaction Content

X Hemisphere X Brain region ($F(2.883, 63.423) = .918, p = .457$, see Table 6). The mean voltages for the asserted and presupposed content for each brain region are depicted in Figure 8.

Figure 8. RM ANOVA on the N400 component (left) and mean voltage of the asserted and presupposed content for each brain region (right). Error bars represent $\pm 1SE$.

N400	df	F	P	Partial eta square
Content	1, 22	4.29	.052	.163
Content X Hemisphere	2, 44	.70	.504	.031
Content X Brain Region	1.18, 25.99	3.5	.067	.137
Content X Hemisphere X Brain Region	2.88, 63.42	.92	.457	.040

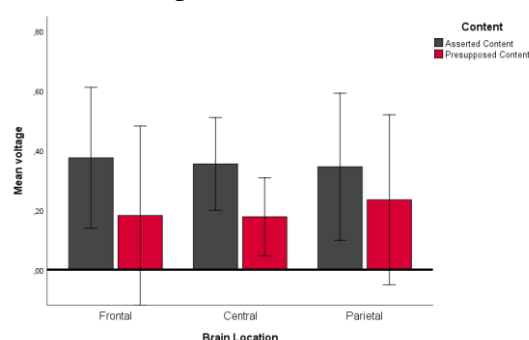


P600

The analysis of the P600 shows that there is not enough evidence that the asserted and presupposed content differ significantly ($F(1, 22) = 1.411, p = .247$). In addition, the results reveal that the mean amplitude with respect to the following interactions is not significant: (i) Content X Brain Region ($F(1.262, 27.774) = .034, p = .966$), (ii) Content X Hemisphere ($F(2, 44) = 1.305, p = .281$), and (iii) Content X Hemisphere X Brain region ($F(2.900, 63.794) = .155, p = .966$; see Figure 9).

Figure 9. RM ANOVA on the P600 component (left) and mean voltage of the asserted and presupposed content for each brain region (right). Error bars represent $\pm 1SE$.

P600	df	F	P	Partial eta square
Content	1, 22	1.41	.25	.060
Content X Hemisphere	2, 44	1.30	.28	.056
Content X Brain Region	1.26, 27.77	.034	.97	.002
Content X Hemisphere X Brain Region	2.90, 63.79	.155	.92	.007



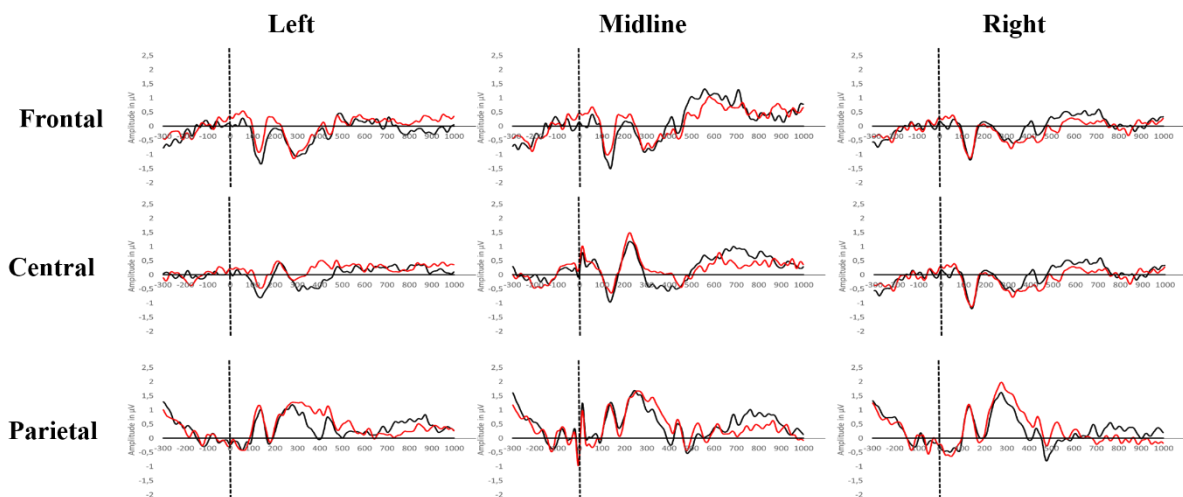


Figure 10. ERP Grand averages for all three brain regions and hemispheres of experiment 2.

3.3. Discussion

The second experiment aimed to assess whether the higher processing cost for the P600 as shown in Experiment 1 remains present in the absence of an ambiguity. Furthermore, it is hypothesized that the presupposed content elicits an N400 compared to the asserted content. Our results indicate that in the absence of ambiguity no significant difference in the P600 time window is found between both contents. In addition, the event-related potentials between the asserted and presupposed content do not differ significantly in the N400 time interval.

4. General Discussion

The two present ERP studies investigate felicitous discourse continuations to the asserted and presupposed content in factive verb constructions. It is hypothesized that the presupposed content elicits an N400 compared to the asserted content. Overall, the results indicate that brain waves for discourse continuations addressing the asserted or presupposed content in factive verb constructions do not differ. Our studies provide no evidence that additive discourse continuations targeting the presupposition of a factive verb construction are cognitively costlier than those targeting the asserted content.

The results of experiment 1 show that there is no evidence for an N400 for the presupposed content. Surprisingly, the asserted content elicited a P600 at fronto-central electrodes. After taking into consideration the results of the second experiment, it is very plausible that this waveform is linked to a more complex ambiguous sentence structure preceding the critical verb in the main content condition. In study 2, the ambiguity preceding the verb was removed. The results show that the fronto-central P600 of the asserted content verb is no longer present. In addition, there is also no evidence of a significant difference

between both contents in the time course between 350 – 500ms for the usually observed central and parietal brain regions.

One may argue that our design was unable to detect possible differences between the asserted and presupposed content in the N400 interval due to the following reasons. Given the use of discourse continuations in which the asserted or presupposed verb was repeated in the subsequent additive sentence, repetition effects may have had an impact on our results. Early research on the N400 component has shown that word repetition attenuates the N400 component in comparison to new words (e.g., van Petten, Kutas, Kluender, Mitchiner, & McIsaac, 1991). In addition, the N400 amplitude is higher to words for a greater lag than for a smaller lag (Nagy & Rugg, 1989). Due to the syntactic constraints of factive verb constructions, the factive complement, i.e. the presupposition, always appeared after the factive verb in both experiments (temporal lag between both verbs was three positions). In consequence, the verb of the factive complement was the most recent verb, which may have attenuated the N400 effect we were looking for. However, recent research shows that context is able to override repetition effects (e.g., Cowles et al. 2007; Swaab, Camblin, & Gordon, 2004). Using written materials, Swaab et al. investigated the impact of prominence. Even though the prominence condition (“*John went to the store after John/he ...*”) had a smaller repetition lag than the non-prominent condition (“*John and Mary went to the store after John/he ...*”), the reported N400 component was higher in the prominent than in the non-prominent condition. In addition, the study by Cowles et al. (2007) presented in the introduction also presents evidence that other discourse factors such as focus misalignment can override repetition effects. As a result, it seems plausible that repetition effects did not attenuate the N400 for the fact presupposed content in our study. We think that the absence of the predicted N400 effect for the factive complement may be linked to another explanation and not simply be a result of the smaller repetition lag of the factive verb complement versus the factive verb.

The standard view on presuppositions indicates that the main content and the presupposition have different discourse attachment properties. For instance, Ducrot (1972) acknowledges that the presupposition is unavailable for discourse attachment. However, he also notes that discourse connectives such as *et* (and) and *si* (if) must be considered as exceptions for his linking law. Our results indicate that *also* must also be exempted from the linkage law as it does not favour the linkage to the asserted over the presupposed content. More precisely, our results reveal that discourse relevant presuppositions appear to be as expected/addressable as the asserted content, which suggests that unavailability to discourse attachment of

presuppositions in factive verb constructions can be overridden by discourse markers, e.g. additive contexts. Such a finding confirms the recent observation by Winterstein (2009) claiming that additive particles can target both contents, that is, the asserted as well as the presupposed content. In consequence, the unavailability to discourse attachment typically displayed by presuppositions may simply be a by-product of discourse structuring and not entirely due to a ‘default’ level of expectedness/addressability between the asserted content and the presupposition.

In question/answer pairs accepting or rejecting the presupposition, Cummins, Amaral and Katsos’ (2012) results clearly indicate that the naturalness ratings decrease significantly when the presupposition is challenged, but not when the asserted content is challenged. This was taken as empirical evidence that discourse moves that target the non-at issue content are considered infelicitous confirming the theoretical *Question Under Discussion* proposal by Roberts (1996, 2012). As proposed by Roberts discourse moves must address the *current question under discussion* in order to be felicitous, which is not the case when the presupposition is re-addressed as it does not move the discourse forward. In contrast to many other presupposition triggers, factive verb constructions may represent a special trigger as their presuppositional behavior may be more sensitive to context and markers of information structure. Consequently, we would also like to discuss our results in the QUD framework.

From the standard perspective of presuppositions (e.g., Gazdar, 1979; Heim, 1992; van der Sandt, 1992), it has been argued that presuppositions, including the complement clause of factive verb constructions, are conventionally triggered: the presupposed proposition does not depend on the context, thus, it is typically considered as context insensitive. In contrast, based on descriptive linguistic analyses and the *Question under Discussion* framework, some authors (e.g., Beaver, 2010; Beaver et al., 2017; Simons et al., 2017) recently challenge the assumption that factive complements are backgrounded by default. Beaver et al.’s (2017) proposal acknowledges that context sensitivity plays, indeed, a crucial role in order to grant the factive complement its presupposed status. According to the authors, in cases where the presupposed content is an answer to the QUD, the factive complement does not exhibit the conventional feature of projection. This usually happens when one speaker contests the claim offered by another speaker (see example 18 in Beaver et al., 2017). Yet, more importantly for our current study is the so-called *Current Question Rule* of the QUD framework:

“The Current Question must contain at least one true alternative, and contains multiple alternatives which are not resolved as true or false in the common ground.”

(Beaver & Clark, 2008, p. 26)

The *Current Question* is tightly linked to the Focus Principle, which represents an informational structural constraint (Beaver & Clark, 2008). For instance, the earlier used factive verb construction in (23) can be uttered in distinct contexts. Firstly, it can provide an answer to the question in (24). In such a scenario (24a) the factive complement is presupposed given that the focus is on the content that carries the true alternative, that is, that it is Mary that knows *p*. However, the same sentence could also be part of a different question as in (25). In such a case, the focus is on the factive complement. According to Beaver et al. (2017), in these cases the factive complement is no longer presupposed.

- 23. Mary knows that Lola takes the bus.
- 24. Who knows that Lola takes the bus?
 - a. [Mary knows]_F that Lola takes the bus.
- 25. What does Mary know?
 - a. Mary knows that [Lola takes the bus]_F.

The QUD framework differs from the standard approach as it acknowledges the importance of information structure, hence indicating the context sensitivity of the presupposition. Even though in our study decontextualized factive sentences were used, our results may suggest that discourse structuring plays a pertinent role. The results of our pretest show that continuations addressing the asserted content to questions like *Does Brian know that Peter takes the bus?* is largely preferred (92%) when compared to continuations addressing the presupposed content since the focus is on the asserted content and not on the presupposed one. Consequently, the presupposition is taken for granted and continuations targeting the presupposed content are considered less plausible. However, if we assume that the backgroundedness of factive complements is not a default scenario, their context sensitivity could explain our ERP results in contexts in which they must be accommodated. More precisely, the findings of our ERP studies indicate that the presupposed content of factive verb constructions using additive discourse continuations appears to be as expected as the asserted content. Such a finding is in line with Beaver et al.’s proposal that the presupposed content of factive verb constructions is not always considered as non at-issue, but the unavailability to discourse attachment typically displayed by presuppositions may simply be a by-product of discourse structuring and not entirely due to a ‘default’ difference between the asserted content and the presupposition.

Beaver et al. (2017) acknowledge that focus can mediate the status of the factive complement. For instance, when manipulating prosody, Tonhauser (2016) found evidence that prosody marking influences whether the factive complement is judged as a speaker's commitment or not. In cases where the focus is on the factive complement, the speaker is judged more likely to be non-committal than in sentences where the predicate is focused. Such a finding highlights once more the importance of information structuring. For future research, it would also be interesting to investigate whether prosody yields similar effects in additive discourse continuations in order to better understand the mediation between information structuring and the interpretation of the factive complement.

Chapter 4

This is the resubmitted version of the following article: Reinecke, R. Nazir, T., Carvallo, S. & Jayez, J. Factive at hand: When presupposition mode affects motor response.

Factives at hand: when presupposition mode affects motor response

Abstract It is well-established that the processing of hand, mouth, and foot-related action terms can activate areas of the motor cortex that are involved in the planning and execution of the described actions. In the present study, the sensitivity of these motor-structures to language processes is exploited to test linguistic theories on information-layering. Human languages possess a variety of linguistic devices, so-called presupposition triggers, which allow us to convey background information without asserting it. A statement such as “*Marie stopped smoking*” presupposes, without asserting it, that Marie used to smoke. How such presupposed information is represented in the brain is not yet understood. Using a grip force sensor that allows capturing motor brain activity during language processing, we investigate effects of information-layering by comparing asserted information (*In the living room, Peter irons his shirt*) with information embedded under a presuppositional factive verb construction (*Louis **knows** that Peter irons his shirt*; Experiment 1) and a non-factive verb construction (*Louis **believes** that Peter *irons* his shirt*; Experiment 2). Furthermore, we examine whether the projection behavior of a factive verb construction modulates grip force under negation (*Louis **does not know** that Peter irons his shirt*; Experiment 3). The data show that only the Presupposed Action verb in affirmative contexts (Experiment 1) triggers an increase in grip force comparable to the one of Asserted Action verbs, whereas the non-factive complement shows a weaker response (Experiment 2) and an even weaker response is observed for projective action verbs (Experiment 3). While the first two experiments seem to confirm the sensitivity of the grip force response to the construction of a plausible *event model*, in which the motor action is represented as taking place, the third one raises the question of how robust this hypothesis is and how it can take the specificity of projection into account.

Keywords: language processing, presupposition, negation, language-induced motor activity

1. Introduction

Human languages possess a variety of linguistic devices, so-called *presupposition triggers*, which allow us to convey background information without asserting it. Among these, we find factive verbs, like *to know*. When someone says *Paul knows that Mary writes a letter*, the verb *know* presupposes the truth of the complement clause that Mary writes a letter and asserts that Paul is certain that Mary writes a letter (Egré, 2008; Kiparsky & Kiparsky, 1970). The former corresponds to the background information, the latter to the foreground or assertive information. Presupposition is, thus, information which is old, previous, or given, or at least presented as such (Stalnaker, 1974). After having been extensively scrutinized from a theoretical perspective (e.g. Beaver, 2001; Gazdar, 1979; Geurts, 1999; Heim, 1983; Karttunen, 1974; Stalnaker, 1974; Schlenker, 2008), presuppositions have been more recently investigated experimentally. The current experimental literature on presuppositions provides insights into the time course of their interpretation as well as into the cognitive costs associated with presupposition processing (e.g. Domaneschi, 2016; Schwarz, 2015).

This paper aims at deepening the understanding of the cognitive underpinnings of presupposition processing by focusing on its sensori-motor correlates. The relationship between language processing and motor activation has received great attention within the field of cognitive neuroscience (see Kiefer & Pulvermüller, 2012; Pulvermüller, 2005; Willems & Casasanto, 2011 for a review) but its implications for linguistic theories have just started to be explored. In this paper, we address the question of whether presuppositional contexts modulate the sensori-motor activation elicited by action verbs. While hand-related action verbs in simple affirmative assertive sentences trigger a response in sensori-motor structures of the brain (e.g. Aziz-Zadeh et al., 2006; Hauk et al., 2004; Tettamanti et al., 2005), it has been shown that it is not always the case in other linguistic environments, such as negation or volitional verbs (*want*, *desire*), (e.g. Aravena et al., 2012, 2014; Zwaan et al., 2010; Papeo et al., 2016; Tettamanti et al., 2008). The question then naturally arises whether hand-related action verbs trigger a similar response when they are part of the presupposition. Answering this question is interesting from two perspectives. First, it would augment our knowledge of the array of contexts in which a sensori-motor response can be evoked. Second, it would contribute to a better understanding of the cognitive status of presuppositional information. In particular, if, as the descriptive and theoretical literature suggests, presuppositions are not the main piece of information in the linguistic message, it is possible that this secondary or peripheral status is reflected in a difference of impact on the sensori-motor system.

In order to convey a more concrete sense of what is at stake, we proceed as follows in this introduction: First, we present a short overview of recent studies indicating the context-sensitivity of sensori-motor activation during language processing. Second, we introduce the linguistic phenomenon of presuppositions and discuss the properties of factive verbs. Finally, we give an overview of the experimental studies presented in the paper.

1.1. Variations in sensori-motor cortex activation during language processing

A large body of evidence shows that sensori-motor cortices are recruited during the processing of action-related language. Early studies highlighted that arm-, mouth- and leg-related words can activate areas of the motor cortex that are involved in the planning and execution of the described actions (e.g. Aziz-Zadeh et al., 2006; Hauk et al., 2004; Tettamanti et al., 2005) in a rapid and automatic manner (Pulvermüller et al., 2005). Furthermore, they revealed that the processing of action verbs can also occur when an action content is not explicitly attended (Gallese & Lakoff, 2005; Pulvermüller et al., 2005). However, these early findings on such a *motor resonance* have more recently been challenged by a series of studies which have questioned the automaticity of word-related sensori-motor activation. More precisely, it has been shown that modality-specific brain activity during action word processing is context-sensitive. For instance, Moody and Gennari (2010) show that this activation is modulated as a function of the degree of effort that is implied by the relevant action. The authors found that premotor cortex activation was strongest in a high effort condition (*The athlete is throwing the javelin*), middle in a low effort condition (*The athlete is throwing the frisbee*) and lowest in a no effort condition (*The athlete noticed the frisbee*). So, the description of distinct actions can differentially activate the same brain region in accordance with the effort which is typically associated with the performance of each action.

Crucially, though, language-related sensori-motor activation is not only modulated by extra-linguistic context but appears also to be affected by the *linguistic* context which embeds the relevant action word. One of the first pieces of evidence that the excitability of motor brain structures depends on the linguistic context comes from studies which focus on the distinction between literal and non-literal uses of language. Aziz-Zadeh et al.'s (2006) results indicate that literal hand-, foot-, and mouth-related action verbs activate similar motor brain structures when actions of the respective type are observed, whereas their non-literal counterpart, in expressions such as *chewing over the details*, *grasping the idea*, and *kicking off the year*, did not elicit the same response. In accordance with this finding, Raposo et al. (2009) also highlight the context sensitivity of action verbs, that is, the fact that context is a crucial factor of how an action verb

is processed. Their data indicate that isolated action verbs (e.g. *grab*) activate motor regions to a higher degree than action verbs in literal sentential contexts (e.g. *The fruit cake was the last one so Claire grabbed it*). In addition, the motor and premotor cortices are not activated when action verbs are presented in an idiomatic context (e.g. *The job offer was a great chance so Claire grabbed it*). Much evidence confirms the substantial difference of activation between the literal and idiomatic use of action verbs (Cacciari et al., 2011; Desai et al., 2013; Lauro et al., 2013; but see Boulenger et al., 2008; Boulenger et al., 2012 – for a detailed interpretation of their different findings see Willems & Casasanto, 2011). Lauro et al. (2013) examine the difference between the literal use of action verbs and three different figurative meanings, i.e. metaphors, fictive-motion, and idioms. Their results point out that literal and idiomatic uses of action verbs appear to be endpoints of a motor brain activation continuum, that is, literal action verbs activate premotor brain areas, whereas action verbs that are part of an idiom do not. Metaphors like *Paul throws his sadness away* range between these two poles of the continuum. This intermediate status is typically explained by arguing that even if metaphors depict action simulations that are impossible to perform, the comprehension process relies on past body related experiences in order to correctly infer the metaphorical meaning (for a theoretical view see Gibbs et al., 2004; Gibbs, 2006).

The linguistic modulation of sensori-motor activity is not limited to the literal/non-literal distinction as other linguistic factors have also been shown to be critical. Firstly, the same action word embedded in a negated sentence (*I do not push the button*) does not activate the brain's motor structures in the same way as in affirmative sentences (e.g. Aravena et al., 2012; Tettamanti et al., 2008). Furthermore, no language-induced motor activity is present when action words are embedded within a volitional context (*Fiona wants to sign the contract*) (Zwaan et al. 2010; Aravena et al., 2014). However, motor structures can be activated by a gapped verb, that is when the context sets up an expectation of an upcoming motor-related action such as in “John closes a juice bottle and Jim [] a lemonade bottle” (Claus, 2015). Altogether, these studies highlight that contextual manipulations of lexical properties – interpretation of metaphors and idioms, the presence of a negation operator, a volitional or a gapped verb – have an impact on the involved brain structures.

Contextual manipulations that involve discourse properties also have an impact on the elicited sensori-motor activation. For instance, van Ackeren et al. (2012) showed that a sentence such as *It is very hot here* can be processed in different ways. In a context where this utterance can be interpreted as an indirect request of action – seeing a picture of a window (which triggers

the indirect request *open the window*) – cortical motor areas are activated, whereas this is not the case when the utterance is not interpreted as an indirect request – seeing a picture of a desert (for related findings see also van Ackeren et al., 2016; Egorova et al., 2014). These findings provide the first evidence that sensori-motor activation is elicited even when the information is conveyed implicitly and must be inferentially derived in order to understand what is meant (an implicature in the sense of Grice, 1975). Van Ackeren et al.’s (2012) results highlight that discourse properties – such as the layering of information realized by the distinction between what is literally said and what is implicated – also drive sensori-motor activation. Thus, it appears worth extending these findings and investigating how further interactions of language and context play an active role in modulating the sensori-motor activation elicited by action verbs. We now turn to the phenomenon of linguistic presupposition, which is assumed information beyond what is said and what is implicated.

1.2. Presuppositions

Linguistic presupposition is a type of information which is triggered by the presence of certain linguistic expressions (*presupposition triggers*) and is conveyed in discourse as part of the background of the conversation. A variety of distinct linguistic forms such as definite descriptions as in (1), change of state verbs as in (2), iterative adverbs as in (3), wh-question as in (4) and constructions like temporal clauses as in (5) trigger presuppositions (for an extensive list see Levinson, 1983).

1. I have to pick up my sister at the airport.
 - a. I have a sister. (Presupposition)
2. Peter stopped smoking.
 - a. Peter used to smoke. (Presupposition)
3. Barack Obama was elected again.
 - a. Barack Obama was elected before. (Presupposition)
4. When did Michael leave the house?
 - a. Michael left the house. (Presupposition)
5. Before Strawson was even born, Frege noticed presuppositions.
 - a. Somebody named Strawson was born. (Presupposition)

As can be seen from these examples, presupposition triggers are often used without even noticing it and are ubiquitous in discourse. In contrast to implicatures, which are heavily dependent on inference, the presuppositional layering is *coded* as a property of constructions. The presupposition triggers of interest in our study are *factive* verbs, which presuppose that

their complement clause expresses a *true* proposition (Egré, 2008; Kiparsky & Kiparsky, 1970). For instance, in (6) the factive verb *know* presupposes that Mary writes a letter (6b) and asserts that Paul is certain that Mary writes a letter (6a). It is important to note that the speaker is committed to the truth of the content she conveys by using the presupposition (Peters, 2016).⁴² Similarly, several authors, including for instance Geurts (1999) and Reboul (2017) note that presuppositions are not cancellable or defeasible, hence the oddness of a sentence like in (7), where the presupposition is negated. Presuppositions are typically part of the common ground, that is, the set of beliefs shared by the participants. In this line, presuppositions are not considered as the questions under discussion – not *at issue* in the current linguistic terminology – since they are taken for granted and (presented as) admitted by the participants (Ducrot, 1972; Stalnaker, 1974). Along these lines, presuppositions are considered to condition the appropriateness of an utterance. Using the sentence in (6) out of the blue would lead to presupposition failure (Stalnaker, 2002) because the presupposition of (6b) is not yet part of the common ground. Presupposition failure may result into accommodation, that is, the process by which the hearer accepts the presuppositional content as true and includes it into her set of beliefs (Heim, 1983; Lewis, 1979).

6. Paul knows that Mary writes a letter.

- a. (6a) Paul is certain that Mary writes a letter. (Assertion)
- b. (6b) Mary writes a letter. (Presupposition)

7. Mary didn't write a letter and Paul knows that she wrote a letter.

Recent experimental investigations comparing contextually satisfied versus accommodated presuppositions indicate that accommodated presuppositions are integrated rapidly (for a review, see Schwarz, 2015). However, in the accommodation condition, higher processing costs are involved with respect to the triggering point, that is, at the position of the presupposition trigger and with the word that immediately follows the presupposition trigger (EEG study by Domaneschi et al., 2018; self-paced reading study by Tiemann et al., 2011; Domaneschi & Di

⁴² This does not entail that the speaker believes the presupposition. As pointed out by a reviewer, it is sufficient that the speaker *accept* the presupposition in the terms of Stalnaker (2002), that is, treat it as true, no matter whether she believes it or not. However, the speaker remains committed to the truth of the content conveyed by the presupposition. In some cases, this content does not correspond to the literal meaning. For instance, recycling an example of Stalnaker, two speakers could use deliberately a description that they know to be inappropriate, just because they also know that it has been used to successfully identify an entity. For instance, they could agree to designate a man drinking sprinkling water by *the man with a martini* because they have believed at some point that the man in question was actually drinking martini. In such a case, they are *not* committed to the truth of the literal description but to the truth of a related, but different, description: *the man that we designated by the property of drinking a martini*.

Paola, 2017; eye-tracking study by Tiemann & Schwarz, 2012). More precisely, in a sentence like *Peter stopped smoking*, the verb *smoking* elicited a biphasic N400/P600 in the accommodation condition, that is, when no information about smoking had been provided a priori in comparison to the satisfaction condition, where prior information about smoking has been provided (Domaneschi et al., 2018). Nevertheless, these higher early sentential processing costs fade away towards the end of the sentence and do not have an impact on the accuracy ratings and on the response time to a question regarding the accommodated presupposed content (see for instance the behavioral results of Domaneschi et al., 2018; Domaneschi & Di Paola, 2019). Further evidence that accommodated presuppositions come with an early extra processing cost but are integrated rapidly is provided by Masia and colleagues (2017). The authors directly compare event-related potentials recorded during the processing of assertive and presupposed content, in which indefinite descriptions like *a migration* vs definite descriptions like *the migration* were used. For the latter, the presupposition – a specific migration – had to be accommodated and was not satisfied a priori. The authors observed a larger N400 for the presupposition condition, which is compatible with the hypothesis of an extra processing cost during processing the accommodated presupposition. Such a result fits well with the nature of the N400 component, which is usually linked to semantic or thematic relations (for a review, see Kutas & Federmeier, 2011). In the case of a definite, the hearer does not have a rich expectation about the upcoming word, given its prior absence in discourse, consequently an N400 is elicited. However, this effect, at least for definite descriptions, is only transitory since no associated P600 effect was observed by the authors. The P600 usually reflects discourse updating, that is the resolution of a prior incongruence (Friederici, 2002). Masia et al.’s finding shows that in the case of definite descriptions the information of the presupposition does not generate an incongruence, hence the absence of a P600. Such an immediate integration “may be most naturally compatible with accounts that all assume presupposed content [to] be encoded conventionally” (Schwarz, 2016; p. 286). Further evidence regarding the immediate availability of the presupposed content comes from eye-tracking studies using the visual world paradigm. These studies show that, after the onset of the presupposition trigger, fixations shift immediately to the picture containing both asserted and presupposed information, that is, depicting the presupposed and asserted content in one picture (see Romoli et al., 2015; Schwarz, 2014 for *also* and *stop*). In conclusion, processing presuppositions comes with an additional cost when the presupposition is not yet part of the common ground; however, such a cost, if present, only appears to be detectable on-line and fades away rapidly.

1.3. Presupposition Projection

Further evidence of the difference between asserted and presupposed content comes from linguistic tests and from criteria such as the so-called *projection* property of presuppositions: When an operator that suspends or shifts the truth value is applied to a sentence containing a presupposition trigger, it affects the asserted piece of information but, in general, not the presupposition. For instance, the negation of the factive verb in (8), denies that Paul is certain that Mary writes a letter, that is, it alters the meaning of the asserted content in comparison to the sentence in (6). However, the presupposition remains untouched, that is, the negated sentence still presupposes that Mary writes a letter, exactly as the positive sentence in (6) does. This and similar observations on questions as in (9) and on modal verbs as in (10) correspond to what linguists have called *presupposition projection* (see for instance Chierchia & McConnell-Ginet, 1990; Ducrot, 1972; Geurts, 1999; Heim, 1983).

8. Paul does not know that Mary writes a letter.

9. Does Paul know that Mary writes a letter?

10. Paul might know that Mary writes a letter.

After extensive scrutiny in the descriptive and theoretical literature, the projection phenomenon has also received some experimental examination. For instance, Chemla and Bott (2013) investigated the strength of the projection effect in factive verb constructions and found evidence that the projective interpretation was derived faster than the non-projective interpretation. Similarly, using a picture selection task, Romoli and Schwarz (2015) show that the projective interpretation is preferred and chosen significantly faster. Such results suggest that presuppositions have a behavioral correlate when processing the presupposed content of a negated assertion.

In contrast to factive verbs, non-factive verb constructions as in (11) impose no constraint on the truth-value of the embedded *that*-clause (for an overview on factive and non-factive mental states see Nagel, 2017). As noted earlier, the sentences in (12) and (14) presuppose the truth of the complement, whereas its truthfulness in (11) and (13) may depend, among other factors, on the reliability of Paul (Nagel, 2017).

11. Paul thinks that Mary writes a letter.

12. Paul knows that Mary writes a letter.

13. Paul does not think that Mary writes a letter.

14. Paul does not know that Mary writes a letter.

1.4. The Present Research

Our study is aimed at (i) investigating the cognitive correlates of presupposition processing and, at the same time, (ii) extending our current understanding of which linguistic contexts modulate motor brain structures. The phenomenon of presupposition is special in three respects.

(1) As mentioned above, motor resonance during the processing of action verbs is not observed within sentential environments that involve negation (Aravena et al., 2012; Tettamanti et al., 2008; Papeo et al., 2016) or volitional verbs (Aravena et al., 2014; Zwaan, et al., 2010). A straightforward interpretation of these observations is that the discourse or situation model (cf. Zwaan and Radvansky, 1998) constructed by listeners in such cases does not include the *event*, which, consequently, does not generate a motor response (see Aravena et al., 2014). Sensori-motor activation is triggered when the action of the corresponding verbal group actually takes place. Taylor and Zwaan (2008) called this the *Linguistic Focus Hypothesis*. In this line, saying that *Paul does not throw the ball*, for instance, leaves no room for an event of throwing a ball in the situation model. If presuppositions are considered as true by default, they are part of the depicted situation and should therefore trigger a motor response whenever a motor action is involved (e.g. the word *writes* in a factive verb construction as in (12)). Contrariwise, if presuppositions are peripheral information, one could also expect that they will not elicit the same response as assertions. Our study will shed light on how presuppositions are processed in the motor brain structure.

(2) Most of the currently available observations and experiments on presuppositions concern linguistic operators or contexts (e.g. for aspectual verbs and definite descriptions, Domaneschi et al., 2018; for *wieder (again)*, Schwarz & Tiemann, 2012, for processing factives versus non-factives, Shetreet et al., 2019). Operators like negation or interrogation reveal projection properties, while contexts are relevant to the discourse-based properties of presupposition triggers, like satisfaction or accommodation. In contrast, we have only scarce information (mostly syntactic) about possibly *intrinsic*, that is context-independent, properties of triggers. Does a presupposition in a simple decontextualized assertive sentence have cognitive properties that distinguish it from an assertion or are such properties visible only in richer environments (embedding operators, or the presence of an explicit context)? Given that a large part of the literature on motor resonance focuses on isolated words or simple sentences, it is necessary to design experiments that allow testing these intrinsic properties of presupposition triggers.

(3) Studying presupposition triggers raises the question of which trigger(s) to use in experiments. Factive verb constructions are a particularly interesting starting point from different aspects. First, with factives, the assertive and presupposed contents are explicitly expressed at the sentential level, which is a unique characteristic when compared to other presupposition triggers such as so-called *aspectual* verbs⁴³. This explicitness allows one to directly compare the presupposed content of *Paul knows that Mary writes a letter* to an assertion such as *Mary writes a letter* without making an effort to infer the implicit presupposed content as with other presupposition triggers. Second, it was shown that, in otherwise totally parallel clausal complement constructions, factive verbs (*know*-type) presuppose the truth of its complement clause, whereas non-factive verbs (*believe*-type) do not commit one to the veracity of their complement clause. Therefore, it makes sense to investigate whether this distinction also has a cognitive motor resonance counterpart.

On these grounds, we present three experiments, in which a grip force sensor is used to monitor variations of grip force between thumb and index finger after the onset of a critical word (a hand-related action verb in our case). A word-induced increase of grip-force can be interpreted as an incomplete inhibition that arises from primary motor cortex activity (Aravena et al., 2012; 2014; Jeannerod, 1994). Previous research has shown that the grip force plays an essential role with respect to the predictive and reactive control of the capacity to hold and lift objects (for a review see Delevoye-Turrell & Wing, 2005). Healthy adults, whose anticipatory predictive and reactive control is intact, easily adjust grip force to the mass and texture of an object (Johansson et al., 1984). Crucially, previous studies have demonstrated the link between grip force and motor brain activity: the primary, premotor, supplementary and cingulate cortical motor areas play a crucial role when information is sent via spinal motor neurons to the finger muscles (e.g., Dum & Strick, 1991; Lemon, 1993). Moreover, recent neurophysiological evidence using the fMRI technique showed that when gently holding an object, grip forces activate the left primary sensorimotor cortex, the ventral premotor cortex and the left posterior parietal cortex (Kuhtz-Buschbeck et al., 2001). By investigating grip force in a healthy adult population, it has been demonstrated that subtle grip force variations have also been observed during language processing depending on the action status. When comparing action verbs and non-action related

⁴³ The term *aspectual* in this context denotes *change of state* or *transition* verbs like *begin*, *stop*, *resume*, *interrupt*, *continue*, etc. Their presupposed content is entailed by default. The sentence *Mary stopped smoking* asserts explicitly that *Mary does not smoke* and presupposes that *Mary used to smoke*.

nouns, Frak et al. (2010) found that grip force variation increased for the former but not for the latter. This finding was extended to verbs by Aravena et al. (2012, 2014) and Nazir et al. (2017), with a direct comparison of action and non-action verbs.

Grip-force variation is typically measured while participants actively listen to auditory stimuli. Using this tool, the following three research questions will be addressed:

(RQ1): Does the presupposed (action-related) content of factive verb constructions elicit an increase in grip force?

The first experiment addresses the issue whether a piece of information which is (i) true but (ii) syntactically marked as backgrounded activates motor brain structures. As noted above, the hybrid status of presuppositions (they are true but secondary) fosters doubt about which prediction is a priori the most plausible. Presuppositions are part of the situation model; however, their marginal status compared to an assertion may impact the processing in motor brain structures.

(RQ2): Does the entailed (action-related) content of non-factive verb constructions elicit an increase in grip force?

The second experiment directly compares the action-related content of an assertion to the non-factive complement. The a priori plausible predictions depend on the results of the first experiment. If the presupposition of factive verbs has a sensori-motor impact in virtue of being true, it is expected that this impact is weaker or absent with non-factive verbs, since the truth of the embedded clause is not guaranteed.

(RQ3): Does the presupposed (action-related) content of negative factive verb constructions elicit an increase in grip force?

The third experiment addresses the projection phenomenon of factive verb constructions. Again, if Experiment 1 provides evidence for some sensori-motor activation due to the truth of the presupposition, it is expected that a projective reading (i.e. where the presupposition is not negated) is preferred in projective environments; thus, giving rise to an increase of motor activation comparable to that observed in Experiment 1.

2. Method

In the following we will describe the general method that applies to all experiments. Further details are provided in the respective method sections of the individual experiments.

The present study was approved by the Ethical Committee CPP (Comité de Protection des Personnes) Sud-Est II in Lyon, France.

Participants

Participants were French undergraduate students and native speakers of French. They had normal or corrected to normal vision, no history of neurological or psychiatric disorders, and were right-handed as attested by the Edinburgh Handedness questionnaire. All participants gave an informed written consent and were informed that they could end the experiment at any moment. They were paid for their participation.

Stimuli

All stimuli sentences contained hand-related action verbs involving grip actions⁴⁴, except the control sentences, which contained non-action verbs. Sentence specific characteristics are detailed in the method sections of the individual experiments. All stimuli are provided in the Supplementary Material⁴⁵.

⁴⁴ As pointed out by a reviewer, the hand-relatedness of the experimental stimuli does not guarantee that the observable effects are limited to the hand. This is quite true. There is no strong specificity of the motor activation in relation to category of action. For instance, Boulenger et al. (2006) showed that, in a reaching-and-grasping task, hand-related and leg or mouth-related action verbs affected the movement kinematics. However, the hand-related action verbs had the strongest effect. Other studies suggest that there is at least a partial somatotopicality of the action lexicon (see references in Boulenger et al., 2006, pp. 1607-1608). In the context of the present paper, it is not crucial to decide whether hand-related action verbs trigger a (partially) specific activation or a more general one, since what we investigate is whether motor activation, whatever regions it concerns, is modulated by the linguistic status of certain clauses.

⁴⁵ All stimuli, participants' collected data, and figures can also be found here: https://osf.io/jkbh3/?view_only=84b88ca56e7347b987b0d24099dec9e2

Measures and pre-tests

The hand-related action verbs were selected in two steps. First, 20 participants rated a list of 120 hand-related action verbs as to the likelihood that the verb refers to a manual action, using a 5-point Likert scale: (1) never, (2) rarely, (3) sometimes, (4) often, and (5) always. Second, for the 66 verbs that received a rating of at least (4), another group of 58 participants was requested to complete a list of sentences containing the selected verbs (e.g. *Ines ties _____*). We randomly divided the 66 verbs into two lists, each containing 33 verbs. Participants were randomly assigned to one of the two lists. Sentences which met the following criteria were included in the study: (1) Sentence completion was related to a manual activity and (2) the mean cloze probability for the chosen continuation was at least 25%. A final list of 37 sentences served as stimuli for the grip force study.

Recording

The stimuli for all the experiments were recorded in a sound booth by the same female speaker with a Roland Edirol R-09, at a 48KHz sampling rate with 24-bit digitalization. Special care was taken that the speaker maintained a relatively flat prosody and avoided any loudness or pitch variation on the critical words (i.e. the verb and the noun).

Equipment and data acquisition

Two distinct computers were used for data recording and stimulus presentation, in order to ensure synchronization between audio files and grip-force measurements (estimated error < 5 milliseconds). The first computer read the playlist of the pseudo-randomized stimuli. The second computer recorded the incoming force signals from the load cell at a high sampling rate of 1000 Hz. To measure the activity of the hand muscles, a 6-axis load cell of 68 g was used (ATI Industrial Automation, USA, see Figure 1). Like in previous studies (e.g. Frak et al., 2010; Aravena et al., 2012;2014; Nazir et al., 2017), only the three main forces were recorded: the longitudinal (Fx), radial (Fy) and compression forces (Fz), respectively (Figure 1B).

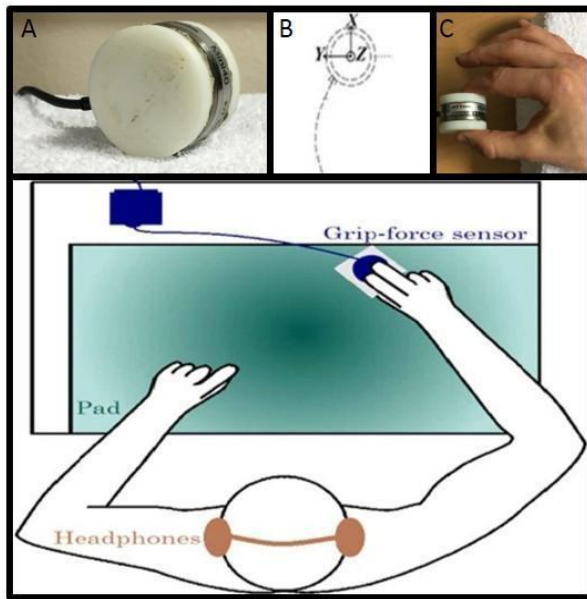


Figure 1. Experimental Material and Settings

Procedure

Participants wore headphones and were comfortably seated behind a desk on which a 15 cm high box was placed. They were asked to rest their right wrist on the box. Their hand was detached from the box, that is, it was free-standing and not in contact with the table when participants held the grip-force sensor with their right hand (see Figure 1C). The experimenter demonstrated the correct way to hold the grip force sensor and participants were requested to hold the cell with a constant force, measured as 1.5 Newton (N). The thumb and index finger remained on the load cell during each block.

The experiment started with a training session of two blocks (in total, 21 stimuli), in which instructions about the experiment were given. In this session, the participants got familiarized with the task and had the opportunity to ask any question they found relevant. When they felt ready, the experiment started. Participants had to listen to 111 stimuli, distributed into 10 blocks, 9 blocks of 11 stimuli and a final block of 12. In order to avoid muscular fatigue, a 30-second pause occurred between two consecutive blocks, but the participants could ask for more if they judged that they needed more time to relax. At the beginning of each block, they had to control their initial grip force and adjust it to 1.5 N, using the screen to monitor their performance. The experimenter informed the participant and started the auditory presentation as soon as the mentioned grip force level was met and no fluctuations occurred. Participants kept their eyes closed for the duration of each block. At the end of each block, they put down the cell and a question with respect to the Action/Non-Action related verb appeared on the

(A) A standalone 6-axis load cell of 68 g was used (ATI Industrial Automation, USA). (B) The directions of the recorded forces: longitudinal (F_x), radial (F_y), and compression (F_z). (C) Participants held the grip-force sensor with their right thumb and index. Their wrist was placed on a 15 cm high box. **Bottom panel:** Participants wore headphones and were comfortably seated behind a desk on which a pad was placed. They were asked to rest their arms on the pad when holding the sensor.

screen in front of them, which had to be answered by using the left (“yes”) or right (“no”) button of the mouse. The total length of each experiment was approximately 25 min. Participants were debriefed at the end of the experiment.

Data Analysis

Data processing and visualization were carried out in *R* (R Core Team, 2019) using a number of specialized libraries, most notably *stats* (R Core Team, 2019), *lme4* (Bates, Maechler, Bolker & Walker, 2015), *forcats* (Wickham, 2019) and *ggplot2* (Wickham, 2016).

Prior to data analysis, each signal component was pre-treated in order to eliminate the electro-magnetic oscillations of the cell. We used the function *loess* implemented in basic *R*. This function derives its name from the contraction of *LOcally weighted Scatterplot Smoother*. It replaces every point of a scatter plot by the average of a weighted linear regression calculated on neighbor points. More precisely, starting from any value y at position x , the algorithm (i) selects points in an interval provided by the user, (ii) calculates a regression line over these points, giving more weight to the points closer to x , (iii) returns the value of the regression equation at x . The oscillating waveform is thus replaced by a smooth curve. A visual trial-and-error procedure led to an interval of 0.15, meaning that 15% of all the points were kept around each value to estimate the regression line. The result of this preprocessing is illustrated in Figure 2, where the initial series of peaks is replaced by the white curve.

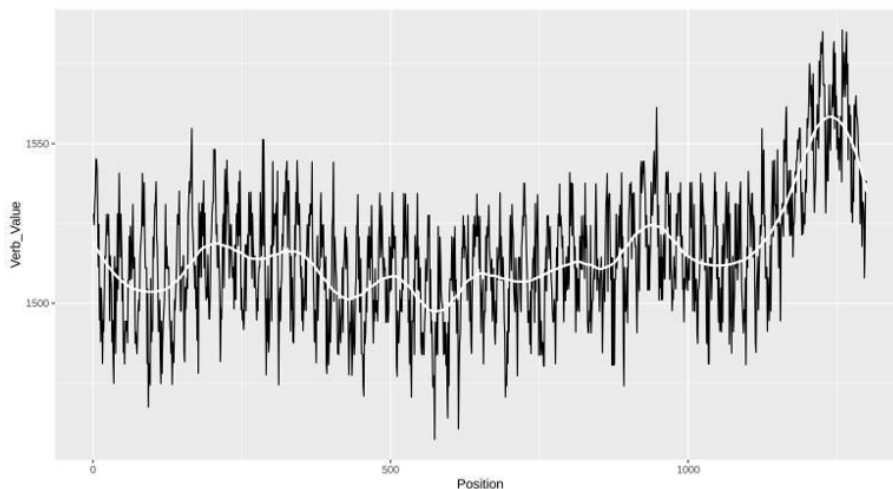


Figure 2. Replacing the oscillating waveform with the loess function in *R*

Finally, a baseline correction was performed from -300 to 0 ms prior to target onset. This correction was implemented because of a possible global change in grip-force during the session (≈ 25 min per participant), and because we were only interested in grip-force changes. Thus, we adjusted the post-stimulus values by subtracting the baseline values from all of the

values in the epoch. Given that the participants were asked to hold the grip-force sensor throughout the experiment, a ‘negative’ grip-force refers to a lesser grip-force and not to the absence of grip-force, which is impossible in this context (the cell would just fall).

Only F_z (compression force) was included in the analysis because this parameter was determined to be the most accurate indicator of prehensile grip-force (e.g. Frak et al., 2010). Since the expressions describing hand-related actions using a verb *and* a noun phrase, as in *tie* (verb) *her shoes* (noun phrase), we analyzed possible effects not only after the onset of the verb (either a hand-related action verb or a non-action verb), but also after the onset of the noun. Using the *Praat* software (Boersma & Weenink, 2019), the F_z signals were segmented offline. The temporal distance between the verb and the noun phrase varies across stimuli. A preliminary visual investigation had shown that, on average, the noticeable effects occur in the 300-1000 ms region after verb onset (for very similar time windows, see also Aravena et al., 2012; 2014). However, in order to detect possible more fine-grained variations at later stages, we included a larger region, extending until 1000 ms after the ‘latest’ noun, that is the noun with the largest distance from the onset of its verb. This resulted into a 2305 ms time span for the first and second experiments (maximum interval between noun onset and verb onset = 1005 ms), and a 1958 ms time span for the third experiment (maximum interval between noun onset and verb onset = 658 ms). We also studied an even later temporal window, a point to which we return when presenting the third experiment in Section 3.3.

Before starting the statistical analysis, we inspected the average time- F_z plots for each participant in order to detect *negative drifts*, that is global and systematic decreasing curve slopes during the first 1000 ms after verb onset. This might indicate that the participant did not hold the cell with sufficient pressure, due to inability, stress or misunderstanding. An example of negative drift is given in Figure 3 (participant 16 in experiment 3).

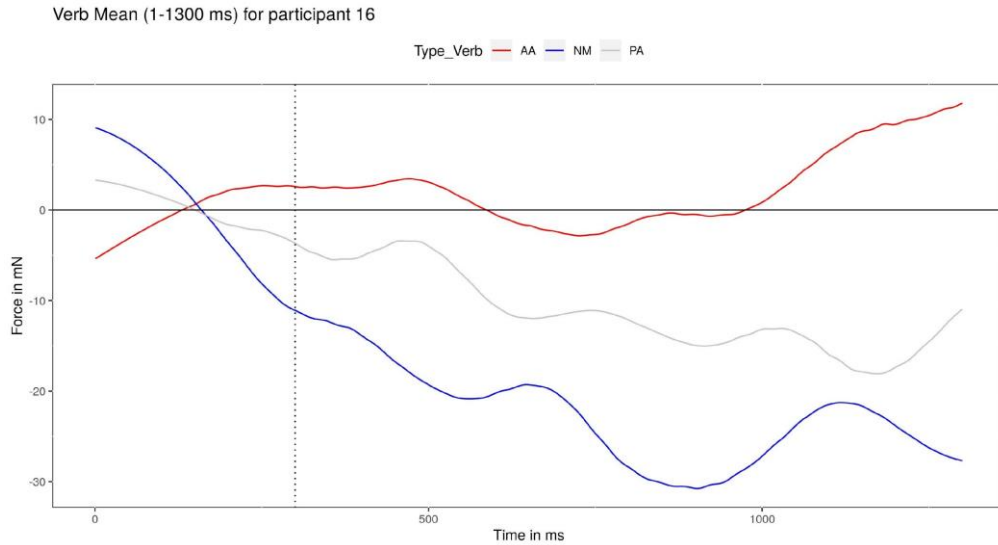


Figure 3. An example of negative drift

Although there is large variation across participants, a rapid (during the first 1000 ms) and uniform decrease in intensity is unusual. We preferred to ignore the contribution of participants with negative drifts because there was the risk of incorporating data which did not correspond to the experimental conditions. Moreover, following the filtering options of Aravena et al. (2012, 2014), we also eliminated trials that showed points above 200 mN or below -150mN. To detect such points, we chose a relatively large time window starting from verb onset to 500 ms after noun onset. All the final data sets are provided in the Supplementary Material.

The statistical analysis is a bit technical. To keep the focus on the results and their interpretations, we provide only a compact summary in the rest of this section, leaving a more detailed exposition to the appendix. We analyzed the grip force variations using two strategies. First, we ran linear mixed-effects models in a (constant shift/constant span) moving window setting. Specifically, the variations for the different conditions were statistically compared over 300 ms intervals (constant span). The endpoints of the 300 ms time interval were gradually shifted to the right by 100 ms (constant shift). So, 1-300 ms, 101-400 ms, 201-500 ms, 301-600 ms, etc. time-windows were investigated in succession. The chosen models were *maximal*, in the sense of Barr et al., 2013⁴⁶. In the context of our experiments, this means running models with the structure described in Table 1.

⁴⁶ Given that we have no interaction structure, the problem of negotiating type I error against power loss does not occur here (Bates et al., 2015; Matuschek et al., 2017).

Table 1. *Structure of the maximal mixed-effect models*

Fixed effect	Random effect 1	Random effect 2
Intensity of grip force (dependent variable) in function of condition (independent variable)	Participant (intercept and slope)	Item (intercept)

The fixed effect measures the dependence of grip force on condition (like in any standard linear model with categorical independent variables). The first random effect takes into account a possible individual sensitivity of participants to (i) the experimental device, for instance in relation to their particular grip force strength and (ii) the various conditions. The second random effect takes into account possible differences between the various items (sentences) presented to participants. While the fixed and first random effects are only marginally different from what a standard ANOVA with repeated measures estimates, the second random effect makes a genuine difference and contributes to seriously limit the type I error rate, making this type of maximal model the currently recommended choice for most behavioral experiments in psychology (Brauer & Curtin, 2018; Singmann & Kellen, 2020).

However, it turns out that our data are not linear. As a result, although linear mixed-effects models provide us with an approximation, it is safer to complement them with non-parametric measures and to accept the existence of an effect only if all the tests agree on its direction. Specifically, we started from the grip force values observed for *items and participants*. For each 300 ms time window, each participant and each item in each condition, we recorded the mean of the item. We ranked the items by means in ascending order and, for each pair of conditions, compared their grip force values for each time point. An item was considered as ‘winning’ over its competitor if the former had at least 1.5 more higher values than the latter. Otherwise the competition resulted in a ‘tie’. To illustrate, in the factive experiment (Experiment 1), the first two rows of the comparison table are as follows (Table 2).

Table 2. An example of time window ‘participant’ contrast pair comparison. First two rows of the global count table for Experiment 1. (NA = Non-Action, PA = Presupposed Action)

Window	Comparison	Part.	Items	Winners	Losers	W. Counts	L. Counts
1-300	NA-PA	1	ruine (<i>ruins</i>) vs. voit (<i>sees</i>) - caresse (<i>caresses</i>)	tie	tie	159	141
1-300	NA-PA	1	impose (<i>imposes</i>) vs. sait (<i>knows</i>)- peigne (<i>combs</i>)	PA	NA	259	41

The first three columns indicate that we are in the first time window (1-300 ms), comparing items of type Non-Action (NA) and Presupposed Action (PA) for participant 1. The *Items* column contains abbreviated names for the item pairs. Remember that, for each pair, the item of type Non-Action (e.g. an item containing a verb phrase of the form X *Ruine*_{NON-ACTION} Y) occupies the same rank as the item of type Presupposed Action (e.g. an item containing a verb phrase of the form X *Voit*_{FACTIVE} que Y *Caresse*_{ACTION} Z). The *Winners* (*Losers*) column shows the winners (losers) and the last two columns the corresponding figures. In the first row, there is a tie because the count difference is small (18 values). In the second row, the PA items has more than six times more higher values than the NA item.

We can extract various information from this initial table. The most important ones are (i) the total counts and (ii) the counts by participant. The total counts are the sums of counts across participants for each condition, *excluding* the counts of ties. We used count sums to compare differences between conditions by means of Fisher tests. For instance, in the factive experiment, we compared the count sum contrast between Action and Non-Action with the count sum contrast between Action and Presupposed Action. Is one of these contrasts significantly bigger than the other or are they in the same order of magnitude? The counts by participant are, for each temporal window and pairs of conditions, the numbers of winners in each condition for each participant, again excluding ties. For instance, in the 1-300 ms window of the count data for Experiment 1, we have, when comparing Non-Action (NA) and Presupposed Action (PA): 20 vs. 3 for participant 1, 2 vs. 18 for participant 2, 4 vs. 17 for participant 4, etc. We ran Wilcoxon paired tests on such vector pairs. For instance, the Wilcoxon paired test does not detect a significant difference between the two mentioned vectors ($p = .13$). Running through the contrasted scores by participant, the test tells us whether a condition produces significantly more winners than the compared condition.

We are interested in comparing the results of the mixed-effects model, the Fisher test and the Wilcoxon test. Suppose that, for some time-window, the mixed model delivers a significant p value when comparing conditions C1 and C2 and a non-significant p value when comparing C1 and C3. If, in addition, (i) the Wilcoxon test also delivers a significant p value when comparing C1 and C2 but no significant p value when comparing C1 and C3 and (ii) the Fisher test tells us that the contrasts C1 vs. C2 and C1 vs. C3 are significantly different, we can be reasonably sure that some effect takes place which separates C1 and C2 but not C1 and C3. This and similar configurations will be our main targets in the statistical analysis.

3. EXPERIMENTS

3.1. Experiment 1: Factivity

Method

Participants

30 participants (25 women, 18 – 32 years old; $M_{age} = 21.7$, $SD_{age} = 1.55$) participated in this study. All were right-handed ($M_{laterality} = .83$; $SD_{laterality} = .165$; cf. Oldfield, 1971).

Stimuli

A total of 111 French sentences served as stimuli. 37 target hand-related action verbs were used. 8 distinct French factive verbs were used with respect to the factive stimuli: *voir* (to see, 5 times), *s'apercevoir* (to realize, 3 times), *entendre* (to hear, 5 times), *réaliser* (to realize, 6 times), *remarquer* (to notice, 6 times), *observer* (to observe, 5 times), *se rendre compte* (to realize, 2 times), and *savoir* (to know, 5 times). In addition, 37 sentences containing asserted non-action verbs served as control sentences (see Aravena et al., 2012; 2014; Frak et al., 2010; Nazir et al., 2017). The action verbs and asserted non-action verbs were controlled for number of letters and number of syllables (New, Pallier, Ferrand, & Matsos, 2001). Three examples of experimental stimuli are provided in Table 3.

All critical verbs were in the present tense and in the singular third person. Action verbs always appeared in the fifth position of the sentence. Non-action verbs appeared in the fifth position in 33 sentences, in the sixth position in 3 sentences and in the fourth position in 1 sentence. The onset of the target verb and the total duration of the sentence was determined using *PRAAT*. The onsets of the critical verb and noun for the Asserted Action condition (*Before leaving*, *Ines ties her shoes*) were on average 1406ms ($SD = 205ms$) and 1882ms ($SD = 239ms$) after the beginning of the sentence; for the Presupposed Action (*Daniel sees that Anne ties her*

shoes.), they were on average 1255ms ($SD = 160$ ms) and 1676ms ($SD = 193$ ms); for the Non-Action condition (*For dinner, Peter would like chicken.*) they were 1257ms ($SD = 183$ ms) and 1734ms ($SD = 218$ ms).

Table 3. Example of stimuli used in Experiment 1 and their approximate English translation

Condition	Sample stimulus	English approximate translation
Asserted Action	Avant de partir, Ines <u>lace</u> ses chaussures.	Before leaving, Ines <u>ties</u> her shoes.
Presupposed Action	Daniel voit qu'Anne <u>lace</u> ses chaussures.	Daniel sees that Anne <u>ties</u> her shoes.
Non-Action	Pour le dîner, Pierre <u>souhaite</u> du poulet.	For dinner, Peter <u>would</u> like chicken.

The order of the three conditions was pseudo-randomized. No more than two items of the same category appeared consecutively. To control for order effects, we independently generated random orderings for each participant. The 111 sentences were divided into 10 blocks. The first 9 blocks contained 11 sentences, the last one 12 sentences. After each block a yes/no comprehension question concerning the action/non-action part of the sentences was asked in order to keep participants attentive during listening to the auditory stimuli. The amount of yes/no questions was balanced, that is, a participant answered either 5 yes and 6 no question or 6 yes and 5 no questions. We did not measure accuracy because the task involved memory, not motor response, and the goal was only to keep participants more attentive.

Data Analysis

As explained above, we first examined the differences between the different conditions using maximal mixed-effects models on successive time intervals, shifted by 100 ms. In contrast to other experiments of the same type (Aravena et al., 2012; 2014), we took into account a large global time span ranging from verb onset to 1000ms after noun onset. This allows one to observe possible effects of noun phrases. With a sentence like *Before leaving, Ines ties her shoes*, one can expect to detect a motor response ‘after’ *ties*, but it is not a priori clear whether the noun phrase *her shoes* plays a role in triggering the response, or, in other terms, whether the semantic content of the verb alone is sufficient or whether the full verb phrase *ties her shoes* adds significantly to the motor response.

5 participants were removed because of negative drift (3, 10, 12, 15, 19). 24 items with an intensity below -150mN or above 200 mN were suppressed (11 for Asserted Action, 9 for Presupposed Action and 4 for Non-Action).

Results

The averaged results of grip force activation for all three conditions are depicted in Figure 4.

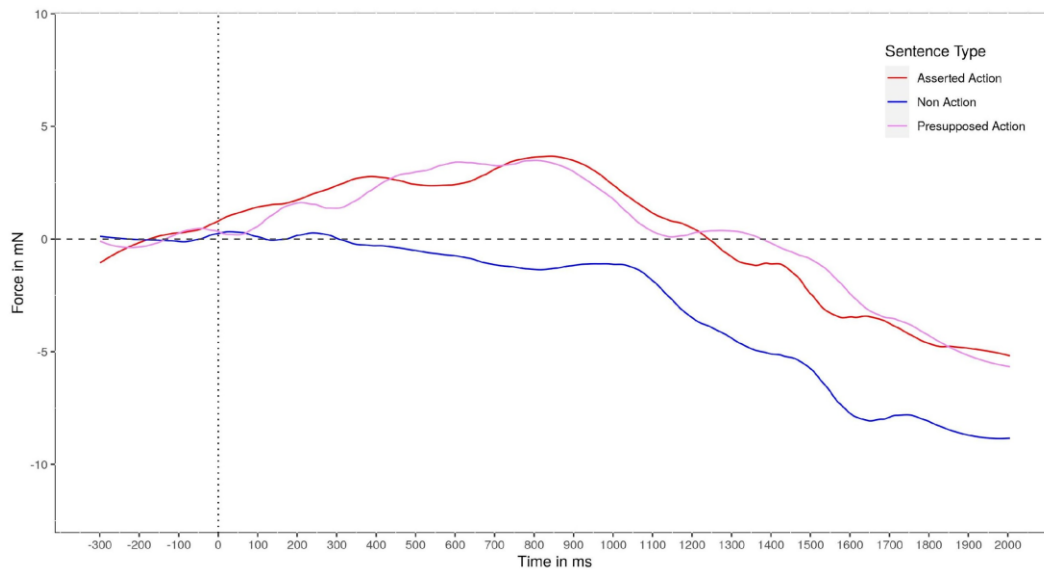


Figure 4. Modulation of grip force amplitude across conditions in Experiment 1.

The statistical results indicate that significant differences exist in grip force variation for the 500-800 ms, 600-900 ms and 700-1000 ms time intervals between the Asserted Action and Non-Action condition as well as between the Presupposed Action and Non-Action one. The Fisher tests⁴⁷ are consonant with the contrasts calculated by the mixed-effects models and Wilcoxon tests. Asserted Action (respectively Presupposed Action) is more different from Non-Action than from Presupposed Action (respectively Asserted Action) (see for example [1] (respectively [2]) in Table 4). The Asserted Action vs. Non-Action and Presupposed Action vs. Non-Action contrasts are not evaluated as significantly different, except in the 500-800 ms window (Table 4, [3]). This is due to the fact that the Asserted Action condition is comparatively less distinct from Non-Action than Presupposed Action.⁴⁸

⁴⁷ To recall, count scores sum winner items across participants for each condition in the Contrasts column (see Table 4).

⁴⁸ Barplots for significance along time can be found in the Supplementary Material.

Table 4. *p* values for the mixed model, Wilcoxon test, and Fisher exact test of Experiment 1. * = $p < .05$, ** = $p < .001$

Windows	Mixed model	Wilcoxon test	Contrasts	Count scores	Fisher
501-800	.065	.04*	AA vs. NA	445 vs. 234	<.001**
	.8	.15	AA vs. PresA	338 vs. 376	
501-800	.065	.04*	NA vs. AA	234 vs. 445	.007* [3]
	.045*	.02*	NA vs. PresA	209 vs. 544	
501-800	.8	.15	PresA vs. AA	376 vs. 338	<.001**
	.045*	.02*	PresA vs. NA	544 vs. 209	
601-900	.052	.02*	AA vs. NA	461 vs. 239	<.001** [1]
	.98	.7	AA vs. PresA	353 vs. 363	
601-900	.052	.02*	NA vs. AA	239 vs. 461	0.14
	.037*	.005*	NA vs. PresA	221 vs. 505	
601-900	.98	.7	PresA vs. AA	363 vs. 353	<.001** [2]
	.037*	.005*	PresA vs. NA	505 vs. 221	
701-1000	.064	.02*	AA vs. NA	475 vs. 237	<.001**
	.8	1	AA vs. PresA	357 vs. 353	
701-1000	.064	.02*	NA vs. AA	237 vs. 475	0.73
	.06	.008*	NA vs. PresA	238 vs. 496	
701-1000	.8	1	PresA vs. AA	353 vs. 357	<.001**
	.06	.008*	PresA vs. NA	496 vs. 238	

We note two additional points. First, Figure 4 shows a steady decrease of intensity, relatively uniform across conditions, starting at about 850-1000 ms after verb onset. This is a general phenomenon, which can be observed in the three experiments. It probably reflects a two-stage automatic process: participants focus on the stimulus and, then, activation drops before the next stimulus. Second, the *p* values obtained are moderate, in particular when compared to those reported in previous similar studies (e.g. Aravena et al., 2012, 2014). This is not surprising given that we used maximal models. To illustrate the difference with more standard models, one can run the ‘equivalent’ of a RM ANOVA for mixed-effects models, that is a model where the random intercept for items is suppressed. The *p* values are then as follows: for the 500-800 window, $p = .017$ for the Asserted-Action vs. Non-Action comparison, $p = 0.01$ for Presupposed-Action vs. Non-Action and $p = 0.79$ for Asserted Action vs. Presupposed Action (for the 600-900 window, the *p* values are .015, .01 and .97 respectively). Clearly, these *p* values are smaller, as it is the case for the Asserted Action vs Non-Action comparison and for the presupposed action vs non-action one, and larger, as it is the case for non-significant asserted action vs presupposed action comparison, only because one ignores the item-based variation, which, to repeat, is quite important.

Discussion

The first experiment addresses the question of whether true but backgrounded action-related information activates motor brain structures. If presuppositions are considered as true by default, it seems that they should trigger a motor response. However, since presuppositions are backgrounded information, they might not elicit the same response compared to simple assertions. Our results reveal that Presupposed Action constructions elicit an increase in grip force. More precisely, grip force in the Presupposed Action condition is significantly higher than in the Non-Action condition and does not differ from the grip force in the Asserted Action condition.

Previous research has shown that language-induced motor activation is not triggered by the presence of an action verb *per se* but depends on contextual factors – cf. the interpretation of metaphors and idioms, the presence of a negation operator or of a volitional verb. More precisely, negative operators (Aravena et al., 2012; Tettamanti et al., 2008) and volitional contexts neutralize such an activation (Aravena et al., 2014; Zwaan et al., 2010). Furthermore, discourse properties – such as the layering of information of what is said and what is implicated – also have an impact on the involved motor structures (van Ackeren et al., 2012). The present study extends these findings to the presupposition triggered by factive verbs.

We used factive verb constructions to manipulate the layering of the described action. Under some approaches to presupposition (e.g. Stalnaker, 1974), the action *Mary throws the ball* is considered as novel information in an assertion as in *Mary throws the ball*, whereas the same information is considered as backgrounded in a factive verb construction as in *Paul knows that Mary throws the ball*. Our results indicate that the novel and the backgrounded information trigger a comparable increase in grip force. Such a result appears at a first sight counter-intuitive with respect to other studies on presupposition processing, which show that processing accommodated presuppositions comes with a transient processing cost (EEG study by Domaneschi et al., 2018; Masia et al., 2017; self-paced reading study by Tiemann et al., 2011; Domaneschi & Di Paolo, 2017; eye-tracking study by Tiemann & Schwarz, 2012). Since we used decontextualized sentences, accommodating the presupposition could thus have either weakened or delayed the onset of the grip force effects. However, the results show that the increase of grip force for the Presupposed Action condition starts at least as early as for the Asserted Action condition. Moreover, the trajectory of the grip-force curve does not differ significantly in the two conditions. This suggests that the action denoted by the factive

complement (for instance throwing a ball or tying one's shoes) is immediately integrated in the situation model, as it is for an assertive sentence.

Sensori-motor activation is triggered by linguistic contexts where the action denoted by the corresponding verbal group is presented as actually taking place. According to the *Linguistic Focus Hypothesis*⁴⁹ (Zwaan and Taylor, 2008), a motor resonance is triggered when the action presents the focus of an utterance. Hence, negative (*Marie does not throw the ball*) and volitional sentences (*Paul wants to throw the ball*) do not give rise to the phenomenon observed for assertive sentences (*Marie throws the ball*), simply because the action under a negative or volitional operator is not (yet) true in a model of the current situation. Consequently, the linguistic surrounding can switch off motor semantic features when they appear to be irrelevant within the situation model. If we admit that a sentence like *Paul knows that Mary throws the ball* communicates the truth of the complement clause, the situation model includes the proposition that *Mary throws the ball* as the sentence corresponding to a simple assertion does. From this point of view, it is not surprising that the grip force activation of the Presupposed Action verb has a comparable trajectory as that of the Asserted Action verb.

More generally, the results indicate that the *truth-conditional status* of the presupposed information (about a hand-related action) elicits an increase in grip force. This supports the idea that presuppositions engage the speaker's *commitment* (see Peters, 2016), or, in other terms, that the speaker who uses a presupposition presents himself as believing it is true (but see note 1 in the introduction for a more nuanced explanation based on Stalnaker (2002)). When the addressee has no particular reason to question the beliefs of the speaker, she takes them for granted if she considers the speaker as sufficiently reliable in terms of honesty and competence. To ensure that the observed increase in grip force relates to the fact that the hand-related action verb occurs in the complement of a factive verb that guarantees its truth (e.g. *know*), we designed a second experiment where we replaced factive verbs with non-factive verbs such as *believe* or *think*. If our hypothesis is correct, this manipulation should weaken or neutralize the motor effect.

3.2. Experiment 2: Non-Factivity

⁴⁹It is important to note that Zwaan and Taylor's (2008) use of the term *focus* is different from what linguists call 'focus'. For Zwaan and Taylor, focus is linked to an action that takes place at the current time point.

Method

Participants

34 participants (24 women; 19 – 35 years old; $M_{age} = 22.71$, $SD_{age} = 4.03$) participated in this study. All were right-handed ($M_{laterality} = .95$; $SD_{laterality} = .15$).

Stimuli

A total of 111 French sentences served as stimuli (see Supplementary Material). Thirty-seven target hand-related action verbs were embedded into Asserted Action and Non-Presupposed sentences. In addition, thirty-seven sentences containing asserted non-action verbs were used. In contrast to experiment 1, the sentences for Presupposed Action were replaced by Non-Presupposed ones (see Table 5). We avoided to have both factive and non-factive sentences in the same experiment in order to prevent a contrastive reading (*know* vs. *believe*), which might have induced the participants to interpret the complement of a non-factive verb as (probably) false. 8 distinct French non-factive verbs were used with respect to the factive stimuli: *imaginer* (*to imagine*, 5 times), *dire* (*to say*, 5 times), *soupçonner* (*to suspect*, 4 times), *suspecter* (*to suspect*, 5 times), *penser* (*to think*, 5 times), *croire* (*to believe*, 5 times), *supposer* (*to suppose*, 4 times), and *soutenir* (*to claim*, 4 times). All other selection and condition criteria used for experiment 1 also applied for this experiment.

The onsets of the critical verb and noun for the Asserted Action condition (*Before leaving, Ines ties her shoes*) were on average 1406ms ($SD = 205$ ms) and 1882ms ($SD = 239$ ms) after the beginning of the sentence; for the Non-Presupposed Action (*Daniel imagines that Anne ties her shoes.*), they were on average 1290ms ($SD = 187$ ms) and 1714ms ($SD = 203$ ms) ; for the Non-Action condition (*For his meal, Peter would like chicken.*) they were 1257ms ($SD = 183$ ms) and 1734ms ($SD = 218$ ms).

Table 5. *Example of Stimuli Used in Experiment 3 and their Approximate English Translation*

Condition	Sample stimulus	English translation
Asserted Action	Avant de partir, Ines <u>lace</u> ses chaussures.	Before leaving, Ines <u>ties</u> her shoes.
Non-Presupposed Action (non-factive construction)	Daniel imagine qu'Anne <u>lace</u> ses chaussures.	Daniel imagines that Anne <u>ties</u> her shoes.
Non-Action	Pour son repas, Pierre <u>souhaite</u> du poulet.	For his meal, Peter <u>would like</u> chicken.

Equipment, data acquisition, and procedure were exactly the same as presented in Experiment 1.

Data Analysis

The data analysis was exactly the same as in Experiment 1.

4 participants were ignored because of negative drift (participants 2, 16, 19, 31). 102 items with a grip force below -150mN or above 200 mN were suppressed (39 for Asserted Action, 34 for Non-Presupposed Action and 29 for Non-Action).

Results

The averaged results of grip force activation for all three conditions are depicted in Figure 5.

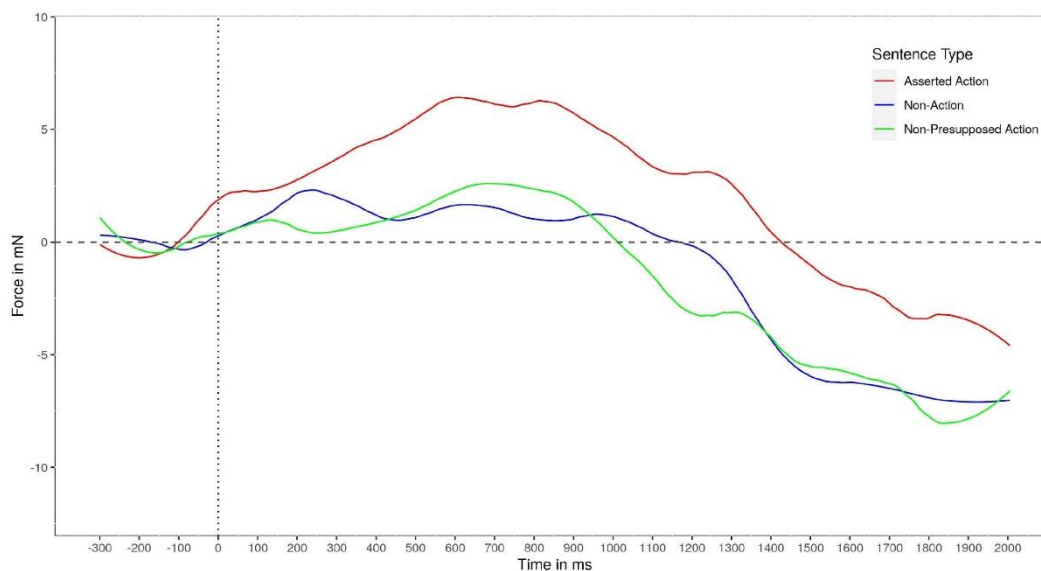


Figure 5. Modulation of grip force amplitude across conditions in Experiment 2.

The results indicate that significant differences emerge in the time interval between 300 – 700 ms. More precisely, Asserted Action is more different from Non-Action than from Non-Presupposed Action. When compared to the Non-Presupposed Action condition, the Asserted Action condition shows only a moderate or small significance, which is in sharp contrast to the

Asserted Action vs. Non-Action comparison, which also extends over a wider time interval, i.e. until 1000 ms. Combining the p values, the count scores and Fisher results, the results indicate that Non-Presupposed Action and Non-Action conditions do not differ significantly. Whenever a Non-Presupposed Action vs. Non-Action contrast is compared to another contrast, the Fisher tests are significant. Smaller but significant p values are also observed when Asserted Action is compared to the other two conditions (Table 6, see [1]-[5])⁵⁰.

Table 6. p Values for the Mixed Model, Wilcoxon Test, and Fisher Exact Test of Experiment 2.
* = $p < .05$, ** = $p < .001$

Windows	Mixed model	Wilcoxon test	Contrasts	Count scores	Fisher
301-600	.05*	.008*	AA vs. NA	506 vs. 237	.006* [1]
	.07	.098	AA vs. NPresA	485 vs. 305	
301-600	.05*	.008*	NA vs. AA	237 vs. 506	<.001**
	.93	.8	NA vs. NPresA	378 vs. 399	
301-600	.07*	.098	NPresA vs. AA	305 vs. 485	<.001**
	.93	.8	NPresA vs. NA	399 vs. 378	
401-700	.03*	.03*	AA vs. NA	537 vs. 241	<.001** [2]
	.08	.09	AA vs. NPresA	477 vs. 311	
401-700	.03*	.03*	NA vs. AA	241 vs. 537	<.001**
	.86	.5	NA vs. NPresA	371 vs. 430	
401-700	.08	.09	NPresA vs. AA	311 vs. 477	<.001**
	.86	.5	NPresA vs. NA	430 vs. 371	
501-800	.024*	.008*	AA vs. NA	524 vs. 273	.038*[3]
	.1	.1	AA vs. NPresA	488 vs. 316	
501-800	.024*	.008	NA vs. AA	273 vs. 524	<.001**
	.76	.3	NA vs. NPresA	345 vs. 441	
501-800	.1	.1	NPresA vs. AA	316 vs. 488	<.001**
	.76	.3	NPresA vs. NA	441 vs. 345	
601-900	.025*	.007*	AA vs. NA	532 vs. 273	.048*[4]
	.137	.1	AA vs. NPresA	490 vs. 309	
601-900	.025*	.007*	NA vs. AA	273 vs. 532	<.001**
	.69	.5	NA vs. NPresA	345 vs. 419	
601-900	.13	.1	NPresA vs. AA	309 vs. 490	<.001**
	.69	.5	NPresA vs. NA	419 vs. 345	
701-1000	.045*	.009*	AA vs. NA	534 vs. 275	<.001** [5]
	.147	.16	AA vs. NPresA	484 vs. 343	
701-1000	.045*	.009*	NA vs. AA	275 vs. 534	<.001**
	.79	.66	NA vs. NPresA	374 vs. 427	
701-1000	.147	.16	NPresA vs. AA	343 vs. 484	<.001**
	.79	.66	NPresA vs. NA	427 vs. 374	

Discussion

⁵⁰ Barplots for significance along time can be found in the Supplementary Material.

The second experiment directly compares the action-related content of an assertion to the non-factive complement. Without prior context, the truth of the non-presupposed complement is unknown, that is, the information is neither true nor false. If, as we assume, the truth of the complement is a prerequisite for the recruitment of motor structures during the processing of action verbs, a weaker or null increase of the grip force should be expected with non-factive complements. Our results show that the Asserted-Action condition shows a significant increase in grip force when compared to the Non-Action condition and a moderate or small significance when compared to the Non-Presupposed Action condition, whereas the difference between the Non-Presupposed Action and Non-Action conditions is not significant. This contrast suggests that the Non-Presupposed Action condition (Experiment 2) and Presupposed Action condition (Experiment 1) trigger different grip force activations. However, the p values and the results of the Fisher tests are compatible with a more nuanced hypothesis, namely that Non-Presupposed Action is slightly more susceptible to motor response than Non-Action. Admittedly, the observed differences are small but this is not a priori unlikely, given that the sentences in the Non-Presupposed Action condition describe a hand-related action occurring in a situation which, though not presented as the *actual* situation, is still a *possible* situation, whose truth is assumed by an agent different from the speaker. We return to this point in the general discussion section.

Taken together, the results of experiments 1 and 2 suggest that the driving force behind the observed grip force modulations is the truth-conditional status of the action-related verb. In experiment 1, the presupposition of a factive verb (e.g. *know*) is presented as true and the observed motor activation is not different from that of action-related verbs in simple assertive sentences. In experiment 2, the presupposition is not presented as true, since it is embedded under a non-factive verb (e.g. *believe*), which does not presuppose the truth of the complement clause. In that case, the grip force does not reach the activation of Asserted-Action condition and, in fact, does also not differ significantly from the Non-Action condition. Contrariwise, the grip force activation of the Presupposed-Action condition, as observed in experience 1, is significantly larger than that of the Non-Action condition. Overall, the results of the two experiments confirm that action-related verbs in themselves are not always sufficient to generate a motor response and that the linguistic environment plays a crucial role (e.g. Willems & Casasanto, 2011).

Our results suggest that the presuppositional status in itself is not different from the asserted status for factive constructions, although differences between presupposed and asserted

content have been observed when presuppositions are put into a discourse context (see, for instance, Masia et al., 2017, for definite versus indefinite descriptions and Simons, Beaver, Roberts, & Tonhauser, 2017, for factive constructions). A part of the theoretical literature on presuppositions assumes that, by default, presuppositions project, that is, are considered as true under certain operators like negation or interrogation. Accordingly, one might argue that they should trigger a motor activation under these operators. But, even though the truth-conditional status plays an important role, it is perhaps not sufficient to counteract the effect of operators which express opposition (negation) or uncertainty (interrogation). Admittedly, negation or interrogation do not bear directly on the presupposition. A sentence like *Paul doesn't know that Mary writes the letter* negates a certain knowledge of the agent Paul, but not the proposition that Mary writes the letter. Still, it might be the case that the negation affects the force of the presupposition. This can be done in at least two ways. First, negation could be *parasitic* on the presupposition, meaning that, although it does not combine with the presupposition, it could somehow 'taint' it. For instance, Aravena et al. (2012) suggest that negation could block the motor semantic representation of the negation target (for candidate neurophysiological grounds for this idea see de Vega et al., 2016; Papeo et al., 2016; Tettamanti et al., 2008). Second, it has been argued that, in some cases, negated factive verbs do not give rise to projection (Beaver, Roberts, Simons, & Tonhauser, 2017; Simons et al., 2017). For instance, a sentence like *Paul didn't observe that Mary was in the office* can mean either that Mary was in the office and Paul did not notice her (the projection interpretation) or that Paul had no evidence that Mary was in the office (the non-projection interpretation). Adopting a projective reading, the perspective of the speaker outweighs the perspective of Paul (the agent). In contrast, a non-projective reading focuses on the perspective of the agent. Consequently, the latter interpretation should not elicit a grip force activation, whereas the former one should elicit one. The goal of our third experiment is to determine whether the negation operator influences the motor response in projective environments.

3.3. Experiment 3: Projection

Method

Participants

29 participants (15 women; 18 – 30 years old; $M_{age} = 21.06$, $SD_{age} = 3.22$) participated in this study. All were right-handed ($M_{laterality} = .91$; $SD_{laterality} = .19$).

Stimuli

A total of 111 French sentences served as stimuli. We decided to have a slightly more complex context clause for projective environments (a full sentence instead of a prepositional clause). This is due to the fact that, in some cases, having only a prepositional clause made the full target sentence somewhat unclear. For instance, *In the launderette, Michael does not know that Cédric irons his shirt* does not a priori make much sense if Cédric is not himself in the launderette. To solve this referential problem and help participants to attribute some relevance or plausibility to the action clause embedded under the projection environment (*X does not know that*), we replaced *in the launderette* by the sentence *Cédric is in the launderette*. Sentences for other conditions were modified accordingly. There are two possible problems with this choice. First, even though we chose very vague initial sentences we perhaps ran the risk of favoring the projective interpretation. Second, lengthening the stimuli when compared to the first two experiments might have some effects on processing.

Concerning the first possibility, one has to keep in mind that our primary interest is the comparison between conditions and not between experiments. We show below that, in the third experiment, the projection effect is late, moderate and restricted to a subset of participants, quite unlike the activation for factive sentences in the first experiment. Therefore, it is reasonable to conclude that motor activation under the Projection condition is not comparable to motor activation under the Presupposed Action condition of the first experiment. This conclusion is all the more plausible as the Presupposed Action condition could not benefit from the (hypothetical) effect of an initial sentence and had no advantage in this respect, contrary to the Projection condition. Moreover, it is not clear whether adding some linguistic material has a positive effect on motor response. We mentioned above the results of Raposo et al. (2009), who found a stronger motor activation for isolated verbs like *grab* than for the same verbs in a sentential context (*The fruit cake was the last one so Claire grabbed it*).

As for the effect of length, there seems to be no effect at all. First, there is no correlation between length and activation intensity in general: the average correlations for the Asserted

Action condition are 0.17 for experiment 1, -0.008 for experiment 2 and 0.033 for experiment 3. It is -0.022 for the late part of experiment 3. It is -0.07 for the Presupposed Action condition of experiment 1, 0.02 for the Projection condition of experiment 3 and -0.08 for the late part of the same experiment. Second, when comparing the time regions where the difference between Asserted Action and Non-Action conditions is maximal, one sees that they are the same (400-1000 interval) for experiment 1 and 3. So, for the same comparison of conditions, there is no earlier or later difference for the projection experiment.

Hand-related action verbs always appeared on the twelfth position (± 2) of the sentence. 9 distinct French factive verbs were used under negation in the projective construction: *voir* (to see, 6 times), *s'apercevoir* (to realize, 4 times), *entendre* (to hear, 4 times), *réaliser* (to realize, 4 times), *remarquer* (to notice, 4 times), *observer* (to observe, 5 times), *se rendre compte* (to realize, once), *savoir* (to know, 5 times) and *constater* (witness, 4 times). A sample of stimuli is provided in Table 7. All previous selection and condition criteria used for experiments 1 and 2 also applied for this experiment.

The onsets of the critical verb and noun for the Asserted Action condition (*Ines is leaving for work. Before going out, she ties her shoes*) were on average 3870ms ($SD = 414ms$) and 4305ms ($SD = 448ms$) after the beginning of the sentence; for the Projected Action (*Robert is busy in the living room. He does not see that Ghislaine ties her shoes*), they were on average 3313ms ($SD = 261ms$) and 3701ms ($SD = 281ms$); for the Non-Action condition (*Samuel greatly prefers poultry. For the dinner he would like chicken*) they were 3501ms ($SD = 302ms$) and 3963ms ($SD = 314ms$).

Table 7. Example of Stimuli Used in Experiment 3 and their Approximate English Translation

Condition	Sample stimulus	English approximate translation
Asserted Action	Ines va partir pour aller travailler. Avant de sortir, elle lace ses chaussures.	Ines is leaving for work. Before going out, she ties her shoes.
Projected Action	Robert est occupé dans le salon. Il ne voit pas que Ghislaine lace ses chaussures.	Robert is busy in the living room. He does not see that Ghislaine ties her shoes.
Non-Action	Samuel préfère de beaucoup la volaille, Pour le dîner il souhaite du poulet.	Samuel greatly prefers poultry. For the dinner he would like chicken.

Measures and pre-tests

To ascertain that the negation of a factive verb does, indeed, leave the factive complement unaffected, we first tested the projection of the factive complement in an online pilot study. Twenty-four French native speakers, aged from 21 to 48 years participated in this study ($M = 31.66$, $SD = 9.82$). None of them followed a program in linguistics. Each participant saw five (randomly selected) of the thirty-seven projection sentences and ten filler sentences. After having read the sentence, the participant had to indicate whether the factive complement was true or false. In 84.2% of all questions, the factive complement was rated as true, whereas in 15.8% the factive complement was rated as false. This difference is significant ($z = 10.59$, $p < .001$, CI for correct answers = 70.10% - 90.70%). In addition, the correct results also differ significantly from chance ($z = 7.62$, $p < .0001$). The results can be seen as evidence that, by default, the factive complement projects, that is, it remains unaffected under a negative operator.

Equipment, data acquisition, and procedure were exactly the same as presented in experiment 1.

Data Analysis

The data analysis was exactly the same as in Experiment 1.

Participant 12 was removed because of recording problems. Furthermore, 6 participants were removed because their grip force recordings showed a negative drift (3, 15, 16, 19, 20, 25). 163 items with a grip force below -150mN or above 200 mN were suppressed (51 for Asserted Action, 53 for Projection and 59 for Non-Action).

Results

The averaged results of grip force activation for all three conditions are depicted in Figure 6.

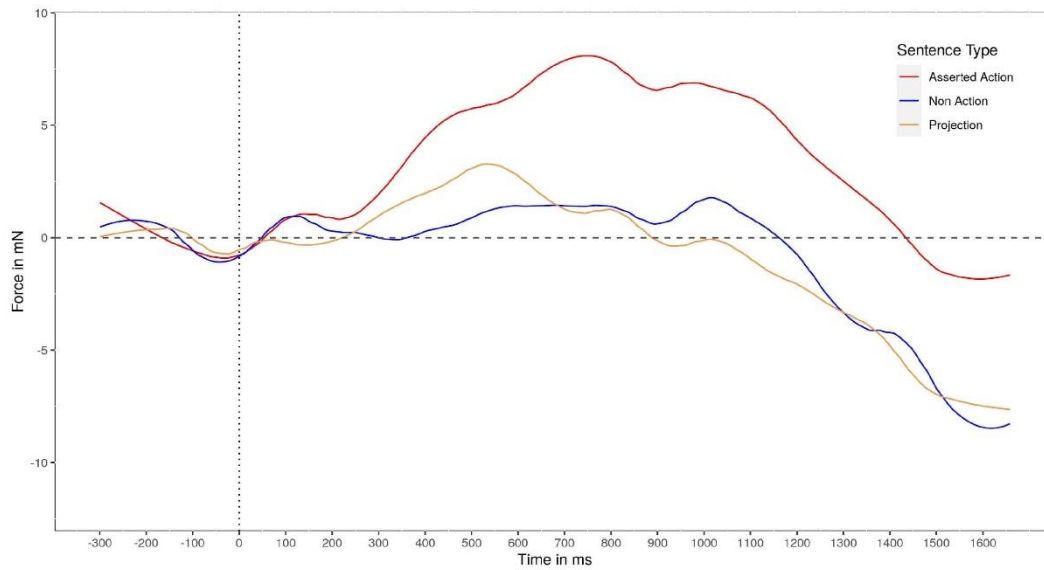


Figure 6. Modulation of grip force amplitude across conditions in Experiment 3.

The results show that significant differences emerge between 600 – 1000 ms after the onset of the action verb between the Asserted Action and Projection condition. Moreover, the findings indicate that only the Asserted Action condition elicits a grip force activation, whereas this is not the case in the Projection and Non-Action condition. The Asserted Action condition elicits a significant higher grip force activation than the Projection and Non-Action condition.

The Fisher tests in Table 8 show that the contrasts between Asserted Action on one side and Non-Action and Projection on the other side are quite comparable. This agrees with the results of the mixed-effects models, which indicate that Projection is close to Non-Action⁵¹.

⁵¹ Barplots for significance along time can be found in the Supplementary Material.

Table 8. *p* Values for the Mixed Model, Wilcoxon Test, and Fisher Exact Test of Experiment 3.
* $p < .05$, ** $p < .001$

Windows	Mixed model	Wilcoxon test	Contrasts	Count scores	Fisher
501-800	.066	.008*	AA vs. NA	445 vs. 175	.9 [1]
	.074	.005*	AA vs. ProjA	420 vs. 162	
501-800	.066	.008*	NA vs. AA	175 vs. 445	<.001**
	.81	.34	NA vs. ProjA	255 vs. 336	
501-800	.074	.005*	ProjA vs. AA	162 vs. 420	<.001**
	.81	.34	ProjA vs. NA	336 vs. 255	
601-900	.058	.006*	AA vs. NA	457 vs. 166	.7 [2]
	.04*	.005*	AA vs. ProjA	422 vs. 162	
601-900	.058	.006*	NA vs. AA	166 vs. 457	<.001**
	1	.54	NA vs. ProjA	268 vs. 321	
601-900	.04*	.005*	ProjA vs. AA	162 vs. 422	<.001**
	1	.54	ProjA vs. NA	321 vs. 268	
701-1000	.07	.01*	AA vs. NA	456 vs. 165	.23 [3]
	.033*	.004*	AA vs. ProjA	426 vs. 180	
701-1000	.07	.01*	NA vs. AA	165 vs. 456	<.001**
	.86	.56	NA vs. ProjA	279 vs. 339	
701-1000	.033*	.004*	ProjA vs. AA	180 vs. 426	<.001**
	.86	.56	ProjA vs. NA	339 vs. 279	

Exploratory analysis

It has been noted that projection is not an automatic or effortless process, a point to which we return in the next discussion section. Taking this possibility into account, we decided to investigate whether the limits of our temporal windows (1000 ms after noun onset) had possibly prevented us from detecting some relevant phenomenon. The intuition was that we might have missed some late episode in the response to the sentences, between the noun onset and the beginning of the next auditory stimulus. Figure 7 shows the last part of the average grip-force activations across participants and items for our three experiments. While the two plots concerning the experiments on factivity and non-factivity do not show anything different from a simple pressure decrease, before the participants refocus on the next stimulus, the plot for the projection experiment suggests that the Projection condition is associated with a rise starting at about 1300 ms after noun onset.

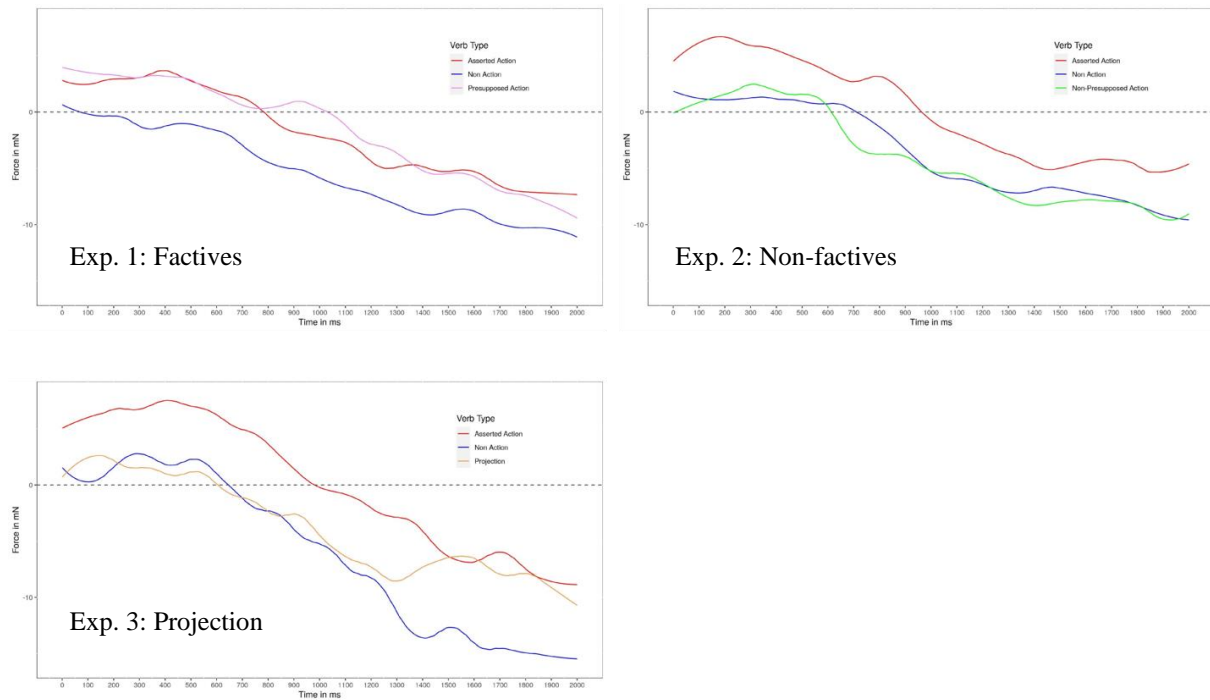


Figure 7. Plots for the Last Part of the Time Point Series: Factive (top left), Non-Factive (top right) and Projection (bottom left)

The results are summarized in Table 9. The Mixed model column does not contain any significant or approximately significant figure. But the p values for the Asserted Action vs. Projection contrast are markedly superior to those for the Asserted Action vs. Non-Action contrast in all the regions mentioned in table 9. This is not the case for the contrasts Non-Action vs. Asserted Action and Non-Action vs. Projection, which are always similar. The Wilcoxon tests also deliver larger values for Asserted Action vs. Projection than for Asserted Action vs. Non-Action. They deliver *inferior* values for Non-Action vs. Asserted Action when compared to Non-Action vs. Projection, except for the last interval (1700-2000ms after noun onset) where the figures are comparable. The Fisher tests are always significant – although on different scales, except for the last two intervals. The p values obtained through the mixed-effects models and the Wilcoxon tests suggest that Projection is closer to Asserted Action than to Non-Action. According to the mixed-effects models, Asserted Action and Projection are equidistant from Non-Action whereas, according to the Wilcoxon tests, Projection is closer to Non-Action. The Fisher tests indicate similar distributions of counts for the Non-Action vs. Assertion/Projection in the 1600-1900 and 1700-2000 windows⁵².

⁵² Bar plots for significance along time can be found in the Supplementary Material.

Table 9. *p* Values for the Mixed Model, Wilcoxon test, and Fisher Exact Test of the Last 2000 ms of Experiment 3. * $p < .05$, ** $p < .001$

Windows	Mixed model	Wilcoxon test	Contrasts	Count scores	Fisher
1201-1500	.098	.02*	AA vs. NA	444 vs. 207	.025* [1]
	.32	.09	AA vs. ProjA	382 vs. 233	
1201-1500	.098	.02*	NA vs. AA	207 vs. 444	<.001**
	.38	.24	NA vs. ProjA	253 vs. 371	
1201-1500	.32	.09	ProjA vs. AA	233 vs. 382	<.001**
	.38	.24	ProjA vs. NA	371 vs. 253	
1301-1600	.13	.01*	AA vs. NA	454 vs. 203	<.001** [2]
	.68	.42	AA vs. ProjA	349 vs. 273	
1301-1600	.13	.01*	NA vs. AA	203 vs. 454	.007
	.22	.12	NA vs. ProjA	244 vs. 397	
1301-1600	.68	.42	ProjA vs. AA	273 vs. 349	<.001**
	.22	.12	ProjA vs. NA	397 vs. 244	
1401-1700	.16	.02	AA vs. NA	461 vs. 197	<.001** [3]
	.93	.8	AA vs. ProjA	320 vs. 284	
1401-1700	.16	.02*	NA vs. AA	197 vs. 461	.01
	.18	.09	NA vs. ProjA	232 vs. 400	
1401-1700	.93	.8	ProjA vs. AA	284 vs. 320	<.001**
	.18	.09	ProjA vs. NA	400 vs. 232	
1501-1800	.15	.02*	AA vs. NA	457 vs. 196	<.001**
	.93	.38	AA vs. ProjA	357 vs. 269	
1501-1800	.15	.02*	NA vs. AA	196 vs. 457	.004*
	.18	.15	NA vs. ProjA	242 vs. 400	
1501-1800	.93	.38	ProjA vs. AA	269 vs. 357	<.001**
	.18	.15	ProjA vs. NA	400 vs. 242	
1601-1900	.14	.057	AA vs. NA	439 vs. 218	<.001**
	.89	.59	AA vs. ProjA	334 vs. 282	
1601-1900	.14	.057	NA vs. AA	218 vs. 439	.15
	.19	.15	NA vs. ProjA	241 vs. 410	
1601-1900	.89	.59	ProjA vs. AA	282 vs. 334	<.001**
	.19	.15	ProjA vs. NA	410 vs. 241	
1701-2000	.18	.08	AA vs. NA	428 vs. 232	<.001**
	.87	.54	AA vs. ProjA	339 vs. 290	
1701-2000	.18	.08	NA vs. AA	232 vs. 428	.68
	.23	.05*	NA vs. ProjA	233 vs. 409	
1701-2000	.87	.54	ProjA vs. AA	290 vs. 339	<.001**
	.23	.05*	ProjA vs. NA	409 vs. 233	

Taken together, these various measures suggest a small or moderate rise for Projection in the 1600-2000 window. This is due to the late reaction of 11 participants (out of 22). The individual plots for those participants evidence a rise or a high plateau in the 1000 – 2000ms temporal region after noun onset (for averaged grip force activation of the two participant subgroups, see Figure 8, and for a more detailed participant-by-participant depiction, see Supplementary Material).

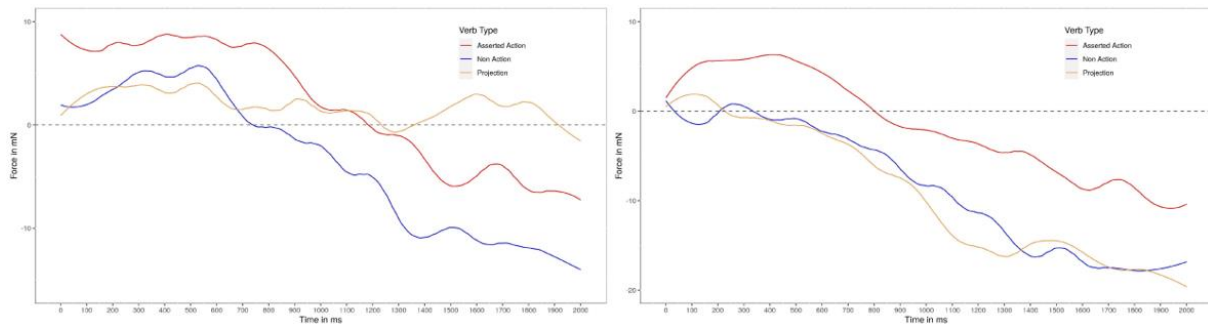


Figure 8. Plots for the Last Part of the Projection Time Point Series: 11 Participants with a final rise (left), Other 11 Participants (right)

The significant results confirm the visual observations of Figure 8. For the subset of participants without any final rise/plateau, the only mixed model values which reach significance concern the contrast between Projection and Asserted Action in the 900 – 1500 ms time windows. These results correspond to the trough of the Projection curve in Figure 8 (right). For the subset of participants with a final rise/plateau, the results are presented in Table 10. The mixed model and Wilcoxon p values indicate that Projection departs from Non-Action. The Fishers tests provide in general significant p values. The lowest values are those of the contrast between Asserted Action vs. Projection and Asserted Action vs. Non-Action. This is due to the fact that Asserted Action occupies an intermediate position, see Figure 8 (left) and the figures in the Count scores column of Table 11. So, the Fisher exact test reflects the symmetric status of Asserted Action, superior to Non-Action but inferior to Projection, even though none of these differences is significant⁵³.

⁵³ Bar plots for significance along time can be found in the Supplementary Material.

Table 10. *P Values for the Mixed Model, Wilcoxon test, and Fisher Exact Test of the Last 2000 ms of Experiment 3 restricted to Participants Showing a Final Rise/Plateau* * $p < .05$, ** $p < .001$

Windows	Mixed model	Wilcoxon test	Contrasts	Count scores	Fisher
1301-1600	.37 .3	.32 .08	AA vs. NA AA vs. ProjA	210 vs. 105 113 vs. 178	<.001**
1301-1600	.37 .07	.32 .02*	NA vs. AA NA vs. ProjA	105 vs. 210 81 vs. 229	
1301-1600	.3 .07	.08 .02*	ProjA vs. AA ProjA vs. NA	113 vs. 178 229 vs. 81	<.001*
1401-1700	.4 .2	.09 .1	AA vs. NA AA vs. ProjA	221 vs. 97 97 vs. 192	
1401-1700	.4 .06	.09 .03*	NA vs. AA NA vs. ProjA	97 vs. 221 75 vs. 231	.1
1401-1700	.2 .06	.2 .03*	ProjA vs. AA ProjA vs. NA	192 vs. 97 231 vs. 75	
1501-1800	.4 .2	.3 .09	AA vs. NA AA vs. ProjA	216 vs. 97 122 vs. 178	<.001**
1501-1800	.4 .047*	.3 .02*	NA vs. AA NA vs. ProjA	97 vs. 216 81 vs. 233	
1501-1800	.2 .047*	.09 .02*	ProjA vs. AA ProjA vs. NA	178 vs. 122 233 vs. 81	<.001**
1601-1900	.4 .24	.15 .15	AA vs. NA AA vs. ProjA	213 vs. 112 102 vs. 198	
1601-1900	.4 .043*	.15 .02*	NA vs. AA NA vs. ProjA	112 vs. 213 80 vs. 236	.01*
1601-1900	.24 .043*	.15 .02*	ProjA vs. AA ProjA vs. NA	198 vs. 102 236 vs. 80	
1701-2000	.43 .26	.1 .2	AA vs. NA AA vs. ProjA	207 vs. 116 101 vs. 202	<.001**
1701-2000	.43 .052*	.1 .02*	NA vs. AA NA vs. ProjA	116 vs. 207 83 vs. 226	
1701-2000	.26 .052*	.2 .02*	ProjA vs. AA ProjA vs. NA	202 vs. 101 226 vs. 83	.09

Discussion

The main finding of our last experiment is that, in contrast to the other two experiments on factive and non-factive constructions, grip force activation is not uniform in the case of projection. Projection differs significantly from Asserted Action in the first 1600 ms after verb onset, whereas no significant difference is observed with respect to Non-Action in the same time window. The situation is different in the last time window (2000 ms after noun onset),

where we observe that half of the participants show a rise or relatively high plateau for Projection.

The absence of a grip force activation in the initial window could a priori be attributed to at least two possible scenarios. First, the negation of the factive verb may have tainted a grip force activation of the true presupposed content. Such an explanation would be in line with research that suggests that negation does not give rise to a motor representation (e.g. Aravena et al., 2012; de Vega et al., 2016; Papeo et al., 2016; Tettamanti et al., 2008). Second, it is also possible, as has been argued by Beaver et al. (2017) and Simons et al. (2017) that, in some cases, a projective interpretation of the presupposition of a negated factive verb construction does not arise.

Given that some grip force activation occurs in a later time window, it is highly unlikely that negation affects the grip force activation of projective actions in such a way that it completely blocks the motor semantic representation. In addition, considering the results of the previous two experiments on factive and non-factive constructions, it is more plausible that the projective interpretation of the presupposition of a negated factive verb construction in decontextualized sentences is less uniform, delayed and/or weaker than the factive interpretation (Experiment 1). As we will see in the next section, this is consonant with certain empirical and experimental observations about projection.

4. GENERAL DISCUSSION

Using the grip force sensor technique (Aravena et al. 2012, 2014; Frak et al. 2010; Nazir et al. 2017), the present study is the first – to our knowledge – to investigate the involvement of the sensori-motor system in coded information layering. In Experiment 1, we compared asserted information with information embedded under a presuppositional factive verb construction. In Experiment 2, we extended our investigation to a non-factive verb construction. Lastly, we examined whether the projection behavior of a factive verb construction modulates sensori-motor activation under negation (Experiment 3). Our results indicate the following:

1. The presupposed factive complement triggers an increase in grip force. The presupposed content of factive verb constructions elicits a significantly higher grip force response than non-action verbs. The grip force response between the asserted and presupposed content does not differ significantly⁵⁴.

⁵⁴ To align the target position of the action verb in the asserted action condition (*Before leaving, Ines ties her shoes*) with the one of the presupposed action condition (*Paul sees that Ines ties her shoes*), we used a locative or

2. The grip force activations recorded under the Non-Presupposed Action condition are not significantly different from those for the Non-Action condition. It is important to note that the p values for the mixed models and the Fisher tests are compatible with a more nuanced hypothesis, namely that Non-Presupposed Action is slightly more susceptible to motor response than Non-Action.
3. Our results show that the Asserted Action condition shows a significant increase in grip force when compared to the Non-Action or Non-Presupposed Action conditions, whereas the difference between the Non-Presupposed Action and Non-Action conditions is not significant. This contrast suggests that Non-Presupposed Action verbs (Experiment 2) and Presupposed Action verbs (Experiment 1) trigger different grip force activations.
4. When the factive verb is negated, the construction does not elicit a grip force response in the reference window (roughly, the first 1600 ms after verb onset). The grip force response of the Projection verb of negated factive verb constructions differs significantly from Asserted Action verbs but not from Non-Action verbs. In the late window before the next stimulus, that is 2000 ms after noun onset, a small/moderate positive deviation is observed. A more fine-grained analysis confirms this tendency for half of the participants.

With sensori-motor activation as criterion, in Experiment 1 we tested the assumption that the backgrounded status of the factive complement engages motor brain structures differently compared to asserted content. This assumption was not confirmed. It is worth noting here that, based on descriptive linguistic analyses, Beaver (2010) and Simons et al. (2017) recently challenged the backgrounded status of factive complements altogether. Moreover, the corpus analysis by Spenader (2002) indicates that in more than fifty percent of the cases, the factive complement is introduced as new information. Mazzearella, Reinecke, Mercier, and Noveck's (2018) results on the impact of different levels of meaning on speaker commitment are also

temporal Preposition Phrase (PP) just before the asserted action clause. Given that the action clauses included the same action verbs, the only difference between the two mentioned condition is that the former contained this preposition phrase. Results' by, for instance Singh et al. (2016) revealed that plausibility impacts the processing between assertions and presuppositions that must be accommodated. In their study, the authors report that the difference between assertions and presuppositions arises in implausible but not in plausible contexts. Given that our one sentence experimental stimuli were not influenced by prior sentences as this was the case in Singh et al., the only factor that may have had an influence was the prepositional phrase. If the PP would have made the action more plausible (or predictable), then the asserted action verb should have elicited a higher grip force response. However, this is not what our results indicate since there is no significant difference between the asserted and presupposed action condition. Moreover, if there is any effect, it cannot explain the difference between the first two experiments: in both cases the stimuli for the Asserted Action condition are the same, but the contrast with the factive (*know*) vs. non-factive (*believe*) condition is not the same.

relevant. Using a selective trust paradigm, they show that trust scores between the asserting and presupposing speakers, in a condition where the presupposition conveys new information, as it is the case in the present study, do not differ significantly after the message is found unreliable. In this line, it is thus not such a surprise that the factive complement that conveys not yet shared information also triggers a sensori-motor response. In this line, it is thus not such a surprise that the factive complement also triggers a sensori-motor response. It is important to note that the activation differs significantly from the Non-Action condition. Combined with the result of our second experiment, which showed that the complement of a non-factive verb construction does not trigger a strong activation, it appears that the sensori-motor activation is modulated by the *truth-conditional status* of the action verb, not by the ‘novelty’ of the conveyed information. The difference between factives and non-factives (*know* vs *believe*) is not the fact that the complement clause describes some novel event or not, but the fact that the complement is presented as true or not. In this respect, it should be noted that the factive complement was not accented in the auditory material, which minimizes the possibility that this information represented the focus of the sentence. A follow-up study should investigate whether a focus manipulation, that is, accenting the asserted content while simultaneously de-accenting the presupposed content, affects sensori-motor correlates of the presupposed action. In conclusion, our findings extend the current knowledge about the contextual factors that modulate sensori-motor activity and demonstrate once more that language induced sensori-motor activation depends, in subtle ways, on contextual manipulations of lexical and discourse properties (e.g. van Ackeren et al. 2012; 2016; Egorova et al., 2014, 2016).

A reviewer remarks that situation models are also constructed “for events that are mentioned but do not take place”, and that, as a result, the relation between grip force activation and situation models is perhaps not so clear. Indeed, some recent literature supports the idea that actions linguistically presented as non-occurring, as in negated or counterfactual sentences, are correlated with an activation of brain regions involved in action execution. Urrutia et al. (2012), using fMRI, studied brain activation for sentences like *Since Pedro decided to paint the room, he is moving the sofa* (factual) or *If Pedro had decided to paint the room, he would have moved the sofa* (counterfactual). They concluded that the parietal cortex hosts the computation of action representations irrespective of the reality status of the sentences. De Vega et al. (2014) reached a similar but even stronger conclusion after another fMRI study where they contrasted factual, negated and counterfactual sentences using action verbs. For all their conditions, they found a similar activation in parietal regions, which are also involved in action observation.

Admittedly, the interpretation of such results is not crystal-clear (see the *Embodied or Conceptual Representations?* section in de Vega et al., 2014). Assuming that the conclusion of the authors is correct, that is, that some regions of the motor system are activated for negated and counterfactual sentences in a comparable way to factual assertions, how is it that we observe a variation with the grip force paradigm? There is at least one obvious possible explanation: the temporal resolution of fMRI and grip force is not the same. Urrutia et al. (2012) and de Vega et al. (2014) report a temporal resolution of 2000 ms, which is quite inferior to the temporal resolution of grip force (about 30 ms). If temporal resolution is the main factor, one can conclude that the two findings are perfectly compatible: actual *and* non-actual situation models activate motor system, but actual ones activate motor system in a rapid and strong way, resulting in an “overflow of language-induced cortical motor activity to the muscles” (Cayol & Nazir, 2020, p. 9). If there is some motor activation for counterfactuals, this could explain why we did not get a sharper difference between the Asserted Action and Non-Presupposed Action conditions in the second experiment. A sentence like *Paul believes that Ines ties her shoes* expresses the point of view of Paul, and the action clause is part of an alternative situation model, not unlike the alternative situation model of a counterfactual.

In philosophy of language and formal semantics, there is a rich tradition of *modal* analysis of propositions in terms of *possible worlds* (Portner, 2009). Although this framework is very abstract and not geared toward cognitive plausibility, it offers an interesting intuition: possible worlds can be *anchored* to a reference world. In everyday communication, this is the current world of our experience, in fiction this is the world of the fiction itself. These worlds are hyper-logical idealized situation models which provide the reality/fiction *baseline* in relation to which other worlds are located. We submit that, in the case of linguistic stimuli, strong grip force effects are observed when a participant listens to sentences which *commit* the speaker to a baseline situation model where a bodily action occurs. As we have explained in our answer to a comment by another reviewer (see note 1), commitment is the public conventional guarantee that a speaker offers as to her own beliefs. Of course, speakers may lie or joke, but, unless they provide evidence to the contrary, they are automatically perceived as sincere and serious and hearers react to the description they give of the baseline world. This does not entail that hearers necessarily believe what is said. Do the participants ‘believe’ the person who utters the various sentences in our experiments? We don’t know and are not even sure that the question makes sense. The important point is that a bodily action is referred to in the baseline world, whether this world is considered to be identical to our real world or not. In belief sentences like *Paul*

believes that Ines ties her shoes, we don't know whether the belief that Ines ties her shoes is true or false but we know that the speaker does not endorse its truth in the baseline world. What she is committed to is the truth of Paul believing that Ines ties her shoes. In contrast, with a factive verb like *know*, the speaker is committed to the truth of *Ines ties her shoes* in the baseline world, by the very definition of factive verbs.

The results of Experiment 1 and 2 are also relevant to the classic problem of *compositionality*, that is, the idea that the meaning of a sentence is a function of its grammatical structure and the meaning of its parts (Hinzen et al., 2012). This discussion is often centered on the question of whether the meaning of single words is computed first and then combined into a global interpretation, or whether a global interpretation is derived immediately or at some intermediate stage (see Degen, 2013 for a discussion of implicatures). Our results provide evidence against an account that considers that the dominant factor of motor activation is the lexical content of the action verb because the critical action verb does not provoke a grip force response in all conditions (e.g. no grip force increase in the non-presupposed complement in Experiment 2 nor in the first 1600 ms for the negated factive verb constructions of Experiment 3). In this respect, the first two experiments confirm the sensitivity of the grip force response to the construction of a plausible situation model based on the representation of events and all three experiments confirm the crucial impact of linguistic constructions on the motor response.

Regarding the symmetric findings in Experiments 1 and 3, it could be argued that negation blocked or delayed a possible motor representation in Experiment 3. Given that (i) the results of our pre-test of the third experiment indicate that the factive complement was considered as true in 84.2% of all questions, (ii) in the experimental material, we took care of adding an introductory clause facilitating projection and (iii) we observed a late activation of motor response in Experiment 3, we can safely assume that negation does not just suppress any representation of the event as true in the event model. In other terms, in a micro-text like *Robert is busy in the drawing-room, he does not see that Ghislaine is tying her shoes*, the negation of the second sentence can hardly be considered as *preventing* hearers to derive the proposition that Ghislaine is indeed tying her shoes and adding it to the current event model.

On the other hand, in view of the difference between Experiments 1 and 3, there is no question that negation affects the motor response. But *how*? Simons et al. (2017) and Beaver et al. (2017) have recently put forward a framework that challenges the conventional view of projection. According to the conventional view (e.g. Gazdar, 1979a, b; Heim, 1983, 1992), presuppositional behavior is considered as context independent, that is, it does not

systematically interact with contextually available information. In this line, factive complements *always* project, irrespective of the presence of entailment-canceling operators, such as negation and interrogation, or of different contexts. In contrast, Beaver et al. (2017) clearly show that the projective readings of factive complements can be contextually suppressed as illustrated by two of their examples as in (15) and (16), where the critical sentence is underlined. In example (15), the presupposed content referred to by *that* (i.e. the proposition that the newer designs being proposed are much safer) projects since A does not contradict B, whereas the same presupposition by A in (16) does not project. Beaver et al. claim that in cases where the presupposition is not under discussion as in (15), the content projects, whereas non-projective interpretations arise when the speaker is not committed to the truth of the complement, as in (16).

15. A: People are worried. We have a major nuclear event going on in Japan, and it's far too early to claim that things are under control.

B: Well, again, these are older designs. The newer designs being proposed are much safer.

A: Our citizens don't know that, so they remain concerned. More has to be done to educate and reassure them.

16. A: We have a major nuclear event going on in Japan, and it's far too early to claim that things are under control.

B: Well, again, these are older designs. The government assures us that the newer designs being proposed are much safer.

A: They don't know that. These were claimed to be the same—actually, the AP1000 that you were talking about building down in Vogtle, there are concerns right now about how well the containment will work.

According to Beaver et al.'s account, the projection criterion is not conventionally encoded *per se*, but interacts with the speaker's commitment to the truth of utterance. Adapting this framework to our results, if only the perspective of the speaker was taken into account, assuming that the speaker is judged as trustworthy and reliable, then a grip force activation should have also been observed in the projection experiment. However, given our decontextualized sentences, the speaker's perspective may not be the only one responsible for the recruitment of the motor system. Our results suggest that besides the speaker's perspective, the perspective of the agent may also be considered during the on-line recruitment of motor structures. When the speaker and the agent are committed to the truth of the utterance, then a grip force activation is observed as it is the case with factive verbs. If one of the truth conditions is not fulfilled, that is if either the speaker or the agent is not aware of the truth of the described

event, then a different pattern of activation is observed as it is the case in Experiment 2 and Experiment 3.

In summary, our results indicate that the perspective of the agent also has an effect and so, that the status of the event in the representation of the agent is part of the interpretation process. What remains to be determined is whether the very moderate activation observed for belief verbs and the initial absence for projection is only triggered by the presence of a hand-related action verb, i.e. an effect of the lexicon or rather to the fact that there is at least one point of view in which the motion event takes place, the perspective of the agent for belief verbs and the perspective of the speaker for projection. In the current experiment, the trustworthiness of the speaker has not yet been manipulated. Future research could fill this vacuum by manipulating the reliability of the speaker for the projective action condition. When the presupposed content is considered as true, then a projective reading should arise, which, as a consequence should trigger a grip force activation.

Thanks to the on-line nature of the grip force measure, the three experiments broaden our understanding of which linguistic environments elicit a grip force activation. More specifically, the use of this on-line measure allows to enhance our understanding of which linguistic environments recruit motor brain structures. In addition, it also provides new insights, which are not captured using an off-line measure as our results on the pre-test of the third experiment reveal.

Conclusion and Future Directions

Over the last decades, the question of the role of the sensorimotor system in meaning representation has been vigorously debated by philosophers and neuroscientists. In a recent review, Meteyard et al. (2012) places the answers to this question on a continuum ranging from strong embodied positions (e.g. Gallese & Lakoff, 2005; Glenberg & Kaschak, 2003) to disembodied accounts (e.g. Mahon & Caramazza, 2008).

On the one hand, strong embodied accounts maintain the existence of a close link between linguistic meaning and sensorimotor structures and suggest that language processing depends on the recruitment of distributed networks of sensorimotor structures. On the other hand, disembodied accounts defend the independence of linguistic meaning from sensorimotor structures by arguing that their recruitment is no evidence of an explanatory and causal link between language processing and sensorimotor structures.

There has been ample evidence that the truth may lie between these two opposite positions. A review by Willems and Casasanto (2011) points out that language-induced motor recruitment appears to be highly flexible and is moderated by situational context, be it linguistic or extra-linguistic (with regard to the linguistic context see, e.g., Aravena et al., 2012; 2014; Tettamanti et al., 2008, van Ackeren et al., 2012; with regard to the extra-linguistic context, see, e.g., Hoenig et al., 2008). In our studies, we investigated whether the factivity of a complement clause modulates the recruitment of sensorimotor areas. Our findings suggest that it does: factive action-related complements trigger a grip force activation whereas non-factive complements elicit a weaker response. This challenges the claim that action word meaning automatically recruit motor semantic features and that sensorimotor processing is necessary for conceptual or language processing. Our results are thus compatible with an account that assumes context dependency of language-induced motor activity. The activation of relevant action schemas, recruiting the same neural mechanisms as those active in overt behavior, selectively contributes to meaning representation as a function of the role the action plays in the overall discourse representation.

The current studies open up interesting directions for future research. While they demonstrate the selective involvement of the motor brain in the processing of hand-related action verbs, they leave open the question of what the role of such an activation is. Recent studies by Milleret al. (2018) investigated the sensitivity of ERP measures to hand and foot movements, as well as hand- and foot-associated words. While they consistently found ERP differences for hand versus foot movements, they showed no evidence of a difference for hand-versus foot-associated words. The grip-force method has the potential to further contribute to this line of research by investigating the extent to which the sensorimotor activation it captures is univocally linked to the processing of hand-related semantic meanings (rather than reflecting a more general motor activation).

The implications of the studies presented in this paper go beyond the debate on embodiment, and directly address questions that are relevant to linguistics theories. In the present experiments, we focused on the distinction between factive (*know*) and non-factive verbs (*believe*). By contrasting these two conditions, our data suggest that the truth-conditional status of a clause (as determined by a factive verb) is a precondition for the recruitment of motor structures in language processes. These findings thus support a linguistic theoretical frame that considers the speaker's commitment to the truth of presupposed information as a central property of presuppositions (Peters, 2016), but they are also compatible with the idea that the

agent's perspective has some impact during the recruitment of motor brain structures (Experiment 2).

At this stage, the question naturally arises whether our observations are an effect of the particular structure of factive constructions or whether the conclusions they suggest extend to other presuppositional constructions. Recall that we chose factive constructions as a starting point for our experimental investigation because, in such constructions, the asserted content and the presupposition are expressed explicitly. This is not the case with other constructions. The present investigations must thus be extended to other presupposition triggers and we will briefly discuss some reasonable follow-ups in this direction. One important issue is that, with factives, the action-related verb occurs only in the presupposed part (the clausal complement), which prevents any direct comparison between asserted content and presupposed content in terms of motor response. As a result, what we have shown is that, when there is an action-related verb, the fact that it occurs in the presupposed part does not block or weaken the motor response. But what happens if asserted content and presupposed content have an opposite motor polarity (action vs. no action)?

Change-of-state verbs like *begin* or *stop* illustrate precisely this point. They assert the most recent event and presuppose a less recent state of affairs with an opposite polarity. For instance, *Paul stops ironing his shirt* asserts that Paul does not iron his shirt and presupposes that he has been doing so before. If the situation model contains all events referred to by the sentence, irrespective of their recency, it is possible that the two events (ironing vs. not ironing) cancel out and that no significant motor response is recorded. If the event of not-ironing is more salient, one would predict a null or weak motor response, and, correlatively, a stronger motor response for *Paul begins ironing his shirt*.

While change-of-state verbs are an interesting empirical family because they combine layers of information with opposite polarities, they are not the only ones with distinct presuppositional patterns within the heterogeneous class of presupposition triggers. Another major issue is the role of *focus*⁵⁵, that is, this part of the sentence information which might be taken to address a question. For instance, with clefts such as *It's Paul who irons his shirt*, the presupposition is that someone irons a shirt and the asserted content is that it is Paul who does

⁵⁵ The term *focus* is understood here as in linguistics (a sensible answer to a potential question) and is not to be confused with the meaning it has in Zwaan and Taylor's (2008) paper, mentioned in the introduction.

that. The sentence is most naturally viewed as a possible answer to a question like *Who irons his shirt?* So, the focus is on *Paul*, not on the presupposition, and one may wonder whether there is some effect on the motor response. If the latter is not significant, this would probably indicate that our hypothesis that the truth-conditional status of an action-related event is sufficient to trigger a motor response has to be amended. A similar question arises for *exclusives* (*only, just*), whose focus structure is a matter of debate (Beaver & Clark, 2008). So, more work is needed to construct a more complete picture of the relations between motor response and coded semantic layering.

Chapter 5: Discussion and Conclusion

The work presented in this thesis explores the phenomenon of presupposition with an experimental approach by combining different perspectives on this subject. On the one hand, it explored its place in the context of the assessment of the reliability of communicated information and the trustworthiness of its source. By looking at communication as a primary source of knowledge, we investigated the impact of the way in which information is communicated on the assessment of the trustworthiness of speakers who have been found to be unreliable. This investigation focused on the interpersonal nature of communication and the trust relation that interlocutors establish when they learn from each other via communication. It thus looked at the relation between speakers and addressees, and the way in which this is affected by the transmission of false information as a function of the level of meaning at which the misinformation is communicated. On the other hand, this work adopted a complementary perspective, one that zooms in on the cognitive mechanisms that underpin communication, and more specifically presupposition processing. These two perspectives, the interpersonal and the processing one, are both essential to achieve a better understanding of the complex phenomenon of information layering in communication. In what follows, I will first discuss the main results and implications of the three experimental studies presented in Chapters 2, 3, and 4. I will then conclude by drawing some general conclusions about the overall contribution of this thesis to the constantly evolving field of experimental pragmatics.

Study 1

The first study of this dissertation empirically investigated whether different levels of meaning convey varying degrees of speaker commitment. More precisely, we operationalized commitment as a function of the reputational cost inflicted to the speaker when a piece of communicated information is found unreliable and we compared three different levels of meaning, that is, assertions (what is said/explicatures), presuppositions, and implicatures. The overall results of this study showed that different levels of meaning have an impact on speaker's commitment. In this discussion, I will primarily focus on the results concerning the presupposing speaker.

First, our findings demonstrate that higher reputational costs are incurred by a presupposing than an implicating speaker. More precisely, the latter is trusted more than the former after the conveyed information is found unreliable. Such a finding is highly interesting since both layers of information are considered as part of implicit communication. This suggests that is not implicitness per se to be relevant for considerations about the speaker commitment,

but that the distinction between presuppositions and implicatures has some important implication for an audience's judgment of epistemic trustworthiness. Furthermore, it is important to notice that while presupposition and implicatures typically differ with respect to the distinction of foregroundedness/ backgroundedness, in our study, we controlled for the at-issueness of the content conveyed (which did not vary across different levels of meaning). Given the foregrounded/ backgroundedness distinction, the information conveyed by an implicature and presupposition is usually not on a par since the presupposition is typically information that has already been established a priori. However, in this experiment, after a context story, the participant was presented with information uttered via an implicating speaker (1a) or a presupposing speaker (1b).

1. a. Louis gave a presentation at the central office yesterday evening.
(Implicating speaker)
- b. It was Louis who removed the projector. It is at the central office.
(Presupposing speaker)

The implicature and presupposition carry the exact same content, that is, that both address the question asked by person A of the context story (see Chapter 2, Table 1). Thus, the information conveyed by the presupposing and implicating speaker always corresponded to the main point of the utterance and was highly relevant to evaluate the truth of the utterance and the corresponding speaker's commitment. Therefore, this main result, that is, that an implicated speaker is trusted more cannot simply be reduced to the nature of the content conveyed (at-issueness vs. non at-issueness), but it is related to the information packaging. Presupposed information is not only information that is backgrounded but it is also information that cannot be cancelled when unembedded. As discussed in Chapter 1, Geurts (1999) notes that a speaker that uses a presupposition commits herself to the truth of the presupposition and cancelling this commitment (i) to the information that she has taken for granted or (ii) to the information that can be agreed on *without fuss* (von Fintel, 2000) would result in a very odd discursive move. In contrast, an implicating speaker can, if needed, directly cancel the implicature, which, in turn, may indicate that she is less committed to the information conveyed by the implicature. This is exactly what our experimental results suggest. A speaker who conveys false presupposed information is trusted less than a speaker conveying false information via an implicature independently from the nature of the information. Such a result suggests that implicating allows the speaker to get the exact same message across as a presupposed speaker; however, it incurs less reputational damage than a presupposing one. It seems that implicating is a powerful

strategy to reduce a decline in trust which would occur if the same content is conveyed via a presupposition.

In his theoretical proposal, Moeschler (2013) points out that the notion of commitment is linked to two factors; (1) the nature of the inference – semantic versus pragmatic – and (2) the accessibility of the inferred content. According to the first factor, his theoretical proposal predicted that presuppositions are more committal than implicatures. Applied to our study, this means that a speaker that conveys false information via an implicature should be trusted more than a speaker that conveys false information via a presupposition. Our results are line with the prediction of his proposed first factor. However, Moeschler's second factor predicts that foregrounded information is more committal than backgrounded information. Given though that the information conveyed by the implicating and presupposed speaker, as pointed out before, carried the same content, and that this content was meant to carry the main point of the utterance by addressing the question of speaker A, we may assume that accessibility did not vary across our conditions. This allows us to conclude that, at least in those cases in which the difference in accessibility is neutralized, presupposing is taken to be more committal than implicating. To better understand if accessibility plays a specific role in attribution of speaker commitment, further research should directly manipulate this factor.

Second, concerning the comparison between an asserting and a presupposing speaker, we did not find a significant difference between the two conditions, neither in experiment 1 nor in experiments 2a and 2b. In experiment 1, we used the following presupposition triggers: (i) the iterative *too*, (ii) change of state verb *repair*, (iii) the factive predicate *relieve*, and (iv) an it-cleft construction. In addition, we extended the words and linguistic constructions that can trigger a presupposition to the following ones in experiment 2a: (v) *only*, (vi) a definite description, (vii) an *if ... then* construction, (viii) *even*, (ix) *also*, (x) *too*, and (xi) a temporal construction involving *after*. In our experiments, there was not enough evidence that the two layers of meaning incur different degrees of commitment, even if applying Glanzberg's (2003, 2005) distinction between weak and strong presupposition triggers (as in Experiment 2b). Neither strong triggers, that are presuppositions that should trigger an obligatory repair nor weak triggers, presuppositions that trigger an optional repair, lead to an attribution of a different degree of speaker commitment to the presupposition when compared to the asserted content. Interestingly, this result does not support Moeschler's prediction that presupposing is more committal than asserting.

It is important to note that Moeschler focused on explicatures that are less explicit than the ones used in our experiment. For instance, B's answer in example (2b) is more explicit than the one in (2a) (example is taken from Sperber & Wilson, 1995, pg. 182).

2. A: Do you want to join us for supper?
 - a. B: No, thanks. I've eaten.
 - b. B: No thanks. I've already eaten supper tonight.

In our experiment, the chosen experimental stimuli were similar to the ones in (2a), that is, that the asserted content was maximally explicit in which no gap between the decoding of the utterance and the inference takes place. For this reason, it seems to be important that further research examines different degrees of explicitness to better understand their degree of commitment.

In the following, I will discuss the absence of an effect of the presupposing versus the asserting speaker with respect to the literature on presuppositions. In the theoretical literature on presuppositions, some scholars like Lombardi Vallauri (2016) argue that presupposing is less committal than asserting as the speaker can more easily distance herself from the presupposed content since responsibility can be deferred to another source. In addition, Lombardi Vallauri argues that one of the purposes of a presupposition is "to prevent the addressee from becoming completely aware of the details of that, lest he may challenge or reject it" (pg. 1114). To support his proposal, he reports empirical research that indicates that false information that is not the focus, but only the topic of the utterance incurs lower processing costs (e.g., Wang et al., 2009) and that false information is less likely to be detected (e.g., Bredart & Modolo, 1988). Moreover, conveying false information can be a powerful strategy to incur higher rates of intrusions errors in a memory task (Loftus, 1975). Our results do not support Lombardi Vallauri's predictions neither. It is important to note that his proposal is motivated by and mainly based on an analysis of advertisements or propaganda. This type of communication does not provide the possibility to the addressee to directly challenge the content. In our study, though, direct reputational damage is attributed to the speaker. Therefore, different underlying mechanisms may be at stake. When the speaker can be directly challenged, which is not the case in an advertisement or propaganda, more attention may be attributed to the conveyed information, that is, the information is scrutinized more deeply. Consequently, Lombardi Vallauri's argumentation may not be applicable for communication, in which the speaker can be overtly challenged.

It is important to point out that the study on speaker's commitment did not explicitly distinguish between deceptive and honest but mistaken communicators. Therefore, future research should investigate the impact of intentional and accidental misinformation on the relation between reputational costs and different meaning relations.

In summary, the first study of this dissertation shows that different layers of meaning have an impact on the interpersonal aspects of communication related to violations of commitments to the truth of the message communicated. Higher reputational costs occur for presupposing speakers than for implicating speakers when their message is found unreliable, whereas no difference in terms of reputational damage is found between the asserted and presupposed speakers. To our knowledge, this was the first study that linked speaker's commitment to different levels of meaning.

Study 2

The main aim of the second study was to investigate the on-line processing of discourse attachment in felicitous discourse continuations. In the literature on presuppositions, in particular when it comes to discourse attachment and the distinction between at-issue and non at-issue content, the majority of empirical research indicates that discourse continuations targeting the presupposed content receive lower judgment scores compared to the asserted content (e.g., Cummins et al., 2012) and also incur an immediate processing cost (e.g., Cowles et al., 2007). The second study of this dissertation focused on the processing of a specific type of discourse relations, additive relations, that make attachment to the presupposition possible. In these circumstances, the typical unavailability to discourse attachment of presuppositions can thus be overridden by contextual factors, e.g. additive contexts. Despite being felicitous, we hypothesised that discourse attachments to the presupposed content would come with a processing cost compared to attachments to the asserted content. We found no support for this hypothesis. Contrary to our expectations, our two experiments indicate that, for factive verb constructions, there is no difference between the asserted and presupposed content with respect to felicitous discourse continuations. These results suggest that the different discourse attachment properties of asserted and presupposed content are not due to a default unavailability of the presupposed content in discourse. That is, the presupposition is not by default less accessible than asserted content. When the discourse relation is such that targeting a presupposition is possible, this does not lead to any extra cognitive effort.

An alternative way to explain these data could be to argue that they are the results of the factive complements investigated not having a non-at-issue status. A recent proposal by Beaver

et al. (2017) suggests the context sensitivity of the factive complement. In some contexts, the factive complement could be at-issue and not backgrounded. Therefore, one may argue that the absence of an effect in Study 2 is linked to the at-issueness of the factive complement. This is a possibility; however, we think that it is unlikely that the potential at-issueness is the underlying force behind the absence of an effect. Even assuming that in certain contexts the factive complement does not project, these contexts are quite specific, and their construction may require the presence of additional cues like prosodic cues (e.g., Beaver & Clark, 2008). Given the minimal nature of the contexts created for our experimental stimuli, the accessibility of such an interpretation remains doubtful. Indeed, our pre-test shows that addressing the asserted content to questions like *Did Christel notice that her father regained his appetite?* is preferred; more precisely, continuations to the asserted content were largely preferred (92%) in our forced choice experiment. Therefore, it appears that it is the asserted content, and not the factive complement, to be considered at-issue in answerhood to question scenarios. However, in cases in which both contents can be addressed, as in the additive contexts we exploited, our ERP results suggest that there is no ‘default’ level of expectedness since discourse relevant presuppositions appear to be as expected as the asserted content. It is thus likely that the unavailability to discourse attachment typically displayed by presuppositions is a by-product of discourse structuring.

Future research should investigate whether our findings can be extended to other presupposition triggers in which the presupposed content has a more implicit nature, like change of state verbs.

Study 3

Using the grip force sensor technique (Aravena et al. 2012, 2014; Frak et al. 2010; Nazir et al. 2017), in three experiments, we investigated the involvement of the sensori-motor system in information layering. In Experiment 1, we compared asserted information with information embedded under a presuppositional factive verb construction. In Experiment 2, we extended our investigation to a non-factive verb construction. Lastly, we examined whether the projection behavior of a factive verb construction modulates sensori-motor activation under negation (Experiment 3). The main results of our three experiments indicate the following:

1. Presupposed (Experiment 1) and non-presupposed action verbs (Experiment 2) trigger different grip force activations. More precisely, presupposed action verbs trigger a different grip force response when compared to non-action verbs, but not in comparison

to asserted actions. For non-presupposed actions, our results indicate that the opposite is true.

2. Projected action verbs (Experiment 3) do not elicit an immediate grip force response. More precisely, the grip force response of factive complements in negated factive verb constructions differs significantly from asserted action verbs but not from non-action verbs. Moreover, our results also suggest that a moderate positive activation is observed 2000 ms after noun onset.

In what follows, I will first focus on Experiment 1 and 2 before turning to Experiment 3. Previous research indicated (van Ackeren et al., 2012) that the communicative potential of an utterance in context modulates the sensori-motor activation when this potential involves a request for an action. Our results extend these findings showing that sensori-motor activation is also activated in affirmative contexts in which the information is not part of the asserted content but conveyed as backgrounded information.

In Experiment 1, we hypothesised that action verbs of factive complements would elicit a grip force activation, but that their marginal status compared to asserted information would have had an impact on the corresponding grip force response. Our results indicate that not only do presupposed action verbs elicit a grip force response, but this response does not differ significantly from that elicited by asserted action verbs. It may seem that these results are in line with accounts that favour an automatic activation, according to which it is the sole mention of the action verb that should be responsible for the activation of the sensory and motor system (e.g., Pulvermüller, 1999, 2005). However, taking into consideration the results of Experiment 2, this interpretation of our results cannot go through.

In Experiment 2, we investigated non-factive verb constructions. Our results show that non-factive verb constructions elicit a significant weaker grip force response than asserted actions. Such a result provides evidence that the driving force behind the grip force activation is not the action verb itself, but the embedded structure. The complement of factive predicates is backgrounded and assumed to be true, whereas the complement of non-factive complements has an unknown truth status, that is, it can either be true or false.

Taking together, the results of the first two experiments suggest the following: First, the dominant factor of motor activation is not the lexical content of the action verb but is the linguistic construction that embeds it. It is, thus, the linguistic environment that plays a crucial role during the generation of a motor response (e.g., Willems & Casasanto, 2011). Second, they

also provide evidence that the reported differences in on-line processing between factives and non-factives observed in EEG studies with contextualised scenarios (Ferretti et al., 2009, 2013; Shetreet et al., 2019) are also present in decontextualized ones. With respect to our stimuli, no prior information was provided, so neither the reliability of the source nor the consistency of the embedded information may have had an impact. Therefore, it may be possible that the difference between both predicates is deeply ingrained in the human language system. In one of the early studies on factive and non-factive predicates, Hopman and Maratsos (1978) investigated the factives *know*, *sad*, *happy*, *surprising*, and *nice* and the non-factives *think*, *possible*, *want*, and *desire* in children. Their results indicate that the distinction between factives and non-factives predicates was already well-developed at around age 7. Furthermore, their results also show that cognitive factives are understood with more ease than emotive factive predicates⁵⁶. Even at an early age, children are aware of the presuppositional status of factive complements which, potentially, may activate and train different cortical circuits, which, in turn, build different activation patterns compared to non-factives. Further research should investigate the corresponding circuits activated during the processing of factives and non-factives.

In the last experiment of this study, we investigated if the projected action elicits a grip force response. Our results indicate that this is not the case, at least not immediately after verb onset. However, our results also suggest that the projective interpretation is less uniform, delayed and/or weaker than the factive interpretation of Experiment 1. One may argue that negation blocked or delayed a possible motor response. As discussed in the general discussion of chapter 4, we believe that it is very unlikely that this is really the case. We presented several arguments in favour of this interpretation. Here, I will only focus on the argument based on individual differences, which relies on the observed late activation of motor response in half of the participants. It is interesting to discuss these findings in the context of further data on individual differences in presupposition processing. Chemla and Bott (2013)⁵⁷ investigated the projection phenomenon of factive verb constructions in sentences like (3). Participants who responded *false* to these types of sentences were grouped as global interpreters. In these cases, the factive complement projects (3a). In contrast, responders who responded *true* did not interpret the sentence globally but locally. In these cases, the factive verb does not project.

⁵⁶ In our experiment we used only cognitive factives. For the detailed list, see material section of chapter 6, Experiment. We deliberately avoided the use of emotive factives since they trigger the subjunctive in French, which may have add more complexity.

⁵⁷ Here I will only focus on their experimental sentences.

3. Zoologist do not realise that elephants are birds.
 - a. Global: [elephants are birds] and not [zoologists believe so] (false)
 - b. Local: NOT [(elephants are birds) AND (zoologists believe so)] (true)

62% of the participants interpreted the sentence globally⁵⁸. In addition, Chemla and Bott also examined the reaction times of global and local interpretations⁵⁹. Their results indicate that (i) projection is not a default interpretation and (ii) global responders respond faster than local responders. Taken together, these data suggest the presence of individual differences in the interpretation of projective contents.

Relating their findings to our experiment, only participants that interpreted the sentence globally may have inferred that the action described by the embedded action verb indeed took place. For instance, based on a local interpretation (4b) of one of our stimuli (4), the action of *tying* would not be taken for granted and so, no grip force activation should arise. In contrast with this, the global interpretation (4a) should elicit an activation.

4. Robert is busy in the living room. He does not see that Ghislaine ties her shoes.
 - a. Global: [Ghislaine ties her shoes] and not (Robert believes so)
 - b. Local: NOT [Ghislaine ties her shoes] and (Robert believes so)]

It is important to note though that putative individual differences do not explain the absence of an early grip force activation. In the discussion of chapter 4, we suggested that the prominence or relevance of the agent's (Robert's) perspective over that of the speaker (unknown) might have had an impact on the recruitment of motor structures. Future research could thus investigate the role of perspective taking in language-related sensori-motor activation.

To conclude, the aim of the third study was to investigate the processing of different layers of meaning with respect to the engagement of the sensori-motor system. There is ample of evidence that language-induced motor activation depends on linguistic and extra-linguistic factors (for a review, see Willems and Casasanto, 2011). Moreover, individual differences also play a role during the activation of motor structures (e.g. for a study on handedness, see Willems et al., 2010; for a comparison between hockey and non-hockey player, see Beilock et al., 2008; Lyons et al., 2010). Our results are in line with an account that assumes context dependency of language-induced motor activity and opens up interesting directions for future research. We believe that further investigation of individual differences and of other presupposition triggers

⁵⁸ I only discuss the results of experiment 1. In Experiment 2, 64% interpreted the sentence globally ($SD = 31\%$).

⁵⁹ According to their *true* and *false* responses, participants were ranked as global or local responders. For subsequent analyses, one half was classified as local responders and the other one as global responders.

like aspectual verbs, it-cleft constructions, *wh-question*, etc. could not only contribute to that debate, but also enrich our understanding of the cognitive correlates of presuppositions as well as of individual processing patterns. Lastly, the time-locked nature of the grip force method allows to observe the onset and offset of an activation after the encounter of an action word. To better understand the precise location and the involvement of distinct neural circuits and to complement our current understanding, other neurophysiological methods should be used.

Conclusion

After discussing the contribution of each study, I contextualise our findings within the broader perspective of experimental pragmatics as a discipline. Experimental pragmatics aims at fostering the dialogue between pragmatic theorizing and data generated via experimental methods borrowed from related empirical disciplines. It is important to emphasise that the relationship between theory and data envisaged by this approach should not be seen as a unidirectional process, but as a bidirectional one. On the one hand, thanks to the experimental approach, pragmatic theories can be empirically tested and key notions in pragmatics explored through different experimental settings. On the other hand, empirical data can buttress the development of evidence-based theorizing in pragmatics, as well as in proximal domains such as cognitive psychology and the neuroscience of language. In this conclusive section, I would like to emphasize the ways in which the research presented in this thesis contributes to strengthening the relation between theory and data in both these directions.

From theory to data

The central phenomenon investigated by this thesis was that of presuppositions, one of the levels of meaning identified in pragmatic research. The distinction between different levels of meaning represents indeed one of the key notions, if not *the* key notion, in pragmatics and goes back to the seminal works of Grice and Strawson, among others. Study 1 and Study 3 of this thesis demonstrated that this theoretical distinction has both a social valence and a cognitive significance. Indeed, thanks to different experimental techniques, these studies contribute to a better understanding of how different levels of meaning impact reputation management in communication (interpersonal perspective) and of how they are processed (cognitive perspective). While the relevance of this distinction for reputation management had never been supported by empirical data focusing on the pragmatic modulation of speaker commitment (but see Bonalumi, Scott-Phillips, Tacha, and Heintz (*forthcoming*) for a study which followed our steps in this investigation), much research already contributed to shedding light on the cognitive processing of different levels of meaning (for the distinction between asserted versus

presupposed content and ERPs, e.g., Burkhardt, 2006, 2007; Masia et al., 2017). To our knowledge, though, Study 3 is the first one to show that the presupposed or not-presupposed status of information modulates sensori-motor activation elicited by action-related verbs.

With this in mind, the results of Study 2 may seem to undermine this general conclusion that different levels of meaning maps onto different processing patterns. I believe there is no tension between these results. The main conclusion that should be drawn from Study 2 is that targeting a presupposed content in discourse does not necessarily result in additional processing costs than targeting an asserted one. Indeed, in contexts that equally support attachment to the presupposition or the asserted content, such as those introduced by additive discourse relations, both are easily accessible. This emphasizes the important role of the linguistic context in modulating the processing patterns and cognitive costs of certain discursive strategies. Future research in this field should thus place the context at the centre of the experimental investigation. In the first book carrying the title of *Experimental Pragmatics*, Sperber and Noveck (2004) begin the introductory chapter with the following words:

“How does our knowledge of language on the one hand, *and of the context* on the other permit us to understand what we are told, resolve ambiguities, grasp both explicit and implicit content, recognize the force of a speech act, appreciate metaphor and irony?”

(Sperber & Noveck, 2004, p. 1, *my emphasis*)

Within the first words, the authors acknowledge the role of *the knowledge of language* as well as the role of *the knowledge of context*. When it comes to the literature on presuppositions, many of the on-line studies conducted so far have largely been inspired by established traditions in psycholinguistics which often look at phenomena from a sentence level perspective. Therefore, it is worth extending the research on presuppositions to better understand the importance of context by following the line of some promising research in this direction (e.g., Domaneschi et al., 2018; Domaneschi & Di Paola, 2019; Shetreet et al., 2019, Tonhauser et al., 2018). This will shed light on the flexible processing of presuppositions in context.

From data to theory

Van Berkum, who is a well-known and highly appreciated scholar in the ERP literature on language processing, acknowledged in 2009 that the domain of experimental pragmatics can be beneficial for many related disciplines:

“Over the past few years, it slowly dawned upon me that, for all its high-tech tools and its ability to ‘look under the hood’, the cognitive neuroscience of language interpretation by and large wasn’t making as much progress and impact as it might have [...]. I think a major cause for this delay in progress

and impact is its relative detachment from research in linguistics and classic experimental psychology. If my analysis is correct, then *the emerging interdisciplinary field of experimental pragmatics should benefit us all.*”
(van Berkum, 2009, p. 308, *my emphasis*)

Inspired by this research attitude, the work presented in this thesis aimed at a contribution to some current discussion in the cognitive neuroscience of language by providing new empirical evidence based on a pragmatic understanding of the phenomena at issue. More specifically, when it comes to language processing, much debate involves the extent to which this is *embodied*, and involves the recruitment of sensori-motor areas. The results of this thesis can thus be relevant to address the broader question of the relation between language comprehension and the sensori-motor system. Furthermore, future research could focus on other presupposition triggers, for instance, those giving rise to more implicit presupposed contents or characterised as less strong than factive verbs. I believe that the investigation of the heterogeneous class of presupposition triggers will not only increase our knowledge of how distinct triggers are processed, but they can also enrich our understanding of the flexibility of language-induced motor activity.

This thesis also intended to contribute new data to shape the theorizing on topics, such as reputation-management, which fall within the scope of work in cognitive and evolutionary psychology. To our knowledge, this study was the first that linked to investigate the extent to which commitment attribution is modulated by pragmatic, rather than lexical, cues. As commitment is a mechanism that plays a crucial role in making communication evolutionary stable – in that it contributes to maintaining it advantageous for speakers and hearers – the obtained results bring to light the relevance of experimental pragmatic data for broader theoretical discussion on the evolution of communication.

For these reasons, I believe that the results of this thesis should be of interests to the broad community of researchers in linguistics, philosophy, psychology, and neuroscience that is committed to the exciting and collective enterprise of understanding the complexity of human language and communication.

Chapter 6 : Résumé de chaque chapitre en français

Introduction

« *De retour à Vienne, tôt dans la matinée, après trois jours revigorants passés à la montagne, le célèbre romancier R. n'eut qu'à survoler la date d'un journal qu'il venait d'acheter à la gare pour se rappeler que c'était aujourd'hui son anniversaire. Son quarante-et-unième anniversaire, eut-il vite fait de calculer, et cela ne lui fit ni chaud ni froid. Il feuilleta distraitement le journal, dont les pages crépitaient sous ses doigts, et prit un taxi pour regagner son appartement.* »

(Stefan Zweig, 1922, *Lettre d'une femme inconnue*)

En lisant l'incipit de cette nouvelle (une de mes préférées), vous commencez à construire un monde fictif dans lequel on imagine que l'histoire se déroule. Vous construisez ce monde en combinant des informations textuelles avec votre propre connaissance du monde réel (vos connaissances sur Vienne, les gares, les kiosques à journaux, etc.). Ce monde fournit un contexte, en constante expansion et ouvert aux révisions, pour interpréter de nouvelles informations au fur et à mesure que l'histoire se déroule. La voix narrative vous invite à prendre certaines informations comme acquises et à les intégrer dans ce contexte. Par exemple, elle *présuppose* que R. est un romancier célèbre ("*le célèbre romancier R., [...]*") qui vit à Vienne mais qui était parti ("*De retour à Vienne, tôt dans la matinée [...]*") pour de courtes vacances ("*[...] après trois jours revigorants passés à la montagne [...]*"). La manière dont ces informations sont présentées suggère qu'elles doivent être prises comme arrière-plan pour interpréter ce qui va se passer en ignorant les détails du récent voyage de R et en vous concentrant sur quelque chose de nouveau. Ce mode de présentation est rendu possible par l'utilisation d'expressions ou de constructions linguistiques, telles que des descriptions définies, des verbes de changement ou des clauses temporelles, que les linguistes ont appelées des *déclencheurs de présuppositions*.

Lorsque Stefan Zweig a publié cette nouvelle, *Lettre d'une femme inconnue*, les philosophes discutaient déjà du phénomène des présuppositions depuis exactement 30 ans. C'est le philosophe Frege qui, en 1892, a introduit la toute première notion de présupposition par rapport à l'utilisation de descriptions définies : « If anything is asserted there is always an obvious presupposition that the simple or compound proper names used have referents » (Frege, 1892, p. 40). Ce fut le début d'une ligne de recherche très active, qui a vu les contributions de philosophes, de linguistes et de psychologues au fil des années, et qui représente toujours l'un des sujets les plus débattus dans l'étude de l'utilisation des langues.

En effet, ces dernières années, la recherche sur les présuppositions a intégré de nouvelles méthodes grâce au développement de la discipline de la *pragmatique expérimentale*, qui a initié une approche expérimentale de l'étude de l'utilisation et de la compréhension des langues, ce qui relève de la pragmatique (voir Noveck, 2018 pour une discussion intéressante sur l'histoire de ce domaine). Cette thèse s'inscrit dans cette tradition de travail, à laquelle elle contribue de deux manières différentes. Premièrement, en soumettant à une investigation expérimentale des questions théoriques qui n'ont pas encore été abordées avec des données empiriques. Deuxièmement, en élargissant le répertoire des méthodes expérimentales qui sont utilisées pour l'investigation des phénomènes pragmatiques. Dans les deux cas, cette thèse contribue à l'approche interdisciplinaire de la pragmatique expérimentale en créant de nouveaux ponts avec la recherche en psychologie et en neurosciences. Dans ce qui suit, j'expose les principales contributions attendues de cette thèse et les questions de recherche sous-jacentes.

Nouvelles questions de recherche en pragmatique expérimentale

I. Comment l'engagement des locuteurs est-il modulé de manière pragmatique ?

Les travaux récents en psychologie évolutionniste et cognitive ont ouvert la question du rôle de l'engagement du locuteur dans le choix des partenaires coopératifs ou des sources d'information. En se concentrant sur l'étude de la confiance comme expression de l'engagement du locuteur, Vullioud, Clément, Scott-Phillips et Mercier (2017) ont découvert que l'excès de confiance peut se retourner contre le locuteur dans les cas où de fausses informations ont été communiquées. Lorsque l'on compare des personnes confiantes (« *Je suis sûr que...* ») à des personnes moins sûres d'elles (« *Je ne suis pas vraiment sûr que...* »), les premières sont plus susceptibles d'être considérées comme des sources d'information fiables ; nous comptons sur les conseils de personnes confiantes pour former de nouvelles croyances ou orienter nos actions futures. Cependant, si le message communiqué s'avère faux ou peu fiable, les locuteurs trop confiants, qui se sont engagés à faire passer le message, encourent des coûts de réputation plus élevés que les locuteurs peu confiants (voir aussi, Tenney, Small, Konrad, Jaswal & Spellmann, 2011 ; Tenney, Spellmann & MacCoun, 2008). Les coûts et les avantages en termes de réputation jouent un rôle crucial pour garantir que la communication reste avantageuse dans une perspective évolutionniste (Dawkins & Krebs, 1978 ; Krebs & Dawkins, 1984 ; Maynard Smith & Harper, 2003 ; Scott-Phillips, 2008). Pour cette raison, la capacité à attribuer un engagement à des locuteurs et à ajuster leur réputation en fonction du respect ou non de leurs engagements représente un moyen important de contrôler la crédibilité de nos

sources d'information et de nous défendre contre le risque de désinformation (Sperber et al., 2010).

L'un des objectifs de cette thèse est d'aborder la question de savoir si l'attribution des engagements à des locuteurs est basée sur des considérations sur la manière dont les informations sont présentées dans le discours. Si tel est le cas, le fait de présupposer une information devrait conduire à attribuer un degré d'engagement différent à l'égard du message communiqué par rapport au fait de communiquer une information explicitement ou d'impliquer cette information. La première étude de cette thèse étend l'enquête sur le coût de l'engagement/de la réputation des locuteurs à différentes strates de signification et aborde la question de recherche suivante :

- (1) Les différentes strates de signification prises en compte: le locuteur communique explicitement une information, le locuteur qui présuppose une information, le locuteur l'implique. Ces strates transmettent-elles différents degrés d'engagement des locuteurs ?

Cette question, pour laquelle nous trouvons des réponses contradictoires dans la littérature linguistique, n'a jamais été étudiée de manière empirique. En effet, certains soutiennent que les présuppositions peuvent être plus responsabilisantes que les affirmations (par exemple, Peters, 2016), tandis que d'autres chercheurs soutiennent qu'un locuteur utilisant une présupposition n'est pas directement responsable de ce contenu (Ducrot, 1984, Lombardi Vallauri, 2016). La première étude de cette thèse permettra d'examiner cette question en testant expérimentalement le degré relatif d'engagement du locuteur à travers différentes couches de sens et d'emprunter des méthodes expérimentales utilisées dans la littérature psychologique sur le choix du partenaire et l'expression de la confiance.

II. Est-il plus coûteux d'enchaîner sur le contenu présupposé dans les attachements de discours ?

En lisant la phrase suivante *Peter a arrêté de fumer parce qu'il aimait ça* ou en répondant à la question *Est-ce que Peter a arrêté de fumer ?* avec *Oui, il fumait pendant plus de 10 ans*, on se rend immédiatement compte qu'il est assez étrange de cibler le contenu présupposé, à savoir que *Peter fumait auparavant*, par une suite de discours ou une réponse. Mais qu'y a-t-il d'étrange dans ces mouvements discursifs ? Leur point commun est qu'ils s'adressent à une information d'arrière-plan et qui n'est pas en discussion (*not at-issue*). En effet, de nombreux chercheurs ont montré que les présuppositions ne sont généralement pas disponibles pour les

attachements de discours (comme "*parce que [...]*", voir Ducrot, 1972), qu'elles ne fournissent pas de réponses aux questions (Grimshaw, 1979) et qu'elles ne portent généralement pas le point principal de l'énoncé (Simons et al., 2010).

Toutefois, cela est possible dans certains contextes particuliers. Par exemple, la suite du discours impliquant une particule additive telle que *aussi* peut enchaîner sur une présupposition. Dans *Lemmy est fier d'être bassiste, Roberto joue aussi de la basse* la suite cible la présupposition que *Lemmy joue de la basse*, et le discours semble être approprié (Winterstein, 2009). On ne sait cependant pas si le fait de cibler une présupposition dans le discours, même si cela est parfois possible, devrait entraîner des coûts de traitement cognitif plus élevés. Si le statut d'arrière-plan des présuppositions les rend moins saillantes ou moins accessibles, cela devrait entraîner des coûts de traitement supplémentaires lorsqu'elles sont ciblées dans la suite du discours (qu'il s'agisse d'une suite du discours ou d'une réponse à une question). La deuxième étude présentée dans cette thèse vise à découvrir les coûts cognitifs, s'il y en a, du ciblage des présuppositions dans le discours. Plus précisément, elle aborde la question de recherche suivante :

(2) Comment les présuppositions sont-elles traitées dans les suites de discours appropriées ?

Cette question n'a jamais fait l'objet d'une étude auparavant. Jusqu'à présent, la recherche expérimentale a étudié des scénarios conversationnels dans lesquels les suites de discours ciblant des présuppositions sont généralement considérées comme inappropriées. Cela a été indiqué par les études empiriques qui ont examiné les notations d'acceptabilité ou d'autres types de jugements de phrases (par exemple, Amaral & Cummins, 2015, Cummins et al., 2012 ; Jayez, 2010, Tonhauser et al., 2018). Ces résultats soulèvent les deux questions suivantes : premièrement, les résultats obtenus sont-ils dus au caractère pragmatiquement inapproprié ou au statut présupposé du contenu concerné ? Deuxièmement, est-ce que l'utilisation de méthodes utilisant une approche en temps réel nous permettrait d'avoir un aperçu plus précis du traitement des présuppositions dans le discours ?

En effet, l'un des principaux inconvénients de la méthode de jugement (acceptabilité, évaluation sur une échelle, etc.), qui est souvent utilisée pour mieux comprendre les continuations des phrases ciblant la présupposition, est qu'elle exige une certaine conscience de la langue, ce qui peut avoir un impact sur le jugement produit par les participants. Pour cette raison, notre étude se concentrera sur les attachements de discours approprié et utilisera la méthode de l'électro-encéphalographie (EEG), qui permet d'étudier les corrélats cognitifs du

traitement des présuppositions en temps réel. Grâce à sa capacité à mesurer le temps en millisecondes, cette méthode apportera un nouvel éclairage sur les coûts de traitement immédiats des présuppositions en ce qui concerne l'attachement du discours.

III. Y a-t-il des corrélats sensori-moteurs du traitement des présuppositions ?

Des recherches récentes en neurosciences ont exploré le rôle du système moteur dans le traitement du langage. Il a été découvert, par exemple, que les verbes d'action provoquent une activation sensori-motrice (voir entre autres Hauk, Johnsrude & Pulvermüller, 2004 ; Tettamanti et al., 2005) : en lisant que *Rob écrit sa thèse*, le verbe d'action *écrire* provoquera l'activation des zones sensori-motrices associées à l'action d'*écrire*. Cette activation semble être modulée, entre autres facteurs, par l'environnement linguistique dans lequel le verbe d'action s'inscrit. Par exemple, elle est réduite lorsque le verbe d'action est nié (*Rob n'écrit pas sa thèse*, voir Aravena et al. 2012 ; Tettamanti et al., 2008). Cette découverte ouvre une piste de recherche très intéressante consacrée à l'impact de l'environnement linguistique sur l'activation sensori-motrice liée au langage. C'est une piste qui commence seulement à être explorée conjointement par des linguistes et des neuroscientifiques ensemble. Il est intéressant de noter que, pour notre objectif, la plupart de ces études se concentrent sur l'effet des expressions ou des opérateurs linguistiques (négation, verbes de volonté comme *vouloir* ou *désirer*) mais n'abordent pas le rôle de la pragmatique et la distinction entre les différentes stratifications de sens. Une exception notable est représentée par van Ackeren et al. (2012), qui ont étudié l'activation sensori-motrice suscitée par des demandes indirectes. Par exemple, ils ont constaté que le fait que la visualisation d'une phrase « *Il fait très chaud ici* » soit présentée avec l'image d'un désert ou avec l'image d'une fenêtre fermée a un impact sur la réponse sensori-motrice des participants. Dans le deuxième cas, la phrase est plus susceptible d'être comprise comme une demande indirecte – *ouvrir la fenêtre* – et provoque donc une activation sensori-motrice. Lorsque la phrase est comprise dans son sens littéral comme une description de l'image - *Il fait très chaud ici* – l'activation sensori-motrice n'est pas observée.

La troisième étude présentée dans cette thèse portera sur la question de recherche suivante :

- (3) Un contenu présupposé active-t-il un degré d'activation sensori-motrice différent de celui d'un contenu posé ou non-présupposé ?

Dans une série de trois expériences, nous examinerons de plus près le traitement des prédicats factifs et non-factifs, par exemple *savoir* contre *supposer*. Alors que les premiers présupposent

la véracité de leurs compléments, les seconds ne le font pas. Non seulement l'emploi de constructions de verbes factifs (*Jacques sait que Rob écrit sa thèse*) permet de comparer directement son contenu d'action présupposée au même contenu d'action posée (*Rob écrit sa thèse*), mais aussi il nous met en position d'étudier si la factivité (*Jacques sait que Rob écrit sa thèse*) déclenche une réponse sensori-motrice distincte par rapport aux verbes non-factifs (*Jacques suppose que Rob écrit sa thèse*).

À notre connaissance, cette étude est la première dans la littérature de pragmatique expérimentale à s'appuyer sur une nouvelle méthode expérimentale : la méthode du capteur de force de préhension (Aravena et al. 2012 ; 2014). Cette méthode mesure la variation de la force exercée par les participants qui tiennent le capteur avec leur index et leur pouce. Cette variation peut être considérée comme une mesure fiable de l'activation des zones sensori-motrices impliquées dans l'exécution d'actions liées aux activités manuelles (par exemple, *l'écriture*). En utilisant cette méthode innovante, notre troisième étude apportera une réponse aux trois questions de recherche spécifiques suivantes :

- (3) a. Le contenu présupposé (lié à l'action manuelle) des constructions de verbes factifs active-t-il une augmentation de la force de préhension ?
- b. Le contenu (lié à l'action manuelle) des constructions de verbes non-factifs active-t-il une augmentation de la force de préhension ?
- c. Le contenu présupposé (lié à l'action manuelle) des constructions de verbes factifs négatifs active-t-il une augmentation de la force de préhension ?

En répondant à ces questions, cette étude contribuera à la littérature expérimentale sur le traitement des présuppositions. Ces dernières années, de plus en plus d'études ont porté sur le traitement en temps réel de déclencheurs de présuppositions distincts. Cet ensemble de travaux expérimentaux a fourni des indications importantes sur le déroulement temporel du traitement des présuppositions. Notre étude enrichit cette littérature en étudiant les corrélats cognitifs des présuppositions sous un nouvel angle. Nous nous concentrerons ici sur la relation entre la stratification du sens et l'activation sensori-motrice. Une telle approche nous permet d'établir ainsi un pont important entre la pragmatique expérimentale et la neurosciences appliquées au langage.

Plan de la thèse

Cette thèse est organisée comme suit. La première et deuxième partie du premier chapitre présentent une revue de la littérature théorique et expérimentale sur les présuppositions qui est

pertinente pour contextualiser les investigations empiriques originales que nous avons menées dans nos trois études. Étant donné l'orientation expérimentale de cette thèse, ces deux parties sont destinées à servir des objectifs très différents. La première partie vise à introduire les notions théoriques fondamentales qui ont occupé une place importante dans la littérature philosophique et linguistique sur les présuppositions. Ces notions clés comprennent notamment celles de *déclencheur de présupposition*, d'*accommodation de présupposition*, de *croyance partagée*, de *factivité*. En outre, cette partie présente les principales propriétés linguistiques et discursives des présuppositions, notamment leur comportement de projection, les propriétés d'attachement au discours et les engagements discursifs. Bien que l'objectif ne soit pas de fournir au lecteur une revue exhaustive de la littérature théorique qui touche à ces questions, cette partie introduira les éléments essentiels à la compréhension de l'investigation expérimentale menée dans le cadre de cette thèse. La deuxième partie vise à offrir une large perspective sur le corpus croissant d'études expérimentales sur les présuppositions, et à les passer en revue de telle sorte que le lecteur bénéficie d'une présentation systématique organisée autour de quelques questions de recherche d'actualité. C'est dans ce contexte que nous présenterons nos trois études expérimentales originales dans les dernières parties du chapitre 1 et présenterons chaque étude en détail dans les chapitres 2, 3, et 4. Enfin, une conclusion rassemblera ces études et leurs implications seront discutées et combinées en une image unifiée (chapitre 5).

Chapitre 1 : Questions ouvertes et aperçu des études

Étude 1 : Comment les différentes couches de sens influencent-elles l'engagement du locuteur ?

1.1. Ce que nous savons

Les présuppositions se projettent généralement et ne peuvent être annulés lorsqu'elles ne sont pas intégrées dans un environnement linguistique particulier. La première caractéristique distingue clairement les présuppositions des *enchâssements* et la seconde distingue les présuppositions des implicatures (Geurts & Beaver, 2011). En outre, j'ai également souligné qu'il existe une littérature émergente en matière de pragmatique qui vise à mieux comprendre comment différentes couches de sens traduisent différents degrés d'engagement des locuteurs. Il a été démontré que plusieurs marqueurs linguistiques traduisent différents degrés d'engagement, par exemple (i) les auxiliaires modaux (*devoir* comparé à *pouvoir*), (2) les adverbes (*certainement* comparé à *peut-être*), et (3) les évidences (*j'ai vu* comparé à *je suppose* contre *les gens disent* ; pour une liste plus exhaustive, voir Boulat & Maillat, 2017). Cependant, on sait peu de choses à propos de l'impact des différentes couches de sens sur l'engagement du locuteur.

Dans sa proposition motivée par une approche théorique, Moeschler (2013) suggère que des couches de sens distincts engagent le locuteur différemment. Il souligne que la notion d'engagement est liée à la notion de force et dépend de deux facteurs : (1) la nature de l'inférence - sémantique ou pragmatique - et (2) l'accessibilité du contenu inféré. Sur la base de la notion de force, Moeschler suggère que des couches de sens distinctes engagent le locuteur de manière différente. Concernant la nature de l'inférence, les *enchâssements* sont plus responsabilisants que les présuppositions, qui sont plus responsabilisantes que les explicitations, les moins responsabilisantes étant les implicatures (voir 1). Cependant, en tenant compte de l'accessibilité, l'ordre change : les explicitations sont plus responsabilisantes que les implicatures, qui sont plus responsabilisantes que les *enchâssements* et les présuppositions (voir 2).

1. Ordre basé sur la nature de la déduction
enchâssement > présupposition > explicitation > implicature
2. Ordre basé sur l'accessibilité du contenu résultant
explicitation > implicature > enchâssement = présupposition

Moeschler reconnaît que le destinataire peut évaluer l'engagement du locuteur sur les deux facteurs ; cependant, il ne fait aucune prédiction claire sur la force de chaque facteur.

Afin d'étudier la question de l'engagement et des relations de sens, l'étude 1 se concentrera sur la dimension sociale et interactionnelle de l'engagement, ainsi que sur la responsabilité du locuteur face à la critique et au blâme, qui sont étroitement liés avec toute violation de l'engagement (Harnish, 2005 ; Haugh, 2013).

Pour étudier l'engagement du locuteur dans cette perspective, une étude intéressante de Vullioud et al. (2017) a manipulé la confiance du locuteur en utilisant des expressions de confiance telles que « *Je suis sûr que c'est lui* » ou « *Je ne suis pas vraiment sûr* », qui sont considérées comme des *signaux d'engagement* (pour un exemple d'histoire, voir le tableau 1). Comme on peut le voir dans l'exemple fourni, les participants se voient présenter le témoignage de deux locuteurs, un confiant et un non-confiant. Ensuite, il est révélé que les informations des deux locuteurs sont fausses (voir l'expérience 2 de Vullioud et al., 2017, la colonne feedback du tableau 1). Les participants doivent alors décider lequel des deux locuteurs ils vont punir et en qui ils vont avoir confiance.

Tableau 1. *Plan d'expérience de Vullioud et al. (2017)*

	Context story	Confidence manipulation	Feedback	Punishment	Trust
Confident speaker	"Hello, I'm trying to reach the Swiss manager for international coordination. Do you know who he is and where I can find him?"	"Hi! International coordination, I know him! It's Mr. Descloux, in building L, for Lausanne. You can believe me, I'm sure it's him."	<i>Participants are told that both speakers were wrong</i>	The first project is a project that has no interest or importance. Taking part in this project is demeaning and can be seen as a kind of punishment . Whom do you give the task to?	The second project is an important and interesting project for a big client. Taking part in this project is gratifying and can be seen as a kind of reward . Whom do you give the task to?
Un-confident speaker		"Hi, hmm, I don't know but I think that for the international coordination, it's Mr. Grandjean, in building B, for Bern. But I'm really not sure".	<i>and then they are told the following:</i> You are the team leader of the two colleagues you saw during the coffee break. You are about to start two new projects.		

Les résultats de Vullioud et al. (Expérience 2) révèlent que lorsque les deux locuteurs se sont trompés, on a fait davantage confiance au locuteur non-confiant. Le dernier a été également moins puni par rapport au locuteur confiant. En d'autres termes, cette étude révèle qu'un locuteur trop confiant encourt des coûts directs plus élevés et une atteinte à sa réputation lorsqu'il s'avère que son témoignage est incorrect. Une telle conclusion soulève la question de savoir si et comment les différentes couches de sens peuvent moduler l'engagement du locuteur et, par conséquent, contribuent à la gestion de sa réputation.

1.2. Ce que nous ne savons pas encore

Actuellement, nous ne savons pas quel est l'impact des différentes couches de sens, ou de relation de sens, sur l'acceptabilité de l'information transmise et la réputation du locuteur en tant que source d'information fiable. Comme indiqué précédemment, pour mieux comprendre cette relation, l'étude 1 se concentrera sur la notion d'engagement.

La littérature linguistique sur la modulation de l'engagement par des relations de sens manque actuellement, tant sur le plan théorique qu'expérimental. Sur le plan théorique, nous manquons de critères de classification bien établis, et les classements reposant sur des critères distincts diffèrent les uns des autres. En outre, cette question n'a pas encore reçu d'attention dans le domaine de la pragmatique expérimentale.

Plus précisément, en ce qui concerne l'engagement du locuteur et les présuppositions, la littérature théorique ne présente pas une explication unifiée. D'une part, des chercheurs comme Peters (2016) constatent que les locuteurs sont fortement engagés lorsqu'ils présupposent quelque chose. D'autre part, les informations véhiculées par les présuppositions sont généralement non controversées (Simons, 2005) et ne font pas l'objet de discussions (par exemple Tonhauser et al., 2013). Par conséquent, il est possible que les présuppositions aient un impact sur le degré d'engagement du locuteur, qui pourrait être plus fort par rapport aux informations de premier plan telles que les contenus affirmés et impliqués. Dans ce cas, la réputation d'un locuteur qui présuppose devrait être plus sévèrement compromise si les informations transmises s'avèrent peu fiables. Lombardi Vallauri (2016), en revanche, soutient qu'un locuteur peut plus facilement se dissocier d'une information présupposée. Puisque le contenu présupposé a déjà été présenté par une autre source (ou au moins supposé faire partie de la croyance partagée entre les interlocuteurs), le locuteur ne devrait pas être tenu responsable de la fausseté du contenu présupposé. Un tel raisonnement peut suggérer que le locuteur n'assume pas de responsabilité directe pour le contenu présupposé transmis (par exemple, Ducrot, 1984 ; Lombardi Vallauri, 2016). Si cela est vrai, l'utilisation d'une présupposition devrait être moins responsabilisante que le fait d'affirmer ou d'impliquer la même information.

Comme indiqué précédemment, l'engagement porté par les différentes couches de sens n'a pas encore fait l'objet d'une étude empirique. Ainsi, nous ne savons pas encore ce qu'il advient de la réputation d'un locuteur lorsque l'information véhiculée par une présupposition s'avère fausse. La première étude répondra à la question suivante :

Le locuteur qui présuppose est-il considéré comme plus responsable du manque de fiabilité du contenu qu'il a transmis ou est-il tenu moins responsables que ceux qui affirment ou ceux qui impliquent ?

1.3. Ce que cette étude nous dira

La première étude de cette thèse examinera empiriquement si les différentes couches de sens traduisent des degrés différents en ce qui concerne l'engagement du locuteur. Plus précisément, nous examinerons si les fausses informations véhiculées par une présupposition entraînent un coût de réputation plus ou moins élevé par rapport aux affirmations et aux implicatures. Cette étude répondra à la question de savoir si la distinction théorique entre les différentes couches de sens a des conséquences sociales importantes en ce qui concerne la manière dont les interlocuteurs contrôlent la fiabilité de leurs sources d'information et adaptent leur réputation en matière de communication. En répondant à cette question, l'étude 1 contribuera à une

meilleure compréhension de la manière dont la confiance est négociée dans l'interaction et établira un nouveau pont intéressant avec la littérature en psychologie évolutionniste et cognitive sur la vigilance humaine face à la désinformation et la possibilité de tromperie.

Étude 2 : Comment les présuppositions sont-elles traitées dans les suites de discours appropriés ?

2.1. Ce que nous savons

De nombreux chercheurs ont fait remarquer que les présuppositions sont généralement soustraites au flux principal du discours. Tout d'abord, Ducrot (1972) soutient que le contenu présupposé d'un énoncé n'est pas disponible pour l'attachement au discours. Dans ses travaux fondateurs, il montre que seul le contenu posé est disponible pour les suites du discours⁶⁰. Deuxièmement, Grimshaw (1979) affirme que répondre à une question par une présupposition conduit à un discours mal formé. Selon elle, les présuppositions n'apportent pas de réponses naturelles aux questions car cela violerait un principe discursif sous-jacent, à savoir que l'on ne peut pas répondre à une question par une réponse qui considère sa réponse comme acquise avant que celle-ci ne soit établie. Troisièmement, dans son cadre théorique *Question Under Discussion (QUD)*, Roberts (1996) souligne que les mouvements discursifs doivent répondre à la question en cours de discussion pour être appropriés. Étant donné que la nature même des présuppositions est qu'elles sont considérées comme des informations qui ont été prises pour acquises, elles sont marginales dans le discours. C'est la raison pour laquelle elles ne contribuent souvent pas au point principal de l'énoncé. Dans de nombreux cas, les continuations du discours qui ciblent la présupposition sans la nier directement sont considérées comme inappropriées.

La littérature expérimentale sur le traitement des présuppositions indique que ces observations linguistiques ont trouvé un appui empirique dans les données expérimentales. Les résultats de Cummins et al. (2012) et d'Amaral et Cummins (2015) montrent que répondre à une question avec une présupposition est jugé moins acceptable que de répondre à une question avec une affirmation. En outre, Cowles et al. (2007) montrent que la réponse à une question utilisant une présupposition déclenche un traitement cognitif qui est différent de celui de la réponse à une question qui cible l'affirmation. Plus précisément, la réponse à une question avec une présupposition déclenche une N400 par rapport à la réponse à une question qui est considérée comme le point principal de l'énoncé. En outre, les conclusions de Wang et al.

⁶⁰ Ducrot mentionne aussi la possibilité d'enchaîner sur les deux contenus au même temps. Par contre, il n'est pas possible de cibler seulement le contenu présupposé.

(2009) suggèrent que les informations inappropriées sont traitées différemment lorsqu'elles sont transmises en tant que présuppositions et tant qu'affirmations. Une telle conclusion suggère que les informations qui contribuent à la *question en discussion* sont examinées de plus près que les informations qui ne sont considérées que comme marginales par rapport au flux principal du discours.

Les présuppositions sont non seulement jugées moins acceptables ou traitées différemment lorsqu'elles apportent des réponses à des questions, mais aussi lorsqu'une continuation du discours cible le contenu présupposé dans des scénarios de justification causale. Les résultats de Jayez (2010) soulignent que les suites ciblant le contenu présupposé dans des scénarios de discours de conséquence utilisant les marqueurs *alors* et *donc* sont jugées moins acceptables que leurs homologues, c'est-à-dire le contenu posé.

Jusqu'à présent, la littérature expérimentale n'a étudié que les cas où la prise en compte des informations présupposées dans les suites du discours est considérée comme inappropriée. Cependant, les suites de discours dans lesquelles le contenu présupposé n'est pas considéré comme inapproprié n'ont pas encore fait l'objet d'une enquête.

2.2. Ce que nous ne savons pas encore

Comme le montre en détail la première partie du chapitre 1, le fait d'enchaîner un discours sur le contenu présupposé est généralement considéré comme inapproprié. Cependant, il existe également des scénarios d'attachement du discours dans lesquels le ciblage du contenu présupposé ne représente pas une violation pragmatique. L'observation linguistique proposée par Winterstein (2009) révèle que les suites discursives contenant le déclencheur *aussi* représentent une exception notable à l'observation plus générale. Par exemple, la suite dans (3a) *Robert l'est aussi* est intuitivement aussi appropriée que la suite dans (3b) *Robert joue aussi de la basse*. Dans le premier cas, la suite du discours cible le contenu affirmé, tandis que dans le second cas, le contenu présupposé est abordé.

3. a. Lemmy est fier d'être bassiste, Roberto l'est aussi.
- b. Lemmy est fier d'être bassiste, Roberto joue aussi de la basse, [bien qu'il n'en soit pas fier].

Pour Winterstein, la particule additive *aussi* peut se référer à toute proposition antérieure indépendamment du niveau de sens exprimé si la même force entre *aussi* et ses antécédents existe. C'est exactement le cas dans les scénarios d'attachement du discours en (3a) et (3b). Selon sa proposition, les deux attachements sont considérés comme appropriés. À notre connaissance, aucune recherche n'a examiné ces attachements discursifs d'un point de vue

expérimental. Pour cette raison, la deuxième étude de cette thèse vise à apporter une réponse à la question de recherche suivante :

Les attachements de discours appropriés qui ciblent le contenu présupposé sont-ils plus exigeants de manière cognitive que les attachements de discours qui ciblent le contenu affirmé ?

2.3. Ce que l'étude relative à cette question de recherche nous dira

Jusqu'à présent, la recherche expérimentale a porté sur le jugement et le traitement des présuppositions concernant la réponse à des questions ou dans des scénarios d'attachement du discours où un tel attachement est considéré comme inapproprié. C'est la raison pour laquelle il est difficile de dire si les différences entre jugements et traitements des présuppositions par rapport aux contenus affirmés sont dues à une anomalie pragmatique ou à la nature même des présuppositions, c'est-à-dire au fait qu'elles ne sont pas en discussion. Afin de mieux comprendre l'impact sous-jacent, il est utile d'examiner les cas dans lesquels l'attachement du discours au contenu présupposé n'est pas considéré comme inapproprié. Une telle recherche expérimentale apportera des informations importantes sur le traitement des présuppositions dans les attachements du discours. Il semble raisonnable de supposer que, bien que le contenu présupposé soit approprié, il est traité différemment, car les informations transmises sont périphériques et ne font pas avancer le discours dans la direction souhaitée. Si tel est le cas, une telle constatation nous indiquera que le coût de traitement est directement lié aux présuppositions et non au fait qu'elles sont pragmatiquement ou discursivement inappropriées.

Afin de mieux comprendre le rôle sous-jacent des présuppositions dans les attachements du discours appropriés, la méthode pour mesurer les potentiels évoqués sera utilisée car elle permet de mieux comprendre les corrélats cognitifs des présuppositions et d'éviter d'exploiter les processus métacognitifs. La majorité des études portant sur les continuations discursives et le statut de présuppositions ont utilisé des jugements (par exemple Amaral & Cummins, 2015, Cummins et al., 2012 ; Jayez, 2010, Tonhauser et al., 2018). Afin d'éviter tout rôle des considérations métalinguistiques, nous avons utilisé la même méthode que celle utilisée par Cowles et al. (2007) qui ont étudié les ERP examinant la réponse aux questions en utilisant des clivées. Cette méthode permet d'étudier les corrélats cognitifs en temps réel des présuppositions dans les attachements de discours appropriés.

Étude 3 : Quels sont les corrélats cognitifs des différentes couches de sens dans les phrases décontextualisées ?

3.1. Ce que nous savons

Au cours des cinquante dernières années, la recherche a permis de mieux comprendre la projectivité des présuppositions et sa *non-at-issueness* et d'étudier ces propriétés de manière expérimentale. Grâce à ces travaux, nous disposons aujourd'hui de nombreuses connaissances sur le traitement des présuppositions. Tout d'abord, les présuppositions non encore introduites dans le discours précédent, incohérentes sur le plan contextuel et ambiguës sont traitées différemment par rapport aux présuppositions déjà introduites dans le discours précédent, les présuppositions cohérentes sur le plan contextuel et les informations ambiguës impliquant une assertion. Deuxièmement, les présuppositions ne sont pas, dans la plupart des cas, le point principal du discours et, par conséquent, moins adressables que le contenu affirmé.

La dernière étude de cette thèse vise à mieux comprendre les fondements cognitifs du traitement des présuppositions en se concentrant sur les activations sensori-motrices. Dans le domaine des neurosciences cognitives, l'impact du traitement du langage sur l'activation motrice a fait l'objet d'une série d'études au cours des deux dernières décennies (voir pour une revue Pulvermüller, 2005 ; Willems & Casasanto, 2011 ; Kiefer & Pulvermüller, 2012). Ces travaux ont permis de faire des découvertes importantes sur le traitement du langage lié à l'action. Par exemple, nous savons maintenant que les verbes d'action liés à la main (par exemple *écrire*) dans des phrases affirmatives simples déclenchent une réponse dans les structures sensori-motrices du cerveau impliquées dans l'exécution de l'action correspondante (par exemple Aziz-Zadeh, Wilson, Rizzolatti, & Iacobini, 2006 ; Hauk, Johnsrude & Pulvermüller, 2004 ; Tettamanti et al., 2005). Il a été démontré que cette activation est modulée par l'environnement linguistique et semble être réduite en présence de négation ou de verbes de volonté (*désir*) (par exemple, Aravena et al., 2012, 2014 ; Zwaan, Taylor, & de Boer, 2010 ; Papeo, Hochmann, & Batelli, 2016 ; Tettamanti et al., 2008).

Quelques études dans ce domaine se sont penchées sur l'aspect pragmatique. Par exemple, Lauro, Mattavelli, Papagno et Tettamanti (2013) ont trouvé des preuves que l'activation du cortex sensori-moteur est modulée par les utilisations figuratives du langage. Dans leur étude, ils montrent que les utilisations littérales et idiomatiques des verbes d'action suscitent une réponse sensori-motrice, alors que cette réponse est absente lorsqu'il s'agit de verbes d'action qui véhiculent un sens métaphorique. En outre, une étude intéressante de van Ackeren et al. (2012) prolonge les résultats précédents de Lauro et al. (2013) en montrant que le potentiel communicatif d'une phrase dans son contexte peut également moduler l'activation

sensori-motrice. Comme nous l'avons longuement expliqué au chapitre 1, le sens pour le locuteur va souvent au-delà de ce qui est codé linguistiquement. Par exemple, une phrase « *Il fait chaud ici* » peut transmettre le sens littéral de « *il fait chaud* ». Cependant, la même phrase prononcée dans un contexte où des personnes sont assises dans une pièce chaude et adressée à une personne proche de la fenêtre peut également signifier que le locuteur a l'intention de transmettre une demande indirecte, à savoir *ouvrir la fenêtre*. C'est exactement ce que van Ackeren et al. ont manipulé et leurs résultats montrent un effet de ces manipulations contextuelles sur l'activation du cortex sensori-moteur. Les propos véhiculant une demande indirecte qui invite le destinataire à effectuer une action déclenchent une activité sensori-motrice, alors que les mêmes propos dans un contexte qui ne donne pas lieu à cette interprétation ne le font pas. Dans leur étude, la phrase « *Il fait chaud* » ici a été montrée soit avec une image de fond d'un désert, soit avec l'image de fond d'une fenêtre fermée. Dans le premier exemple, la phrase a été interprétée littéralement, alors que dans le second, le destinataire va au-delà du sens littéral pour en déduire le sens véhiculé (la demande indirecte d'ouverture de la fenêtre). Ce n'est que lorsque la phrase *Il fait chaud ici* impliquait une demande indirecte que celle-ci a provoqué une activation sensori-motrice. À notre connaissance, c'est la première preuve que l'inférence pragmatique contribue à moduler la mobilisation du système moteur dans le traitement du langage. La question qui se pose naturellement est de savoir si les différentes couches de sens jouent un rôle distinct dans la modulation de l'activation sensorimotrice des verbes d'action. Il semble donc important d'examiner d'autres phénomènes pragmatiques, au-delà des usages figuratifs du langage et de la demande indirecte, afin de mieux comprendre la place de la pragmatique dans l'activation sensorimotrice des verbes d'action. Pour cette raison, l'étude 3 contribue à cette littérature en étudiant le phénomène linguistique des présuppositions.

La méthode choisie pour l'étude 3 est la méthode du capteur de force de préhension, qui sera examinée en détail au chapitre 4. Il s'agit d'une nouvelle méthode prometteuse permettant de mesurer indirectement l'activation sensorimotrice des zones du cerveau impliquées dans la planification et l'exécution d'actions liées à la main. Des preuves récentes montrent que cette méthode mesurant le décours temporel précis après l'occurrence du verbe d'action permet de mesurer les variations subtiles de la force de préhension lors de l'écoute de verbes d'action isolés liés à la main ou de verbes d'action intégrés dans des phrases affirmatives. Tout d'abord, Frak, Nazir, Goyette, Cohen et Jeannerod (2010) ont montré que les verbes d'action manuelle provoquent une activation de la force de préhension alors que les noms non liés à des actions manuelles ne le font pas. Deuxièmement, les résultats d'Aravena et al. (2012) soulignent que

les verbes d'action manuelle déclenchent une réponse de force de préhension lorsqu'ils font partie de phrases affirmatives comme *Paul écrit une lettre*, alors que les phrases négatives comme *Paul n'écrit pas de lettre* ne déclenchent pas une telle réponse. Dans une étude consécutive, Aravena et al. (2014) ont étendu ces résultats aux verbes de volonté comme *vouloir* en montrant que la présence d'un verbe d'action manuelle ne suffit pas à déclencher une réponse de force de préhension. Plus précisément, les contextes de volonté tels que *Paul veut signer le contrat* ne déclenchent pas une réponse de force de préhension. Troisièmement, Nazir et ses collaborateurs (2017) soulignent que la méthode du capteur de force de préhension est une méthode fiable qui est capable d'évaluer la localisation de la source de l'activité induite par le langage par rapport aux structures motrices du cerveau et qui a une résolution temporelle élevée puisqu'elle permet de mesurer la variation de la force de préhension en millisecondes dès que le verbe d'action est rencontré.

3.2. Ce que nous ne savons pas encore

À notre connaissance, il s'agit de la toute première étude sur la force de préhension qui étudie les corrélats cognitifs des présuppositions. C'est pourquoi elle ne se contentera pas de fournir des informations importantes sur le traitement des présuppositions, mais permettra également d'élargir notre compréhension actuelle des contextes linguistiques qui modulent les structures motrices du cerveau.

Dans la section précédente, nous avons souligné que les environnements linguistiques affirmatifs comme *Paul écrit une lettre* provoquent une activation de la force de préhension, alors que les verbes d'action faisant partie d'une négation comme *Paul n'écrit pas de lettre* ou les phrases de volonté comme *Paul veut écrire une lettre* ne provoquent pas une telle activation. Une interprétation possible de ces résultats est que les activations de la force de préhension ne sont déclenchées que lorsque le modèle de discours ou de situation (cf. Zwaan et Radvansky, 1998) de la phrase inclut l'événement. Dans les cas où l'événement n'a pas lieu, une activation de la force de préhension n'a pas lieu non plus. Par exemple, un verbe d'action dans un contexte négatif comme dans *Paul n'écrit pas de lettre* ne laisse aucune possibilité qu'une activité ait lieu. De même, un événement n'a pas nécessairement lieu dans un contexte de volonté comme dans *Paul veut écrire une lettre*.

Une présupposition est une information qui est considérée comme acquise, mais qui ne constitue pas l'élément principal de l'énoncé. Si le système sensori-moteur est activé par des actions qui impliquent l'événement, alors les verbes d'action présupposés devraient également susciter une activation puisque l'événement a certainement eu lieu. Cependant, il est également

plausible que le caractère général de la présupposition ait un impact sur le traitement des verbes d'action présupposés. Compte tenu de son statut périphérique, on pourrait également s'attendre à ce que les verbes d'action présupposés ne suscitent pas la même réponse que les verbes d'action affirmés. Cette étude nous permettra de mieux comprendre comment les présuppositions sont traitées dans les structures motrices du cerveau. Pour ce faire, nous étudions le traitement des verbes d'action qui font partie de compléments factifs tels que *Pierre sait que Paul écrit une lettre*. Dans ces constructions, le temps de l'action est le même que dans son homologue affirmatif *Paul écrit une lettre*. Les verbes factifs sont également comparés aux verbes non-factifs, comme *suspecter*, *imaginer*, *penser*, qui ne présupposent pas la vérité de leurs compléments. Par exemple, la vérité de l'action véhiculée dans les compléments non-factifs comme *Pierre soupçonne que Paul écrit une lettre* n'est pas garantie. Afin de mieux comprendre si cette distinction linguistique se traduit par une activation différentielle des zones sensori-motrices pertinentes, nous allons étudier les activations de la force de préhension des deux structures.

Nous savons que la distinction entre les verbes factifs et non-factifs déclenche des traitements différents, comme le révèlent les études qui ont examiné les coûts cognitifs du traitement d'informations incohérentes. Ferretti et al. (2008, 2013) et Shetreet et al. (2019) ont trouvé des preuves que le traitement d'informations incohérentes dans le discours est modulé par la vérité présupposée de l'information. Dans ces études, les auteurs ont comparé les constructions de verbes factifs et les constructions de verbes non-factifs. Le premier type présuppose la vérité du complément, alors que le second ne le fait pas. Même si le dispositif expérimental mis en place entre les expériences de Ferretti et al. et de Shetreet et al. était différent, leurs résultats révèlent que l'information qui est présupposée et incohérente s'accompagne d'un coût de traitement plus élevé. Plus précisément, Ferretti et al. ont utilisé des scénarios dans lesquels l'information d'intérêt était d'abord transmise par le biais d'une assertion. Puis, dans la phrase cible, cette information était intégrée dans un complément factif ou non-factif, qui était soit cohérent soit incohérent par rapport à l'information antérieure. En revanche, les stimuli expérimentaux de Shetreet et al. ont été mis en place dans l'autre sens. L'information a d'abord été introduite dans une phrase de contexte via une construction factive ou non-factive, qui était soit cohérente soit incohérente par rapport à la phrase cible utilisée. Dans l'ensemble, les deux études fournissent des preuves que le verbe factif crée de fortes attentes discursives à l'égard des événements ultérieurs. Dans les cas où l'information est introduite via la construction d'un verbe factif et contredite par la suite, la détection de ce conflit

s'accompagne d'un coût de traitement, c'est-à-dire d'une déviation positive plus élevée pendant l'intervalle P600 (Shetreet et al., 2019), alors qu'un tel effet est absent dans la condition non-factive. Les coûts de traitement sont observés également en cas d'utilisation d'une configuration inversée, c'est-à-dire lorsque l'information est d'abord introduite via une assertion puis contredite dans le complément factif (Ferretti et al., 2008).

Sur la base de ces résultats, il convient d'examiner si la distinction entre compléments factifs et non-factifs a également une contrepartie en ce qui concerne l'activation motrice cognitive.

3.3. Ce que l'étude relative à cette question de recherche nous dira

Ces recherches jetteront un nouvel éclairage sur l'implication du système sensori-moteur dans le traitement des informations qui sont transmises aux couches de sens distinctes. Pour cette raison, cette recherche permettra d'abord d'élargir nos connaissances sur l'ensemble des contextes dans lesquels une réponse sensori-motrice peut être évoquée. Deuxièmement, elle contribuera à une meilleure compréhension du statut cognitif des informations présupposées. En particulier, si, comme le suggère la littérature théorique, les présuppositions ne constituent pas l'élément principal d'information dans le message communiqué, il est possible que ce statut secondaire ou périphérique se traduise par une différence d'impact sur le système sensori-moteur. En outre, l'étude des constructions factives et non-factives permettra de déterminer si cette distinction théorique, qui est soutenue par des preuves empiriques obtenues par le biais d'études en potentiels évoqués, est également pertinente au niveau de l'activation sensori-motrice liée au langage.

Chapitre 2 : Étude 1

L'engagement joue un rôle crucial dans la stabilisation de la communication. Si l'engagement augmente l'acceptation du message communiqué, il a un prix : plus l'engagement est important, plus est le coût (direct ou lié à la réputation) pour le locuteur si le message est jugé peu fiable (Vullioud et al., 2017). Cela soulève la question de savoir quels indices linguistiques les destinataires déploient pour déduire l'engagement des locuteurs dans la communication. Nous présentons une série d'études empiriques pour tester l'hypothèse selon laquelle des relations de sens distinctes – un locuteur (i) qui affirme explicitement, (ii) qui présuppose ou (iii) qui implique – agissent comme des indices pragmatiques de l'engagement du locuteur. Nos résultats montrent que, après qu'un message p se soit avéré faux, les locuteurs encourrent des coûts de réputation différents selon que p a été explicitement dit, présupposé ou impliqué. Toutes choses étant égales par ailleurs, les participants sont nettement plus susceptibles de faire sélectivement confiance au locuteur qui a impliqué p qu'à celui qui a affirmé ou présupposé p . Ces résultats fournissent la première preuve empirique que l'engagement est modulé par différentes relations de sens, et jettent un nouvel éclairage sur les avantages stratégiques de la communication implicite. Les orateurs peuvent réduire les dommages à leur réputation en transmettant des messages peu fiables lorsque ceux-ci sont communiqués implicitement.

Chapitre 3 : Étude 2

Les présuppositions ne sont généralement pas l'élément principal, c'est-à-dire qu'elles sont en arrière-plan, et les attachements au discours qui ciblent les présuppositions sont considérés comme inappropriés. Dans sa proposition théorique, Winterstein (2009) a montré que les particules discursives additives peuvent être considérées comme une exception. Les attachements discursifs dans les relations discursives additives qui ciblent le contenu présupposé ne sont donc pas considérés comme inappropriés. Pour mieux comprendre l'impact sous-jacent de la distinction pragmatique d'un attachement approprié et inapproprié en lien avec la couche de sens et son traitement cognitif, nous présentons deux expériences en utilisant la méthode de l'EEG. Les déclencheurs de présupposition qui ont été examinés sont les constructions de verbes factifs. Les résultats de nos deux études indiquent ce qui suit : malgré son statut périphérique et le fait de ne pas être en discussion, les attachements du discours au contenu présupposé ne suscitent pas un traitement cognitif distinct par rapport aux attachements au contenu asserté. Nos résultats seront discutés et mis en relation avec le cadre récemment proposé par Beaver et al. (2017) qui remet en question le statut présupposé des compléments de verbes factifs. Selon eux, les compléments de verbes factifs peuvent parfois être considérés comme l'élément principal.

Chapitre 4 : Étude 3

Il est bien établi que le traitement des termes d'action liés à la main, à la bouche et au pied peut activer des zones du cortex moteur qui sont impliquées dans la planification et l'exécution des actions décrites. Dans la présente étude, la sensibilité de ces structures motrices aux processus linguistiques est exploitée pour tester les théories linguistiques sur la stratification de l'information. Les langues humaines possèdent une variété de dispositifs linguistiques, appelés déclencheurs de présuppositions, qui nous permettent de transmettre des informations d'arrière-plan sans les affirmer. Une phrase telle que *Marie a arrêté de fumer* présuppose, sans l'affirmer, que *Marie fumait*. La manière dont ces informations présupposées sont représentées dans le cerveau n'est pas encore complètement comprise. En utilisant un capteur de force de préhension qui permet de capturer l'activité motrice du cerveau pendant le traitement du langage, nous étudions les effets de la stratification d'informations en comparant des informations affirmées (*Dans le salon, Pierre repasse sa chemise*) avec des informations enchâssées sous un verbe factif, qui présuppose la vérité de la clause complément (*Louis **sait** que Pierre repasse sa chemise* ; Expérience 1) et une construction identique avec un verbe non-factif (*Louis **croit** que Pierre repasse sa chemise* ; Expérience 2). De plus, nous examinons si le comportement de projection d'une construction factive module la force de préhension sous la négation (*Louis **ne sait pas** que Pierre repasse sa chemise* ; Expérience 3). Les données montrent que seul le verbe d'action présupposé dans un contexte affirmatif (expérience 1) déclenche une augmentation de la force de préhension comparable à celle des verbes d'action affirmés, alors que le complément non-factif montre une réponse plus faible (expérience 2) et une réponse encore plus faible est observée pour les verbes d'action projective (expérience 3). Si les deux premières expériences semblent confirmer la sensibilité de la réponse de la force de préhension à la construction d'un *modèle d'événement* plausible, dans lequel l'action motrice est représentée comme ayant lieu, la troisième soulève la question de la robustesse de cette hypothèse et de la manière dont elle peut prendre en compte la spécificité de la projection.

Chapitre 5 : Discussion et conclusion

Le travail présenté dans cette thèse explore le phénomène des présuppositions en utilisant une approche expérimentale et en combinant différentes perspectives sur ce sujet. D'une part, il explore sa place dans le contexte de l'évaluation de la fiabilité des informations communiquées et de la fiabilité de leur source. En considérant la communication comme une source primaire de connaissances, nous avons étudié l'impact de la manière dont l'information est communiquée sur l'évaluation de la fiabilité des locuteurs qui se sont avérés peu fiables. Cette enquête s'est concentrée sur la nature interpersonnelle de la communication et sur la relation de confiance que les interlocuteurs établissent lorsqu'ils apprennent les uns des autres par la communication. Elle a donc examiné la relation entre les locuteurs et les destinataires, et la manière dont celle-ci est affectée par la transmission de fausses informations en fonction de la strate de sens à travers laquelle la fausse information est communiquée. D'autre part, ce travail a adopté une perspective complémentaire, qui examine également les mécanismes cognitifs qui sous-tendent la communication, et plus précisément le traitement des présuppositions. Ces deux perspectives, l'une interpersonnelle et l'autre de traitement, sont toutes deux essentielles pour parvenir à une meilleure compréhension du phénomène complexe des strates d'information (*information layering*) dans la communication. Dans ce qui suit, je vais d'abord discuter des principaux résultats et implications des trois études expérimentales présentées dans les chapitres 2, 3, et 4. Je conclurai ensuite en tirant quelques conclusions générales sur la contribution globale de cette thèse au domaine de la recherche en pragmatique expérimentale, qui est en constante évolution.

Étude 1

La première étude de cette thèse a cherché empiriquement à savoir si les différentes couches de sens traduisent des degrés variables d'engagement de la part du locuteur. Plus précisément, nous avons mesuré la relation entre engagement et coût de réputation infligé au locuteur lorsqu'une information communiquée est jugée peu fiable et nous avons comparé trois strates de sens différentes, à savoir les assertions (ce qui est dit), les présuppositions et les implicatures. Les résultats globaux de cette étude ont montré que les différentes couches de sens ont un impact sur la responsabilité attribuée du locuteur. Dans cette discussion, je me concentrerai principalement sur les résultats concernant le locuteur qui présuppose.

Tout d'abord, nos conclusions démontrent que les coûts de réputation sont plus élevés pour un locuteur qui présuppose que pour un locuteur qui implique. Plus précisément, on fait davantage confiance à ce dernier qu'au premier après que l'information transmise ait été jugée

peu fiable. Une telle constatation est très intéressante puisque les deux strates d'information sont considérées comme faisant partie de la communication implicite. Cela suggère que l'implicite en soi n'est pas pertinent pour les considérations sur l'engagement du locuteur, mais que la distinction entre les présuppositions et les implicatures a un retentissement important sur le jugement du public sur la fiabilité épistémique. En outre, il est important de noter que, si les présuppositions et les implicatures diffèrent généralement en ce qui concerne la distinction entre avant-plan et arrière-plan, dans notre étude, nous avons contrôlé la pertinence du contenu transmis (qui ne variait pas selon les différentes couches de sens). Compte tenu de la distinction avant-plan/arrière-plan, l'information véhiculée par une implicature et une présupposition n'est généralement pas comparable, puisque la présupposition est souvent une information qui a déjà été établie a priori. Cependant, dans cette expérience, après une histoire servant de contexte, le participant s'est vu présenter des informations qui ont été transmises par un locuteur qui implique (1a) ou par un locuteur qui présuppose (1).

1. a. Louis a fait une présentation au bureau central hier soir. (Implicature)
b. C'est Louis qui a retiré le projecteur. Il est au bureau central. (Présupposition)

L'implicature et la présupposition ont exactement le même contenu, c'est-à-dire qu'elles répondent toutes deux à la question posée par la personne A de l'histoire contextuelle (voir chapitre 4, tableau 1). Ainsi, les informations transmises par le locuteur qui présuppose et qui implique correspondaient toujours au point principal de l'énoncé et étaient très pertinentes pour évaluer la vérité de l'énoncé et l'engagement du locuteur correspondant. Par conséquent, le résultat principal, à savoir qu'on fait davantage confiance à un locuteur qui implique, ne peut pas être simplement réduit à la nature du contenu transmis (l'information qui en question (*at-issue*) versus l'information qui n'est pas en question (*non-at-issue*), mais il est lié à la couche de l'information. Les informations présupposées ne sont pas seulement des informations d'arrière-plan, mais aussi des informations qui ne peuvent pas être annulées en dehors d'environnements linguistiques particuliers (négation, interrogation, etc.). Comme nous l'avons vu au chapitre 1, Geurts (1999) note qu'un locuteur qui utilise une présupposition s'engage à respecter la vérité de la présupposition et que l'annulation de cet engagement (i) à l'égard de l'information qu'il a prise pour acquise ou (ii) à l'égard de l'information qui peut être acceptée *sans problème* (von Stechow, 2000) entraînerait une démarche discursive très étrange. En revanche, un locuteur qui implique peut, si nécessaire, annuler directement l'implicature, ce qui, à son tour, peut indiquer qu'il est moins engagé envers l'information véhiculée par l'implicature. C'est exactement ce que suggèrent nos résultats expérimentaux. Un locuteur qui transmet une fausse information présupposée est moins fiable qu'un locuteur qui transmet une

fausse information via une implicature indépendamment de la nature de l'information. Un tel résultat suggère que l'implicature permet au locuteur de faire passer exactement le même message qu'un locuteur qui présuppose ; cependant, elle porte moins atteinte à la réputation qu'une présupposition. Il semble que le rejet de l'implicature soit une stratégie puissante pour réduire la baisse de confiance qui se produirait si le même contenu était transmis par le biais d'une présupposition.

Dans sa proposition théorique, Moeschler (2013) souligne que la notion d'engagement est liée à deux facteurs : (1) la nature de l'inférence - sémantique ou pragmatique - et (2) l'accessibilité du contenu inféré. Selon le premier facteur, sa proposition théorique prévoyait que les présuppositions sont plus responsabilisantes que des implicatures. Appliquée à notre étude, cette idée signifie qu'il faut faire davantage confiance à un locuteur qui transmet une fausse information par le biais d'une implicature qu'à un locuteur qui transmet une fausse information par le biais d'une présupposition. Nos résultats sont conformes à la prédiction du premier facteur qu'il a proposé. Cependant, le second facteur de Moeschler prédit que les informations d'avant-plan sont plus responsabilisantes que les informations d'arrière-plan. Étant donné que les informations transmises par le locuteur qui implique et par le locuteur qui présuppose, comme indiqué précédemment, avaient le même contenu, et que ce contenu était en question en répondant à la question du locuteur A, nous pouvons supposer que l'accessibilité ne variait pas selon nos conditions. Cela nous permet de conclure que, au moins dans les cas où la différence d'accessibilité est neutralisée, la présupposition est considérée comme étant plus responsabilisante qu'une implicature. Pour mieux comprendre si l'accessibilité joue un rôle spécifique dans l'attribution de l'engagement à un locuteur, des recherches plus approfondies devraient directement manipuler ce facteur.

Deuxièmement, concernant la comparaison entre un locuteur qui affirme et un locuteur qui présuppose, nous n'avons pas trouvé de différence significative entre les deux conditions, ni dans l'expérience 1 ni dans les expériences 2a et 2b. Dans l'expérience 1, nous avons utilisé les déclencheurs de présupposition suivants : (i) l'itératif *aussi*, (ii) le verbe de changement *réparer*, (iii) le prédicat factif *soulager*, et (iv) une clivée (*C'est X qui ...*). De plus, nous avons étendu les mots et les constructions linguistiques qui peuvent déclencher une présupposition aux suivants dans l'expérience 2a : (v) *seulement*, (vi) une description définie, (vii) une construction *si ... alors*, (viii) *même*, (ix) *aussi (too)*, (x) *aussi (also)*, et (xi) une construction temporelle utilisant *après*. Dans nos expériences, il n'y avait pas suffisamment de preuves que les deux couches de sens impliquent des degrés d'engagement différents, même si l'on applique

la distinction de Glanzberg (2003, 2005) entre les déclencheurs de présuppositions faibles et forts (comme dans l'expérience 2b). Ni les déclencheurs forts, qui sont des présuppositions qui devraient déclencher une réparation obligatoire, ni les déclencheurs faibles, qui sont des présuppositions qui déclenchent une réparation optionnelle, ne mènent à attribuer à la présupposition un degré d'engagement différent de celui du locuteur qui affirme. Il est intéressant de noter que ce résultat ne soutient pas la prédiction de Moeschler selon laquelle la présupposition est plus responsabilisante que l'affirmation.

Il est important de noter que Moeschler s'est concentré sur des explicitations moins explicites que celles utilisées dans notre expérience. Par exemple, la réponse de B dans l'exemple (2) est plus explicite que celle de (2) (l'exemple est tiré de Sperber & Wilson, 1995, p. 182).

2. A : Voulez-vous vous joindre à nous pour le dîner ?

a. B : Non, merci. J'ai mangé.

b. B : Non merci. J'ai déjà dîné ce soir.

Dans notre expérience, les stimuli expérimentaux choisis étaient similaires à ceux de la section (2b), c'est-à-dire que le contenu affirmé était le plus explicite possible et qu'il n'y avait pas d'écart entre le décodage de l'énoncé et la déduction. Pour cette raison, il semble important que des recherches supplémentaires examinent les différents degrés d'explicitation afin de mieux comprendre leur degré d'engagement.

Dans ce qui suit, j'examinerai l'absence d'effet de la présupposition par rapport à l'affirmation du locuteur en ce qui concerne la littérature sur les présuppositions. Dans la littérature théorique sur les présuppositions, certains chercheurs comme Lombardi Vallauri (2016) soutiennent que la présupposition est moins responsabilisante que l'affirmation car le locuteur peut plus facilement prendre ses distances par rapport au contenu présupposé, c'est-à-dire que la responsabilité peut être reportée sur une autre source. En outre, Lombardi Vallauri soutient que l'un des objectifs d'une présupposition est « *to prevent the addressee from becoming completely aware of the details of that, lest he may challenge or reject it* » (p. 1114). À l'appui de sa proposition, il fait état de recherches empiriques qui indiquent que les fausses informations qui ne sont pas le *focus* principal, mais seulement le *topic* de l'énoncé, entraînent des coûts de traitement moins élevés (par exemple, Wang et al., 2009) et que les fausses informations ont moins de chances d'être détectées (par exemple, Bredart & Modolo, 1988). En outre, la transmission de fausses informations peut être une stratégie puissante pour obtenir un taux plus élevé d'erreurs d'intrusion dans une tâche de mémoire (Loftus, 1975). Nos résultats

ne confirment pas non plus les prévisions de Lombardi Vallauri. Il est important de noter que sa proposition est motivée par et principalement basée sur une analyse des publicités ou de la propagande. Ce type de communication n'offre pas la possibilité au destinataire de contester directement le contenu. Dans notre étude, cependant, l'atteinte directe à la réputation est attribuée au locuteur. Par conséquent, différents mécanismes sous-jacents peuvent être en jeu. Lorsque le locuteur peut être directement mis en cause, ce qui n'est pas le cas dans une publicité ou une propagande, une attention plus grande peut être accordée à l'information transmise, c'est-à-dire que l'information est examinée plus en profondeur. Par conséquent, l'argumentation de Lombardi Vallauri ne semble pas être applicable à la communication, dans laquelle le locuteur peut être ouvertement contesté.

Il est important de souligner que l'étude sur l'engagement des locuteurs n'a pas fait de distinction explicite entre les communicateurs trompeurs et les communicateurs honnêtes mais dans l'erreur. Par conséquent, les recherches futures devraient étudier l'impact de la désinformation intentionnelle et accidentelle sur la relation entre les coûts de réputation et les différentes relations de signification.

En résumé, la première étude de cette thèse montre que les différentes couches de sens ont un impact sur les aspects interpersonnels de la communication liés aux violations des engagements envers la vérité du message communiqué. Les coûts de réputation sont plus élevés pour les locuteurs qui présupposent que pour les locuteurs qui impliquent lorsque leur message est jugé peu fiable, alors qu'aucune différence en termes d'atteinte à la réputation n'est constatée entre les locuteurs qui affirment et qui présupposent. À notre connaissance, il s'agit de la première étude qui lie l'engagement des locuteurs à différentes strates de signification.

Étude 2

Le but principal de la deuxième étude était d'examiner le traitement en temps réel de l'attachement au discours dans les suites de discours qui sont considérées comme appropriées. Dans la littérature sur les présuppositions, en particulier lorsqu'il s'agit de l'attachement du discours et de la distinction entre le contenu *en discussion* et le contenu *non en discussion*, la majorité des recherches empiriques indiquent que les suites de discours ciblant le contenu présupposé reçoivent des notes de jugement inférieures par rapport au contenu affirmé (par exemple Cummins et al., 2012) et entraînent également un coût de traitement plus élevé (par exemple Cowles et al., 2007). La deuxième étude de cette thèse s'est concentrée sur le traitement d'un type spécifique de relations discursives, les relations additives, qui rendent possible l'attachement à la présupposition. Dans ces conditions, le caractère inapproprié pour

l'attachement discursif -typique des présuppositions- peut être annulé par des facteurs contextuels, par exemple des contextes additifs. Bien qu'il semble intuitivement approprié, nous avons émis l'hypothèse que l'attachement discursif au contenu présupposé entraînerait un coût de traitement plus élevé par rapport à l'attachement au contenu posé. Nous n'avons trouvé aucune preuve de cette hypothèse. Contrairement à nos attentes, nos deux expériences indiquent que, pour les constructions de verbes factifs, il n'y a pas de différence entre le contenu posé et présupposé en ce qui concerne les continuations de discours appropriées. Ces résultats suggèrent que les différentes propriétés d'attachement au discours du contenu posé et présupposé ne sont pas dues à une indisponibilité par défaut du contenu présupposé dans le discours. C'est-à-dire que les présuppositions ne sont pas par défaut moins accessibles que les contenus posés. Lorsque la relation discursive est telle qu'il est possible de cibler une présupposition, cela n'entraîne aucun effort cognitif supplémentaire.

Une autre façon d'expliquer ces données pourrait être d'affirmer qu'elles sont le résultat des compléments factifs étudiés qui ne font pas partie de l'information d'arrière-plan. Une proposition récente de Beaver et al. (2017) suggère la sensibilité au contexte du complément factif. Dans certains contextes, le complément factif pourrait être *en question*. Par conséquent, on peut argumenter que l'absence d'effet dans l'étude 2 est liée au statut du complément factif qui est potentiellement en avant-plan. C'est une possibilité ; cependant, nous pensons qu'il est peu probable que l'avant-plan potentiel soit le facteur sous-jacent à l'absence d'effet. Même en supposant que dans certains contextes le complément factif ne se projette pas, ces contextes sont très spécifiques, et leur construction peut nécessiter la présence d'indices supplémentaires comme des indices prosodiques (par exemple Beaver & Clark, 2008). Étant donné la nature minimale des contextes créés pour nos stimuli expérimentaux, l'accessibilité d'une telle interprétation reste douteuse. En effet, notre pré-test montre qu'il est préférable d'enchaîner le contenu posé par des questions comme *Christelle a-t-elle remarqué que son père a retrouvé l'appétit ?* Plus précisément, les suites du contenu posé ont été largement préférées (92 %) dans notre expérience de choix forcé. Par conséquent, il semble que ce soit le contenu posé, et non le complément factif, qui doit être considéré en question à des questions. Cependant, dans les cas où les deux contenus peuvent être abordés, comme dans les contextes additifs que nous avons exploités, nos résultats de l'EEG suggèrent qu'il n'y a pas de niveau d'attente *par défaut* puisque les présuppositions pertinentes pour le discours semblent être aussi attendues que le contenu posé. Il est donc probable que l'indisponibilité de l'attachement au discours

généralement observée pour les présuppositions est un sous-produit de la structuration du discours au moyen de relations de discours.

Les recherches futures devraient examiner si nos conclusions peuvent être étendues à d'autres déclencheurs de présupposition dans lesquels le contenu présupposé a une nature plus implicite, comme les verbes de changement.

Étude 3

En utilisant la technique du capteur de force de préhension (Aravena et al. 2012, 2014 ; Frak et al. 2010 ; Nazir et al. 2017), dans trois expériences, nous avons étudié l'implication du système sensori-moteur dans la stratification de l'information. Dans l'expérience 1, nous avons comparé des informations posées avec des informations présupposées par des verbes factifs. Dans l'expérience 2, nous avons étendu notre enquête à une construction non-factive. Enfin, nous avons examiné si le comportement de projection d'une construction de verbe factif module l'activation sensori-motrice sous la négation (expérience 3). Les principaux résultats de nos trois expériences indiquent ce qui suit :

1. Les verbes d'action présupposés (Expérience 1) et non-présupposés (Expérience 2) déclenchent des activations différentes de la force de préhension. Plus précisément, les verbes d'action présupposés déclenchent une réponse de force de préhension différente par rapport aux verbes de non-action, mais pas par rapport aux actions affirmées. Pour les actions non-présupposées, nos résultats indiquent que le contraire est vrai.
2. Les verbes d'action projetés (expérience 3) ne provoquent pas une réponse immédiate de la force de préhension. Plus précisément, la réponse de force de préhension des compléments factifs dans les constructions de verbes factifs liés (*ne voit pas*) diffère de manière significative des verbes d'action affirmés mais pas des verbes de non-action. De plus, nos résultats suggèrent également qu'une activation positive modérée est observée 2000 ms après l'apparition du nom (*Robert ne voit pas que Ghislaine lace ses chaussures*) pour les constructions de verbes factifs négatifs.

Des recherches antérieures ont indiqué (van Ackeren et al., 2012) que le potentiel communicatif d'un énoncé en contexte module l'activation sensori-motrice lorsque ce potentiel implique une demande d'action. Nos résultats prolongent ces conclusions en montrant que l'activation sensori-motrice est également activée dans des contextes positifs dans lesquels l'information ne fait pas partie du contenu affirmé mais est transmise en tant qu'information d'arrière-plan.

Dans la discussion qui suit, je me concentrerai d'abord sur les expériences 1 et 2 avant de passer à l'expérience 3.

Dans l'expérience 1, nous avons émis l'hypothèse que les verbes d'action des compléments factifs provoqueraient une activation de la force de préhension, mais que leur statut marginal par rapport aux informations affirmées aurait eu un impact sur la réponse correspondante de la force de préhension. Nos résultats indiquent que non seulement les verbes d'action présumés provoquent une réponse de force de préhension, mais que cette réponse ne diffère pas de manière significative de celle provoquée par les verbes d'action affirmées. Il peut sembler que ces résultats soient conformes aux théories qui favorisent une activation automatique, selon laquelle c'est la seule mention du verbe d'action qui devrait être responsable de l'activation du système sensoriel et moteur (par exemple Pulvermüller, 1999, 2005). Cependant, compte tenu des résultats de l'expérience 2, cette interprétation de nos résultats ne peut être retenue.

Dans l'expérience 2, nous avons étudié les constructions de verbes non-factifs. Nos résultats montrent que les constructions de verbes non-factifs provoquent une réponse de la force de préhension significativement plus faible que les actions affirmées. Un tel résultat prouve que la force motrice derrière l'activation de la force de préhension n'est pas le verbe d'action lui-même, mais la construction sémantique. Le complément des prédicats factifs est en arrière-plan et supposé être vrai, tandis que le complément non-factif a un statut de vérité inconnu, c'est-à-dire qu'il peut être vrai ou faux.

L'ensemble des résultats des deux premières expériences suggère ce qui suit : Premièrement, le facteur dominant de l'activation motrice n'est pas le contenu lexical du verbe d'action, mais la construction linguistique qui l'intègre. C'est donc l'environnement linguistique qui joue un rôle crucial dans la génération d'une réponse motrice (par exemple, Willems & Casasanto, 2011). Deuxièmement, ces résultats apportent la preuve que les différences de traitement en temps réel entre les factifs et les non-factifs observées dans les études EEG avec des scénarios contextualisés (Ferretti et al., 2009, 2013 ; Shetreet et al., 2019) sont également présentes dans les scénarios décontextualisés. En ce qui concerne nos stimuli, aucune information préalable n'a été fournie, de sorte que ni la fiabilité de la source ni la cohérence des informations intégrées n'ont pu avoir d'impact. Par conséquent, il est possible que la différence entre les deux prédicats soit profondément ancrée dans le système du langage humain. Dans l'une des premières études sur les prédicats factifs et non-factifs, Hopman et Maratsos (1978) ont étudié les factifs *savoir*, *triste*, *heureux*, *surprenant* et *gentil* et les non-

factifs *penser, possible, vouloir et désirer* chez les enfants. Leurs résultats indiquent que la distinction entre les prédicats factifs et non-factifs était déjà bien développée vers l'âge de 7 ans. En outre, leurs résultats montrent également que les verbes factifs cognitifs sont compris plus facilement que les prédicats factifs émotionnels⁶¹. Même à un âge précoce, les enfants sont conscients du statut présupposé des compléments factifs qui, potentiellement, peuvent activer et entraîner différents circuits corticaux, qui, à leur tour, construisent des modèles d'activation différents par rapport aux verbes non-factifs. Des recherches plus approfondies devraient porter sur les circuits correspondants activés pendant le traitement des factifs et des non-factifs.

Dans la dernière expérience de cette étude, nous avons cherché à savoir si l'action projetée déclenche une réponse de force de préhension. Nos résultats indiquent que ce n'est pas le cas, au moins pas immédiatement après l'apparition du verbe. Cependant, nos résultats suggèrent également que l'interprétation projective est moins uniforme, retardée et/ou plus faible que l'interprétation factive de l'expérience 1. On peut dire que la négation a bloqué ou retardé une éventuelle réponse motrice. Comme indiqué dans la discussion générale du chapitre 4, nous pensons qu'il est très peu probable que ce soit réellement le cas. Nous avons présenté plusieurs arguments en faveur de cette interprétation. Ici, je me concentrerai uniquement sur l'argument fondé sur les différences individuelles, qui repose sur l'activation tardive observée de la réponse motrice chez la moitié des participants. Il est intéressant de discuter de ces résultats dans le contexte d'autres données sur les différences individuelles dans le traitement des présuppositions. Chemla et Bott (2013)⁶² ont étudié le phénomène de projection des constructions factives dans des phrases comme (3). Les participants qui ont répondu *faususement* à ces types de phrases ont été regroupés en tant qu'interprètes globaux. Dans ces cas, le complément factif projette (3a). En revanche, les participants qui ont répondu *vrai* n'ont pas interprété la phrase de manière globale mais plutôt d'une manière locale. Dans ces cas-là, le verbe factif ne projette pas (3b).

3. Les zoologistes ne se rendent pas compte que les éléphants sont des oiseaux.
 - a. Global : [les éléphants sont des oiseaux] et NÉG[les zoologistes le croient] (faux)
 - b. Local : NÉG[(les éléphants sont des oiseaux) ET (les zoologistes le croient)] (vrai)

⁶¹ Dans notre expérience, nous n'avons utilisé que des facteurs cognitifs. Pour la liste détaillée, voir la section *Matériel* du chapitre 5, Expérience. Nous avons délibérément évité l'utilisation de factives émotionnelles car elles déclenchent le subjonctif en français, ce qui aurait pu ajouter plus de complexité.

⁶² Ici, je me concentrerai uniquement sur leurs phrases expérimentales.

62% des participants ont interprété la phrase globalement⁶³. En outre, Chemla et Bott ont également examiné les temps de réaction des interprétations globales et locales⁶⁴. Leurs résultats indiquent que (i) la projection n'est pas une interprétation par défaut et (ii) les répondants qui interprètent la phrase d'une manière globale réagissent plus rapidement que les répondants qui interprètent la phrase d'une manière locale. Leurs résultats suggèrent donc la présence de différences individuelles dans l'interprétation du contenu des projections.

En reliant leurs résultats à notre expérience, seuls les participants qui ont interprété la phrase globalement peuvent avoir déduit que l'action décrite par le verbe d'action incorporé a bien eu lieu. Par exemple, sur la base d'une interprétation locale (4b) de l'un de nos stimuli (4), l'action de *lacer* ne serait pas considérée comme une action qui est faite et donc, aucune activation de la force de préhension ne devrait se produire. En revanche, l'interprétation globale (4a) devrait provoquer une activation.

4. Robert est occupé dans le salon. Il ne voit pas que Ghislaine lace ses chaussures.
 - a. Global : [Ghislaine lace ses chaussures] et NÉG[Robert le voit]
 - b. Local : NÉG[(Ghislaine lace ses chaussures) et (Robert le voit)]

Il est toutefois important de noter que les différences individuelles potentielles n'expliquent pas l'absence d'une activation précoce de la force de préhension. Dans la discussion du chapitre 4, nous avons suggéré que l'importance ou la pertinence du point de vue de l'agent (*Robert*) par rapport à celui du locuteur (inconnu) pourrait avoir eu un impact sur le recrutement des structures motrices. Les recherches futures pourraient donc étudier le rôle de la prise de perspective dans l'activation sensori-motrice liée au langage.

Pour conclure, l'objectif de la troisième étude était d'étudier le traitement des différentes strates de signification en ce qui concerne l'engagement du système sensori-moteur. Il existe de nombreuses preuves que l'activation motrice induite par le langage dépend de facteurs linguistiques et extra-linguistiques (pour une revue, voir Willems & Casasanto, 2011). En outre, les différences individuelles jouent également un rôle lors de l'activation des structures motrices (par exemple, pour une étude sur la préférence manuelle, voir Willems et al. 2010 ; pour une comparaison entre les joueurs de hockey et les personnes qui ne jouent pas au hockey, voir Beilock et al. 2008 ; Lyons et al. 2010). Nos résultats sont conformes à une explication qui

⁶³ Je ne parle que des résultats de l'expérience 1. Dans l'expérience 2, 64% ont interprété la phrase globalement ($ET = 31\%$).

⁶⁴ En fonction de leurs réponses *vraies* et *fausses*, les participants ont été classés comme intervenants mondiaux ou locaux. Pour les analyses ultérieures, la moitié d'entre eux ont été classés en tant que répondants locaux et l'autre en tant que répondants globaux.

suppose la dépendance du contexte de l'activité motrice induite par le langage et qui ouvre des orientations intéressantes pour les recherches futures. Nous pensons qu'une étude plus approfondie des différences individuelles et d'autres déclencheurs de présuppositions, comme les verbes de changement, les clivées, les qu-questions comme *que*, *qui*, *comment* + interrogation etc., pourrait non seulement contribuer à ce débat, mais aussi enrichir notre compréhension des corrélats cognitifs des présuppositions ainsi que nous fournir plus d'informations concernant le traitement individuel. Enfin, la nature temporelle précise de la méthode de la force de préhension permet seulement d'observer le début et le décalage d'une activation après la rencontre d'un mot d'action. Pour mieux comprendre la localisation précise et l'implication de circuits neuronaux distincts et pour compléter notre compréhension actuelle, d'autres méthodes neurophysiologiques devraient être utilisées.

Conclusion

Après avoir discuté de la contribution de chaque étude, je souhaite prendre du recul et contextualiser nos conclusions dans la perspective plus large de la pragmatique expérimentale en tant que discipline. La pragmatique expérimentale vise à favoriser le dialogue entre les travaux de la pragmatique théorique et les données générées par des méthodes expérimentales empruntées à des disciplines empiriques proches. Il est important de souligner que la relation entre la théorie et les données envisagées par cette approche ne doit pas être considérée comme un processus unidirectionnel, mais comme un processus bidirectionnel. D'une part, grâce à l'approche expérimentale, les théories pragmatiques peuvent être testées empiriquement. Les notions clés de la pragmatique peuvent donc être explorées dans différents cadres expérimentaux. D'autre part, les données empiriques peuvent étayer le développement de théories fondées sur des observations en pragmatique, ainsi que dans des domaines proches tels que la psychologie cognitive et la neurolinguistique. Dans cette section de conclusion, je voudrais souligner les façons dont les recherches présentées dans cette thèse contribuent à renforcer la relation entre la théorie et les données dans ces deux directions.

De la théorie aux données

Le phénomène central étudié dans cette thèse est celui des présuppositions, une des strates de signification identifiées dans la recherche pragmatique. La distinction entre les différentes strates de signification représente en effet l'une des notions clés, sinon *la* notion clé en pragmatique, et remonte aux travaux fondateurs de Grice et Strawson, entre autres. L'étude 1 et l'étude 3 de cette thèse ont démontré que cette distinction théorique a à la fois une répercussion sociale et une signification cognitive. En effet, grâce à différentes techniques

expérimentales, ces études contribuent à une meilleure compréhension de l'impact des différentes strates de signification sur la gestion de la réputation dans la communication (perspective interpersonnelle) et de la manière dont elles sont traitées (perspective cognitive). Même si la pertinence de cette distinction pour la gestion de la réputation n'a jamais été soutenue par des données empiriques portant sur la modulation pragmatique de l'engagement du locuteur (mais voir Bonalumi, Scott-Phillips, Tacha et Heintz (à paraître) pour une étude qui a suivi notre démarche dans cette enquête), de nombreuses recherches ont déjà contribué à mettre en lumière le traitement cognitif des différentes strates de signification (pour la distinction entre contenu affirmé et présupposé et l'EEG, par exemple, Burkhardt, 2006, 2007 ; Masia et al., 2017). À notre connaissance, cependant, l'étude 3 est la première à montrer que le statut présupposé ou non-présupposé des informations module l'activation sensori-motrice pour les verbes liés à l'action.

Dans cette optique, les résultats de l'étude 2 peuvent sembler saper cette conclusion générale selon laquelle différentes strates de signification correspondent à différents modes de traitement. Je pense qu'il n'y a pas de tension entre ces résultats. La principale conclusion que nous devrions tirer de l'étude 2 est que le ciblage d'un contenu présupposé dans un discours n'entraîne pas nécessairement des coûts de traitement supplémentaires par rapport au ciblage d'un contenu posé. En effet, dans des contextes qui favorisent également l'attachement discursif au contenu présupposé ou au contenu posé, tels que ceux introduits par des relations discursives additives, les deux sont facilement accessibles. Cela souligne le rôle important du contexte dans la modulation de traitement et des coûts cognitifs de certaines stratégies discursives. Les recherches futures dans ce domaine devraient donc placer le contexte au centre des investigations expérimentales. Dans le premier livre portant le titre de *Pragmatique expérimentale*, Sperber et Noveck (2004) commencent le chapitre d'introduction par les mots suivants

“How does our *knowledge of language* on the one hand, *and of the context* on the other permit us to understand what we are told, resolve ambiguities, grasp both explicit and implicit content, recognize the force of a speech act, appreciate metaphor and irony?” (*my emphasis*)

(Sperber & Noveck, 2004, p. 1)

Dans les premiers mots, les auteurs reconnaissent le rôle de la *knowledge of language* ainsi que le rôle de la *knowledge of context*. En ce qui concerne la littérature sur les présuppositions, de nombreuses études examinant le traitement en temps réel menées jusqu'à présent ont été largement inspirées par des traditions établies en psycholinguistique, qui examinent souvent les

phénomènes sous l'angle d'une phrase isolée. Il est donc utile d'étendre la recherche sur les présuppositions pour mieux comprendre l'importance du contexte en suivant la ligne de certaines recherches actuelles prometteuses (par exemple, Domaneschi et al., 2018 ; Domaneschi & Di Paola, 2019 ; Shetreet et al., 2019, Tonhauser et al., 2018). Cela permettra d'éclairer le traitement flexible des présuppositions dans leur contexte.

Des données à la théorie

Van Berkum, qui est un chercheur bien connu et très apprécié dans la littérature en EEG sur le traitement du langage, a reconnu en 2009 que le domaine de la pragmatique expérimentale peut être bénéfique pour de nombreuses disciplines proches :

« Over the past few years, it slowly dawned upon me that, for all its high-tech tools and its ability to 'look under the hood', the cognitive neuroscience of language interpretation by and large wasn't making as much progress and impact as it might have [...]. I think a major cause for this delay in progress and impact is its relative detachment from research in linguistics and classic experimental psychology. If my analysis is correct, then *the emerging interdisciplinary field of experimental pragmatics should benefit us all*. »

(van Berkum, 2009, p. 308)

Inspirés par cette attitude de recherche, les travaux présentés dans cette thèse visaient à apporter une contribution à certaines discussions actuelles dans le domaine de la neuroscience cognitive du langage en fournissant de nouvelles preuves empiriques basées sur une compréhension pragmatique des phénomènes en question. Plus spécifiquement, lorsqu'il s'agit du traitement du langage, une grande partie du débat porte sur la mesure dans laquelle celui-ci est incarné, et implique le recrutement de zones sensori-motrices. Les résultats de cette thèse peuvent donc être pertinents pour aborder la question plus large de la relation entre la compréhension du langage et le système sensori-moteur. En outre, les recherches futures pourraient se concentrer sur d'autres déclencheurs de présuppositions, par exemple ceux qui donnent lieu à des contenus présupposés plus implicites ou caractérisés comme moins forts que les verbes factifs. Je pense que l'étude de la classe hétérogène de déclencheurs de présuppositions permettra non seulement d'élargir nos connaissances sur le traitement de déclencheurs distincts, mais aussi d'enrichir notre compréhension de la flexibilité de l'activité motrice induite par le langage.

Cette thèse visait également à apporter de nouvelles données pour façonner la théorisation sur des sujets, tels que la gestion de la réputation, qui relèvent du champ d'application des travaux en psychologie cognitive et évolutionniste. À notre connaissance, cette étude a été la première à étudier dans quelle mesure l'attribution d'engagements est modulée par des indices pragmatiques, plutôt que lexicaux. Comme l'engagement est un mécanisme qui joue un rôle

crucial dans la stabilité évolutionniste de la communication - en ce sens qu'il contribue à la maintenir avantageuse pour les locuteurs et les destinataires - nos résultats mettent en lumière la pertinence des données pragmatiques expérimentales pour une discussion théorique plus large sur l'évolution de la communication.

Pour ces raisons, je pense que les résultats de cette thèse devraient intéresser la vaste communauté de chercheurs en linguistique, philosophie, psychologie et neuroscience qui s'est engagée dans l'entreprise collective et passionnante de comprendre la complexité du langage humain et de la communication.

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Appendix

Experimental Stimuli of Study 1 (Saying, presupposing and implicating: How pragmatics modulates commitment)

Experiment 1

Full list of stimuli for Experiment 1. The punishment and the trust questions were the same for all stories (see body text).

Story 1

You are the new manager of a small advertising company. The company policy states that employees are not allowed to receive a weekly bonus if they are late more than once. After having been on a two-day business trip, you are back at work. You see that one of your employees, Richard, is not at his desk. So, you send an email to his two office mates and ask whether Richard is coming in. The replies come back as follows:

- Peter [*confident speaker*]: He is late, and I'm sure he was late yesterday too.
- Adam [*unconfident speaker*]: He is late, and I think he was late yesterday as well, but I'm not sure.
- Peter [*presupposing speaker*]: He is late again.
- Adam [*saying speaker*]: He is late today, like yesterday.
- Joe [*implicating speaker*]: Joe: He is late. Yesterday morning his car broke down, I don't know what happened today.

In light of this, you write the following message to Richard: [*type text*]

Later on, you discover that Richard presented a project at a costumer's office yesterday morning and that he was late just today.

Implicature question: Remember what happened. Your employee Richard was not at his desk this morning. You asked his office mates whether he was coming in, and Joe said:

Joe: He is late. Yesterday morning his car broke down, I don't know what happened today.

Does Joe mean that Richard was late yesterday?

Story 2

See body text.

Story 3

You are the new supervisor of a team of shoe designers. Your team has a deadline for submitting a prototype to an important costumer by tomorrow. You have not received the prototype yet, so you send an email to your team members and ask whether there is any progress on the project. The replies come back as follows:

- Peter [*confident speaker*]: We got some delays but it is almost ready! I'm sure the 3D printer hasn't been working until yesterday.
- Adam [*unconfident speaker*]: Nearly done - We were a bit delayed! I think the 3D printer hasn't been working until yesterday, but I'm not sure.
- Peter [*presupposing speaker*]: Almost ready! The 3D-printer was repaired yesterday.
- Adam [*saying speaker*]: Almost ready! The 3D-printer hasn't been working but as of yesterday it is okay.

- Joe [*implicating speaker*]: Almost ready! We could work with the 3D-printer as of yesterday.

In light of this, you write the following message to the IT support: [*type text*]

Later on, you talk to the IT support and you discover that the 3D printer has been working fine for the whole time.

Implicature question: Remember what happened. Your team had a deadline for submitting a project to an important customer by tomorrow, but you had not received the prototype yet. You asked your team members about it, and Joe said:

Joe: Almost ready! We could work with the 3D-printer as of yesterday.

Does Joe mean that the 3D-printer had not been working before yesterday?

Story 4

You are the new supervisor of the IT department at a large university. Last week the main server broke down. Researchers cannot store their data until the new server is in place. Your team received many complaints from several academic units and the atmosphere in the office was very tense. Today, you send an email to your two assistants and ask whether they feel less stressed about the server issue. The replies come back as follows:

- Peter [*confident speaker*]: Yes, and I'm sure the server arrived this morning.
- Adam [*unconfident speaker*]: Yes, and I think the server arrived this morning, but I'm not sure.
- Peter [*presupposing speaker*]: Yes, I'm relieved that the server arrived this morning.
- Adam [*saying speaker*]: Yes, the server arrived this morning. I'm relieved!
- Joe [*implicating speaker*]: Yes, we got a big delivery this morning. I'm relieved!

In light of this, you write the following message to the academic staff: [*type text*]

Later that day, you discover that the new server has not arrived yet and that the delivery concerned the printers you ordered last week.

Implicature question: Remember what happened. The main server broke down and your team received many complaints from the academic staff. This morning you asked your team members whether they felt less stressed about the server issue, and Joe said:

Joe: Yes, we got a big delivery this morning. I'm relieved!

Does Joe mean that the new server arrived in the morning?

Experiment 2a and 2b

The material of Experiment 2a was comprised of eight stories: the four story from Experiment 1 and four additional stories (see below).

Story 5

You are the new supervisor of the IT department at a large university. Last week the main server broke down. Researchers cannot store their data until the server is either repaired or replaced with a new one. Your team

received many complaints from several academic units. Today, you send an email to your two assistants and ask whether there is any progress on the server issue. The replies come back as follows:

- Peter [*presupposing speaker*]: Yes, the new server arrived this morning.
- Adam [*saying speaker*]: Yes, there's a new server, it arrived this morning.

In light of this, you write the following message to the academic staff: [*type text*]

Later that day, you discover that the server is going to be repaired rather than replaced and that the department received a delivery in the morning concerning new printers.

Story 6

You are the new supervisor of the IT department at a large university. Last week the main server broke down. Researchers cannot store their data until the new server is in place. Your team received many complaints from several academic units. Today, you send an email to your two assistants and ask whether there is any progress on the server issue. The replies come back as follows:

- Peter [*presupposing speaker*]: Yes, after the server arrived this morning, I have informed the academic staff about this.
- Adam [*saying speaker*]: Yes, the server arrived this morning and I have informed the academic staff about this.

In light of this, you write the following message to the university mailing list: [*type text*]

Later that day, you discover that the new server has not arrived yet and that the department received a delivery in the morning concerning some new printers.

Story 7

You are the new supervisor of the IT department at a large university. Last week the main server broke down. Researchers cannot store their data until the new server is in place. Your team received many complaints from several academic units. Today, you send an email to your two assistants and ask whether there is any progress on the server issue. The replies come back as follows:

- Peter [*presupposing speaker*]: No, if the new server had arrived, I would have informed the academic staff about this.
- Adam [*saying speaker*]: No, the new server hasn't arrived, so I didn't write to the academic staff.

In light of this, you write the following message to the academic staff: [*type text*]

Later that day, you discover that the new server had arrived yesterday.

Story 8

You are the new manager of an advertising company. Tomorrow you have a meeting with two important and well-known costumers, Ms. Leroy and Ms. Thomas. You are planning to give each of them a gift on behalf of the company: an ink pen to Ms. Leroy and a highly rated bottle of wine to Ms. Thomas. You send an email to two colleagues telling them about your plan and asking them whether Ms. Thomas drinks wine. The replies come back as follows:

- Peter [*presupposing speaker*]: Only Ms. Leroy drinks wine.
- Adam [*saying speaker*]: Ms. Leroy drinks wine but Ms. Thomas doesn't.

In light of this, you write the following message to your assistant: *[type text]*

The day after you decide to give the ink pen to Ms. Thomas and the bottle of wine to Ms. Leroy. After receiving your gift, Ms. Leroy tells you that she has always been allergic to wine.

The material of Experiment 2b was comprised of four stories: Story 1 from Experiment 1 (*again*) and three additional stories (see below).

Story 9

You are the new manager of a small advertising company. The company policy states that employees are not allowed to receive a weekly bonus if they are late more than once. After having been on a two-day business trip, you are back at work. You see that one of your employees, Richard, is not at his desk. So, you send an email to his two office mates and ask whether Richard is coming in. The replies come back as follows:

- Peter [*presupposing speaker*]: He is also late today.
- Adam [*saying speaker*]: He is late today, like yesterday.

In light of this, you write the following message to Richard: *[type text]*

Later on, you discover that Richard had taken yesterday morning off and that he was late just today.

Story 10

You are the new supervisor of the HR team at a large university. Last week the online application platform went down. Prospective applicants cannot send their application until the problem is fixed. Your team received many complaints and you had asked your two assistants to seek a solution. Today, you send an email to them and ask whether there is any progress about it. The replies come back as follows:

- Peter [*presupposing speaker*]: Even John couldn't solve the problem.
- Adam [*saying speaker*]: John was the most likely to solve the problem and he couldn't do it.

In light of this, you write the following message to applicants who reached out for you: *[type text]*

Later that day, you discover that John, the technical assistant of the HR group, is not an expert on maintenance of online platforms and that the head of the IT department had not been informed about the problem.

Story 11

You are the new supervisor of the HR team of a small company. There is an open position for an IT job. If you receive more than one application, you need to organize an interview panel to select among the candidates. A few days ago you have been informally contacted by a potential applicant, Mr. Smith. Today is the deadline and you send an email to your two assistants to ask whether Mr. Smith has indeed applied. The replies come back as follows:

- Peter [*presupposing speaker*]: Yes, Mr. Smith sent an application too.
- Adam [*saying speaker*]: Yes, two people have sent applications, including Mr. Smith.

In light of this, you write the following email to the colleagues who had given their availability to be part of the interview panel: *[type text]*

Later on, you discover that Mr. Smith is the only candidate. Given this, the interview panel is not needed.

Study 3 (Factives at hand: When presupposition mode affects motor response)

Detailed Explanation concerning the analysis

In this paper, we have used linear mixed-effects models as our starting point. This raises two questions. First, in some cases the default algorithm does not converge. This might be taken as an indication that the maximal model is not appropriate, being for instance too complex in regard of the number of observations (Eager & Roy, 2017). However, the availability of the *allFit* function in the *lme4* R package (Bates et al., 2015) allows one to check the results of a series of alternative algorithms. We observed that most of them converge and, more importantly, end up with practically identical *t* and *p* values (including the values calculated by the initial non-converging algorithm). This suggests that the complexity of the model is not problematic and, accordingly, we kept the random maximal structure, using the mean of all *p* values for our final estimation.

The second question is much more problematic, the Q-Q plots and Shapiro-Wilks tests on the residuals of the various models show that these residuals are not normal (see for instance Figure X, which shows the Q-Q plot for the contrast between the Asserted Action (like *Ines ties her shoes*) and Non-Action (like *Peter prefers chicken*) stimuli.

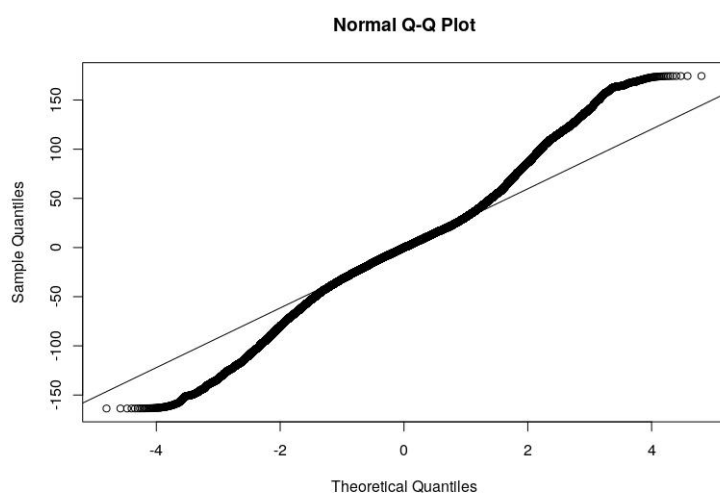


Figure 1. Q-Q Plot for the Asserted Action vs. Non-Action 601-900 ms Window in Experiment 3

No transformation of the response was found to have a positive effect on the non-normality of residuals. It is sometimes assumed that mixed-effects models are robust to

deviations from normality⁶⁵. However, recent literature points out that this may be a serious problem⁶⁶, which calls for specific solutions (for some examples, see Arnau, J., Bono, R., Blanca, M.J. & Bendayan, R., 2012; Field & Wilcox, 2017). The two traditional strategies are: (1) Considering other types of *parametric* models and (2) abandoning parametricity altogether. Identifying the appropriate type of parametric model, if any, seems extremely difficult. The high participant and item-based variability is reflected in plots which do not correspond to any standard probability distribution. Moreover, *generalized* binomial linear models (known as *logistic* regression models) fit by transforming the grip force intensity values into binary (1 vs 0) values gave poor results. We binarized the results in several ways by counting as 1 (respectively 0) the intensities above (respectively equal to or below) the mean, the median, or various given numeric thresholds. In each and every case, the explanatory power of the corresponding models remained low, as evidenced by ROC curves. To give a concrete example, the logistic regression maximal mixed model⁶⁷ for the 601-900 temporal window of the third (projection) experiment delivers the following results for the Asserted Action vs non-action contrast based on the position with respect to the mean: $p = 0.044$, A(real) U(nder) C(urve) = 0.65. The AUC represents the discriminating power of the logistic regression. It estimates the probability that the model will guess the correct value (0 for 0, 1 for 1). We followed the rule of thumb described (Hosmer, Lemeshow & Sturdivant, 2013, p. 177) and considered that the 0.65 value for the AUC is not enough to guarantee that the model has a good discriminating power.

Does it follow that the linear mixed-effects maximal models are devoid of interest? Two question must be distinguished. The first one is whether the figures (likelihood, t values, p values, etc.) calculated by the models are good estimates. In the absence of linearity, the answer is a clear *we cannot know*. The second question is whether the effect or non-effect that the model could suggest are ‘real’, that is, corresponds to some underlying causal mechanism. Here, the answer is relatively simple: mixed-effect models have been devised to separate the statistical

⁶⁵ Or homoscedasticity, for that matter. We are not concerned with homoscedasticity here because our results do not show any obvious sign of heteroscedasticity.

⁶⁶ The non-normality of residuals does not *entail* that a linear maximal model is invalid in a strong sense, that is, that it would distort the data to the point where the hierarchy between conditions is reversed. In general, the effect detected by such models is really there but its numerical estimation (in terms of value) is not reliable.

⁶⁷ We used the *glmer* function of the *lme4* R package with the same structure as in table 1. We note that models with fewer parameters (non-maximal models) make the discriminating power of the model *decrease*. So, there is no hope of getting better results by simplifying the models.

impact of particular objects (very often participants and items), whose internal variation is *random* (i.e. not the focus of an experiment), from that of the main factor(s) (sentence type in the current experiments). When such models are maximal, they exhaust the set of extraneous (random) factors and the effects (impact on mean) they report is what remains once the impact of random factors has been ‘subtracted’ as far as possible. More precisely, the impact of particular objects in the domain of random factors (e.g. particular participants and items) is adjusted.⁶⁸ This has the consequence that maximal mixed-effect models are *stricter* than their non-maximal alternatives. Their *t* and *p* values estimations are almost always inferior and frequently under the significance threshold chosen for the non-maximal variants. Whenever a maximal model reports no effect whereas a non-maximal model reports one, it is because the maximal model has detected a strong variation in one or several random objects and it is good practice to follow its lead and to conclude that one has no evidence of an effect. This extends to cases where simple techniques (for example mean or count comparisons) hint at an effect that the maximal model does not ‘see’. In the case at hand, the difference between a standard RM ANOVA and a maximal model is not so dramatically clear cut. An RM ANOVA is in practice equivalent to a mixed-effect model with a random term for participants (intercept *and* slope) but not for items. The maximal models add a random intercept for items. They make the *p* value increase above 3.5 % on average. This is not sufficient to reverse the conclusions suggested by the ANOVA, even though it provides a different estimation of the effect. Accepting the ANOVA as a more approximate measure would then be perhaps reasonable, but this would not be the best choice when it comes to precision. The likelihood ratio tests show that maximal models fit the data much more tightly. To illustrate, in the 600-900 ms window of Experiment 1, the obtained *p* value for the comparison between Asserted Action and Non-Action is .015 for the ANOVA and .052 for the maximal model. But the likelihood ratio test delivers a value of 17969 for the maximal model against 7928 for the ANOVA⁶⁹, which shows that the former is much more sensitive to sources of variation in the data.

To conclude on this point, we can and must use maximal models as safeguards against false positives and, more generally, to provide better correspondence to the data, unless we have more powerful non-parametric techniques, a point that we examine now.

⁶⁸ See for instance Galwey (2006, chapter 5) for a relatively clear discussion of the adjustment process.

⁶⁹ We used the *ranova* function from the *R* package *lmerTest* (Kuznetsova, Brockhoff & Christensen, 2017).

Concerning non-parametricity, the two methods of choice are (i) applying learning algorithms and (ii) sticking to strictly non-parametric inferential tests. Under the learning perspective and given the high variability already mentioned, it is unlikely that the result of a learning process would resemble a standard mathematical function. The current state of the art in learning procedures rather orients us toward (deep) learning techniques for classification. In this perspective, a crucial point is to decide which type of data we have to analyze. Grip force intensity evolves over time and the observed curves are *time series*, in the sense of temporally ordered sequences of value-time point pairs. Time series have been the subject of substantial investigation in recent years (for a representative example, see Rao, Rao & Rao, 2012), especially in the field of financial modeling where trying to anticipate the future of financial products is a central concern. However, our main research question is the *comparison* of times series, a concept which is somewhat elusive (Aghabozorgi, Shirkhorshidi & Wah, 2015). Time series can have similar shapes but differ by their values. In that case one series is a vertical translation of the other. They can also have similar values and different shapes, for example if the shapes are approximately symmetrical (i.e. typically, two linear shapes with opposite slopes) or if the similar values are not temporally aligned (for example when a segment of one series is similar to a preceding or subsequent segment of the other series). Such aspects make the classification of irregular time series a difficult and largely exploratory enterprise. More technically, the main problem with grip force time series is to determine whether a segment-based approach (Guijo-Rubio, Durán-Rosal, Gutiérrez, Troncoso & Hervás-Martínez, 2020) is appropriate. There exist good software packages in python (*tslearn*, Tavenard, Faouzi & Vandewiele, 2017) and R (*dtwclust*, Sardá-Espinosa, 2019) exploiting iterative or deep learning algorithms for time series comparison. However, at the time being, we lack a robust evaluation of their relevance and efficiency for analyzing the type of data we deal with in this paper.

Non-parametric tests seem to be more promising in the short term. The idea we develop is to use Fisher exact tests and Wilcoxon tests on counts. We proceed in 4 steps.

1. For each 300 ms time window, each participant and each item in each condition, we record the mean of the item. We rank the items by means in ascending order.
2. For each 300 ms time window, each participant and each pair of conditions, for instance Asserted Action versus Non-Action, we compare the items with the same rank, meaning that for each time point (1-300) we note whether item A of rank R in the Asserted Action condition has a higher (lower, or equal) value than item B of rank R in the Non-Action condition. The item which has at least 60 higher values (20% of all the values) is determined to be the “winner”

of the comparison⁷⁰. In any other case the items are considered as equal (“tie”). We tested whether larger thresholds modified significance for the Fisher and Wilcoxon tests. We tried 70, 80, 90 and 100 (23%, 27%, 30% and 33%). This made the p values vary but they remained significant. At this stage, we obtain sequences of comparisons results, for each time window, participant and pair of conditions.

3. Summing by condition across participants gives us the total scores for each time window and each comparison of conditions. For instance, in Table 5 of Section 3.1 (the factive experiment), the first row is:

Table 1. *P Values for the Mixed Model, Wilcoxon test, and Fisher Exact Test.* * $p < .05$, ** $p < .001$

Windows	Mixed model	Wilcoxon test	Contrasts	Count scores	Participant scores (Winners)	Fisher
501-800	.065 .8	.04* .15	AA vs. NA AA vs. PresA	445 vs. 234 338 vs. 376	14 vs. 7, 4 ties 9 vs. 12, 4 ties	<.0001**

The Count Scores column contains the sum of all winner items for each category. For instance, the table tells us that, in the 500-800 window, Asserted Action items win 445 times and Non-Action items 234 times. The Fisher tests reported in the paper are based over count comparisons. In the above table, Asserted Action (AA) is successively compared to Non-Action (NA) and to Presupposed Action (PresA). It may not be apparent how this fits in with the condition of a Fisher test. The figures in the Count scores column are considered as winning *events*, not as items. We partition the initial set of winning events ($1393 = 445 + 234 + 338 + 376$ in total) into Asserted Action winning events ($783 = 445 + 338$) and other winning events ($610 = 234 + 376$). We again partition the set in those winning events involved in an Asserted Action vs. Non-Action competition ($679 = 445 + 234$) and those winning events involved in an Asserted Action vs. Presupposed Action competition ($714 = 338 + 376$). This gives us a Fisher contingency table about which we are interested in determining whether Asserted Action winning events occur more (less, equally) often in the first competition than in the second. This is precisely one of the things a Fisher exact test is able to tell us.

⁷⁰ In other terms, if L1 (respectively L2) is the number of values of item 1 (respectively item 2) which are superior to the corresponding values of item 2 (respectively item 1), the absolute value of the difference (L1 - L2) must be equal or superior to 60 for there to be a winner. Or, equivalently, the winner has 1.5 times more higher values than the loser.

4. Finally, we can exploit another well-known non-parametric test, the Wilcoxon paired test. Consider a participant and a competition between conditions observed at the level of this particular participant in a specific time window. We count the number of winners for each condition for this participant. We do the same for all participants. This gives us two vectors. For instance the Asserted Action vs. Non-Action in the 500-800 window gives [13,16,6,16,21, ...] vs. [9,10,23,7,9,...]. The i -th value in the first (second) vector is the number of Asserted Action (Non-Action) winners. Running a Wilcoxon paired test on such vectors delivers a measure of how different are the two conditions in the chosen time window.

Summarizing, we have seen that standard models cannot offer robust numerical estimations but that the combination of such models with non-parametric simple methods can help us to interpret the observations and to detect the effects differences between conditions, even though, for technical reasons, we cannot express them reliably in the language of probability measures. The crucial point is the convergence or non-convergence of the different measures. Whenever the results of the linear mixed models and the count-based tests coincide, we have reasonable evidence that the presence or absence of an effect of the conditions is grounded in reality and not just an artifact of some strange statistical algorithm. It is then unnecessary to embark on a perilous – and probably endless – discussion about what the exact ‘measure’ of this effect could or should be. However, it happens frequently that the different indicators disagree. In that case, we give priority to the mixed-effects model since, as explained above, it is able to detect unbalanced variation in the random factors, that is, participant and item variables. Accordingly, our method in the paper was to examine the different windows of interest, selecting those which are not clearly too far from the usual significance threshold of .05 and investigate whether the count-based measures are consonant with the model estimation. When selecting windows in the first stage, we decided to select only those which corresponded to an increase or a plateau of the grip force intensity, leaving apart those regions where the intensity drops even when there is a significant difference between conditions. In our present state of knowledge, it is unclear whether such differences in decrease rate reveal something relevant to our concerns.

Experiment 1: Factivity

Table 2 | Experiment 1. Factivity

Onset of target verb and total sentence duration in ms.

Condition	Critical Verb Onset		Critical Noun Onset	
	Mean	SD	Mean	SD
Asserted-Action	1406	202	1882	236
Presupposed-Action	1255	157	1676	191
Non-action	1257	181	1734	215

Table 3 | Experiment 1. Factivity

Stimuli list for all three conditions with verb and noun onset

Verb_Type	Sentence	Verb_Onset	Noun_Onset
Asserted-Action	Avant de partir, Ines lace ses chaussures.	1599	2001
Asserted-Action	Après être arrivé, Julien toque à la porte.	1370	1811
Asserted-Action	Dans la maison, Emma claque la porte.	1313	1659
Asserted-Action	Dans son salon, Sylvain repasse sa chemise.	1451	1988
Asserted-Action	Dans la cour, Chloé caresse son chat.	1197	1728
Asserted-Action	Dans sa chambre, Marie vernit ses ongles.	1100	1749
Asserted-Action	Avec ses amis, Oscar emballe un cadeau.	1331	1782
Asserted-Action	Dans la forêt, Paul scie du bois.	928	1314
Asserted-Action	Devant ses parents, David déballe son cadeau.	1426	1919
Asserted-Action	Dans le magasin, Léo pointe du doigt.	1359	1715
Asserted-Action	Dans sa propriété, Tara taille la haie.	1695	2178
Asserted-Action	Pendant le spectacle, Vincent jongle avec des balles.	1469	2147
Asserted-Action	Pendant le petit-déjeuner, Luc presse un citron.	1664	1981
Asserted-Action	Dans la boulangerie, Charles aplatit la pâte.	1605	2166
Asserted-Action	Derrière son bureau, Brigitte agrafe des feuilles.	1580	2044
Asserted-Action	Dans la boutique, Willy casse un verre.	1453	1773
Asserted-Action	Avant la discussion, Gabrielle serre des mains.	1879	2296
Asserted-Action	Dans le couloir, Cédric gifle son ami.	1190	1729
Asserted-Action	Après sa promenade, Laure frappe à la porte.	1491	2033
Asserted-Action	Dans le bâtiment, Eliott ouvre une porte.	1219	1515

Asserted-Action	Dans son atelier, Yves recoud un bouton.	1265	1860
Asserted-Action	Dans sa chambre, Anne peigne sa poupée.	1300	1726
Asserted-Action	Pour son goûter, Martin étale la confiture.	1389	1831
Asserted-Action	Pendant la rencontre, Lou tend la main à ses ennemis.	1554	2559
Asserted-Action	Pendant sa promenade, Marie cueille des fleurs.	1503	1902
Asserted-Action	Après le dîner, Pierre allume le feu.	1642	2121
Asserted-Action	Avant les exercices, James frotte ses poignets.	1771	2259
Asserted-Action	En pleine matinée, Fanny coud sa robe.	1325	1797
Asserted-Action	Pendant son entraînement, George lance le ballon.	1551	1941
Asserted-Action	Avant de manger, Patrick savonne ses mains.	1422	1986
Asserted-Action	Après le réveil, Clara brosse ses cheveux.	1486	1908
Asserted-Action	Chez ses parents, Hélène épluche des légumes.	1202	1694
Asserted-Action	Dans la poste, Ryan tamponne une lettre.	1126	1720
Asserted-Action	Dans son appartement, Justine branche le téléphone.	1399	1781
Asserted-Action	Dans la cuisine, Denise tord le torchon.	1313	1649
Asserted-Action	En jouant dehors, Jeanne chatouille son frère.	1043	1567
Asserted-Action	Après son travail, Victoria lave son linge.	1421	1806
Presupposed-Action	Daniel voit qu'Anne lace ses chaussures.	1046	1403
Presupposed-Action	Francis s'aperçoit que Sylvain toque à la porte.	1596	1985
Presupposed-Action	Marc entend qu'Aurélien claque la porte.	1160	1490
Presupposed-Action	Louis sait que Julien repasse sa chemise.	1017	1551
Presupposed-Action	Loïc voit que Laure caresse son chat.	960	1453
Presupposed-Action	Claude réalise que Tara vernit ses ongles.	1137	1664
Presupposed-Action	Jean se rend compte qu'Éric emballe un cadeau.	1260	1678
Presupposed-Action	Daniel entend que Ryan scie du bois.	1326	1639
Presupposed-Action	Alexis observe que Cédric déballe son cadeau.	1421	1947
Presupposed-Action	Cédric réalise que James pointe du doigt.	1429	1820
Presupposed-Action	Sébastien sait que Marie taille la haie.	1348	1632

Presupposed-Action	Patrice observe que Raphaël jongle avec des balles.	1343	2081
Presupposed-Action	Michel remarque qu'Yves presse un citron.	1249	1658
Presupposed-Action	Marc sait que Vincent aplatit la pâte.	1126	1591
Presupposed-Action	Jacques observe que Sylvie agrafe des feuilles.	1313	1769
Presupposed-Action	Jonathan entend que Pierre casse un verre.	1208	1586
Presupposed-Action	Pierre voit que Denise serre des mains.	1016	1423
Presupposed-Action	Patrice entend que David gifle son ami.	1220	1735
Presupposed-Action	Quentin s'aperçoit que Chloé frappe à la porte.	1286	1710
Presupposed-Action	François remarque que Martin ouvre une porte.	1371	1728
Presupposed-Action	Xavier s'aperçoit que Luc recoud un bouton.	1333	1791
Presupposed-Action	Patrice sait qu'Emma peigne sa poupée.	872	1239
Presupposed-Action	Daniel voit que Patrick étale la confiture.	1112	1488
Presupposed-Action	Alain observe que Charles tend la main à ses ennemis.	1136	1433
Presupposed-Action	Claude observe que Tara cueille des fleurs.	1209	1533
Presupposed-Action	Jacques réalise que Willy allume le feu.	1267	1635
Presupposed-Action	Francis voit que Léo frotte ses poignets.	1168	1598
Presupposed-Action	Alexis sait que Gabrielle coud sa robe.	1366	1673
Presupposed-Action	Philippe s'aperçoit qu'Eliott lance le ballon.	1259	1594
Presupposed-Action	Cédric constate qu'Elias savonne ses mains.	1389	2000
Presupposed-Action	Antoine remarque qu'Aurore brosse ses cheveux.	1094	1529
Presupposed-Action	Jean-Pierre se rend compte que Jeanne épluche des légumes.	1488	1935
Presupposed-Action	Thierry remarque que Paul tamponne une lettre.	1295	1803
Presupposed-Action	Cédric entend que Victoria branche le téléphone.	1426	1808
Presupposed-Action	Olivier remarque que Fanny tord le torchon.	1379	1686
Presupposed-Action	Gérard réalise que Hélène chatouille son frère.	1508	2069
Presupposed-Action	Michel remarque que Justine lave son linge.	1297	1655

Non-Action	Au cours du meeting, Martin berne l'assemblée.	1645	2013
Non-Action	Avant l'expérience, Viviane teste son matériel.	1681	2187
Non-Action	Pour le dîner, Pierre souhaite du poulet.	1165	1579
Non-Action	Dans la négociation, Jean conseille son cousin.	1518	2078
Non-Action	Pour le projet, Alain impose son avis.	1246	1852
Non-Action	Après l'incendie, Benoît déplore les dégâts.	1371	1902
Non-Action	Après l'accident, Luc questionne le témoin.	1180	1720
Non-Action	Pour l'école, Paul loupe le bus.	973	1412
Non-Action	Pour l'équipe, Philippe recrute un joueur.	1056	1589
Non-Action	Par son arrogance, Toni heurte l'auditoire.	1351	1881
Non-Action	Devant son ami, Sarah situe le problème.	1272	1736
Non-Action	Pour Noël, Julien solde les guirlandes.	904	1355
Non-Action	Pendant la crise, Francis hausse ses tarifs.	1406	1939
Non-Action	Dans le bureau, Ryan enregistre un étudiant.	1144	1724
Non-Action	Devant l'avocat, Pierre nuance ses critiques.	1054	1483
Non-Action	Sur le marché, Daniel vend des légumes.	1174	1460
Non-Action	Pendant le jeu vidéo, Léa compte ses points.	1248	1694
Non-Action	Dans le marais, Clara scrute les oiseaux.	1043	1597
Non-Action	A la loterie, Zoé gagne le gros lot.	1046	1670
Non-Action	Pour son travail, Lucie part en train.	1117	1456
Non-Action	Dans le programme, Marc détecte un problème.	1267	1764
Non-Action	Au monopoly, Bénédicte plume son adversaire.	1383	1831
Non-Action	Devant la fenêtre, Clémence contemple le paysage.	1309	1875
Non-Action	Pour la réparation, Pauline offre son aide.	1449	1974
Non-Action	Dans son travail, Justine cite un article.	1245	1617
Non-Action	Pendant le match, Jean étonne le public.	1052	1406
Non-Action	Dans sa thèse, Adrien prouve le théorème.	1172	1473
Non-Action	Avec sa réponse, Steve fâche son ami.	1394	1923
Non-Action	Dans le contrat, Didier roule son client	1213	1667

Non-Action	Pendant son enquête, Laure démasque le coupable.	1039	1547
Non-Action	Avec ses achats, Margot ruine sa famille.	1398	1841
Non-Action	Grâce à son frère, Léonie rembourse ses dettes.	1370	2074
Non-Action	Dans le journal, Carla dément la rumeur.	1114	1533
Non-Action	Avec ses manips, Héloïse fausse le résultat.	1473	1903
Non-Action	Par son hésitation, Fanny trouble ses partenaires.	1273	1733
Non-Action	Avec sa stratégie, André relance son entreprise.	1493	2068

Experiment 2: Non-Factivity

Table 4 | Experiment 2: Non-Factivity

Onset of target verb and total sentence duration in ms

Condition	Onset Verb		Total sentence duration	
	Mean	SD	Mean	SD
Asserted-Action	1406	202	1882	236
Non-Presupposed-Action	1290	184	1713	199
Non-Action	1257	180	1734	215

Table 5 | Experiment 2. Non-Factivity

Stimuli list for all three conditions with verb and noun onset

Verb_Type	Sentence	Verb_Onset	Noun_Onset
Asserted-Action	Avant de partir, Ines lace ses chaussures.	1599	2001
Asserted-Action	Après être arrivé, Julien toque à la porte.	1370	1811
Asserted-Action	Dans la maison, Emma claque la porte.	1313	1659
Asserted-Action	Dans son salon, Sylvain repasse sa chemise.	1451	1988
Asserted-Action	Dans la cour, Chloé caresse son chat.	1197	1728
Asserted-Action	Dans sa chambre, Marie vernit ses ongles.	1100	1749
Asserted-Action	Avec ses amis, Oscar emballe un cadeau.	1331	1782
Asserted-Action	Dans la forêt, Paul scie du bois.	928	1314
Asserted-Action	Devant ses parents, David déballe son cadeau.	1426	1919
Asserted-Action	Dans le magasin, Léo pointe du doigt.	1359	1715
Asserted-Action	Dans sa propriété, Tara taille la haie.	1695	2178
Asserted-Action	Pendant le spectacle, Vincent jongle avec des balles.	1469	2147

Asserted-Action	Pendant le petit-déjeuner, Luc presse un citron.	1664	1981
Asserted-Action	Dans la boulangerie, Charles aplatit la pâte.	1605	2166
Asserted-Action	Derrière son bureau, Brigitte agrafe des feuilles.	1580	2044
Asserted-Action	Dans la boutique, Willy casse un verre.	1453	1773
Asserted-Action	Avant la discussion, Gabrielle serre des mains.	1879	2296
Asserted-Action	Dans le couloir, Cédric gifle son ami.	1190	1729
Asserted-Action	Après sa promenade, Laure frappe à la porte.	1491	2033
Asserted-Action	Dans le bâtiment, Eliott ouvre une porte.	1219	1515
Asserted-Action	Dans son atelier, Yves recoud un bouton.	1265	1860
Asserted-Action	Dans sa chambre, Anne peigne sa poupée.	1300	1726
Asserted-Action	Pour son goûter, Martin étale la confiture.	1389	1831
Asserted-Action	Pendant la rencontre, Lou tend la main à ses ennemis.	1554	2559
Asserted-Action	Pendant sa promenade, Marie cueille des fleurs.	1503	1902
Asserted-Action	Après le dîner, Pierre allume le feu.	1642	2121
Asserted-Action	Avant les exercices, James frotte ses poignets.	1771	2259
Asserted-Action	En pleine matinée, Fanny coud sa robe.	1325	1797
Asserted-Action	Pendant son entraînement, George lance le ballon.	1551	1941
Asserted-Action	Avant de manger, Patrick savonne ses mains.	1422	1986
Asserted-Action	Après le réveil, Clara brosse ses cheveux.	1486	1908
Asserted-Action	Chez ses parents, Hélène épluche des légumes.	1202	1694
Asserted-Action	Dans la poste, Ryan tamponne une lettre.	1126	1720
Asserted-Action	Dans son appartement, Justine branche le téléphone.	1399	1781
Asserted-Action	Dans la cuisine, Denise tord le torchon.	1313	1649
Asserted-Action	En jouant dehors, Jeanne chatouille son frère.	1043	1567
Asserted-Action	Après son travail, Victoria lave son linge.	1421	1806
Non-Presupposed-Action	Daniel imagine qu'Anne lace ses chaussures.	1311	1698
Non-Presupposed-Action	Francis dit que Sylvain toque à la porte.	1393	1794

Non-Presupposed-Action	Marc soupçonne qu'Aurélie claque la porte.	1275	1699
Non-Presupposed-Action	Louis suspecte que Julien repasse sa chemise.	1455	1903
Non-Presupposed-Action	Loïc pense que Laure caresse son chat.	1254	1759
Non-Presupposed-Action	Claude imagine que Tara vernit ses ongles.	1244	1837
Non-Presupposed-Action	Jean croit qu'Éric emballe un cadeau.	926	1403
Non-Presupposed-Action	Daniel suppose que Ryan scie du bois.	1315	1690
Non-Presupposed-Action	Alexis imagine que Cédric déballe son cadeau.	1515	2074
Non-Presupposed-Action	Cédric soutient que James pointe du doigt.	1378	1835
Non-Presupposed-Action	Sébastien suspecte que Marie taille la haie.	1690	2078
Non-Presupposed-Action	Patrice suspecte que Raphaël jongle avec des balles.	1713	2276
Non-Presupposed-Action	Michel dit qu'Yves presse un citron.	1114	1488
Non-Presupposed-Action	Marc dit que Vincent aplatit la pâte.	1512	1621
Non-Presupposed-Action	Jacques croit que Sylvie agrafe des feuilles.	1317	1772
Non-Presupposed-Action	Jonathan soupçonne que Pierre casse un verre.	1482	1817
Non-Presupposed-Action	Pierre pense que Denise serre des mains.	1240	1636
Non-Presupposed-Action	Patrice soupçonne que David gifle son ami.	1446	2056
Non-Presupposed-Action	Quentin imagine que Chloé frappe à la porte.	1296	1738
Non-Presupposed-Action	François pense que Martin ouvre une porte.	1222	1477
Non-Presupposed-Action	Xavier soutient que Luc recoud un bouton.	1198	1679
Non-Presupposed-Action	Patrice suspecte qu'Emma peigne sa poupée.	1164	1620
Non-Presupposed-Action	Daniel dit que Patrick étale la confiture.	1168	1534
Non-Presupposed-Action	Alain suppose que Charles tend la main à ses ennemis.	1118	1440
Non-Presupposed-Action	Claude soutient que Tara cueille des fleurs.	1108	1450
Non-Presupposed-Action	Jacques pense que Willy allume le feu.	1105	1477
Non-Presupposed-Action	Francis dit que Léo frotte ses poignets.	1094	1482
Non-Presupposed-Action	Alexis imagine que Gabrielle coud sa robe.	1540	1893

Non-Presupposed-Action	Philippe suspecte qu'Eliott lance le ballon.	1515	1916
Non-Presupposed-Action	Cédric croit qu'Élias savonne ses mains.	1050	1627
Non-Presupposed-Action	Antoine croit qu'Aurore brosse ses cheveux.	1132	1574
Non-Presupposed-Action	Jean-Pierre suppose que Jeanne épluche des légumes.	1210	1658
Non-Presupposed-Action	Thierry pense que Paul tamponne une lettre.	998	1505
Non-Presupposed-Action	Cédric suppose que Victoria branche le téléphone.	1428	1867
Non-Presupposed-Action	Olivier soupçonne que Fanny tord le torchon.	1384	1720
Non-Presupposed-Action	Gérard croit que Hélène chatouille son frère.	1085	1625
Non-Presupposed-Action	Michel soutient que Justine lave son linge.	1346	1695
Non-Action	Au cours du meeting, Martin berne l'assemblée.	1645	2013
Non-Action	Avant l'expérience, Viviane teste son matériel.	1681	2187
Non-Action	Pour le dîner, Pierre souhaite du poulet.	1165	1579
Non-Action	Dans la négociation, Jean conseille son cousin.	1518	2078
Non-Action	Pour le projet, Alain impose son avis.	1246	1852
Non-Action	Après l'incendie, Benoît déplore les dégâts.	1371	1902
Non-Action	Après l'accident, Luc questionne le témoin.	1180	1720
Non-Action	Pour l'école, Paul loupe le bus.	973	1412
Non-Action	Pour l'équipe, Philippe recrute un joueur.	1056	1589
Non-Action	Par son arrogance, Toni heurte l'auditoire.	1351	1881
Non-Action	Devant son ami, Sarah situe le problème.	1272	1736
Non-Action	Pour Noël, Julien solde les guirlandes.	904	1355
Non-Action	Pendant la crise, Francis hausse ses tarifs.	1406	1939
Non-Action	Dans le bureau, Ryan enregistre un étudiant.	1144	1724
Non-Action	Devant l'avocat, Pierre nuance ses critiques.	1054	1483
Non-Action	Sur le marché, Daniel vend des légumes.	1174	1460
Non-Action	Pendant le jeu vidéo, Léa compte ses points.	1248	1694
Non-Action	Dans le marais, Clara scrute les oiseaux.	1043	1597

Non-Action	A la loterie, Zoé gagne le gros lot.	1046	1670
Non-Action	Pour son travail, Lucie part en train.	1117	1456
Non-Action	Dans le programme, Marc détecte un problème.	1267	1764
Non-Action	Au monopoly, Bénédicte plume son adversaire.	1383	1831
Non-Action	Devant la fenêtre, Clémence contemple le paysage.	1309	1875
Non-Action	Pour la réparation, Pauline offre son aide.	1449	1974
Non-Action	Dans son travail, Justine cite un article.	1245	1617
Non-Action	Pendant le match, Jean étonne le public.	1052	1406
Non-Action	Dans sa thèse, Adrien prouve le théorème.	1172	1473
Non-Action	Avec sa réponse, Steve fâche son ami.	1394	1923
Non-Action	Dans le contrat, Didier roule son client	1213	1667
Non-Action	Pendant son enquête, Laure démasque le coupable.	1039	1547
Non-Action	Avec ses achats, Margot ruine sa famille.	1398	1841
Non-Action	Grâce à son frère, Léonie rembourse ses dettes.	1370	2074
Non-Action	Dans le journal, Carla dément la rumeur.	1114	1533
Non-Action	Avec ses manip, Héloïse fausse le résultat.	1473	1903
Non-Action	Par son hésitation, Fanny trouble ses partenaires.	1273	1733
Non-Action	Avec sa stratégie, André relance son entreprise.	1493	2068
Non-Action	Par sa position, Mario gêne le trafic.	1286	1614

Experiment 3 : Projection

Table 6| Experiment 3: Projection

Onset of target verb and total sentence duration in ms

Condition	Onset Verb		Total sentence duration	
	Mean	SD	Mean	SD
Asserted-Action	3870	408	4305	442
Projected-Action	3515	257	3701	276
Non-Action	3500	297	3962	309

Table 7| Experiment 3. Projection

Stimuli list for all three conditions with verb and noun onset

Verb_Type	Sentence	Verb_Onset	Noun_Onset
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Asserted-Action	Ines va partir pour aller travailler. Avant de sortir, elle lace ses chaussures.	4005	4486
Asserted-Action	Julien est invité à dîner chez ses cousins. Quand il arrive, il toque à la porte.	4256	4731
Asserted-Action	Emma s'est disputée avec son grand frère. Dans la maison, elle claque la porte.	4009	4486
Asserted-Action	Sylvain s'apprête à aller à un entretien. Dans son salon, il repasse sa chemise.	4033	4643
Asserted-Action	Oscar croit qu'il entend des ronronnements. Dans la cour, Chloé caresse son chat.	3787	4342
Asserted-Action	Marie est une jeune fille plutôt soucieuse d'elle-même. Dans sa chambre, elle vernit ses ongles.	4234	4798
Asserted-Action	Simon et sa bande préparent un anniversaire. Avec ses amis, il emballe un cadeau.	4379	4783
Asserted-Action	Paul est bûcheron professionnel dans le Vercors. Dans la forêt, il scie du bois.	3963	4335
Asserted-Action	Aujourd'hui David fête son anniversaire. Devant ses parents, il déballe son cadeau.	3785	4255
Asserted-Action	Léo est parti en course avec sa tante. Dans le magasin, il pointe du doigt.	3870	4369
Asserted-Action	Fanny aide son oncle pour l'entretien. Dans sa propriété, elle taille les haies.	4026	4403
Asserted-Action	Vincent est le meilleur clown du cirque Pinder. Pendant le spectacle, il jongle avec des balles.	4373	5031
Asserted-Action	Luc prépare une boisson diététique. Pendant le petit-déjeuner, il presse un citron.	4213	4560
Asserted-Action	Charles travaille avec son père qui est boulanger. Dans la boutique, il aplatit la pâte.	4291	4798
Asserted-Action	Brigitte est secrétaire à l'accueil d'une banque. Derrière son bureau, elle agrafe des feuilles.	4105	4599
Asserted-Action	Willy fait les magasins avec sa mère. Dans la boutique, il casse un verre.	3803	4197
Asserted-Action	Gabriel va passer un entretien. Avant l'entrevue, il serre la main du directeur.	3445	3791
Asserted-Action	Cédric s'accroche avec un camarade de sa classe. Dans le couloir, il giflé son ami.	4367	4912
Asserted-Action	Laure part à pieds rendre visite à sa mère. Après sa promenade, elle frappe à la porte.	4366	4779
Asserted-Action	Eliott visite un local pour son entreprise. Dans le bâtiment, il ouvre une porte.	4672	5063
Asserted-Action	Yves est resté à la maison ce matin. Dans son atelier, il recoud un bouton.	3655	4107

Asserted-Action	Anne est particulièrement sage cet après-midi. Dans sa chambre, elle peigne sa poupée.	3784	4222
Asserted-Action	Denis préfère les tartines à tout autre chose. Pour son goûter, il étale la confiture.	3841	4305
Asserted-Action	Raphaël a perdu le match. Cependant, dans le vestiaire, il tend la main à son adversaire.	4046	4287
Asserted-Action	Joelle est en randonnée pour la journée. Pendant sa promenade, elle cueille des fleurs.	3883	4260
Asserted-Action	Ce soir il fait assez froid dans le salon. Après le dîner, Pierre allume le feu.	3345	3752
Asserted-Action	James fait de la gymnastique acrobatique. Avant les exercices, il frotte ses poignets.	3993	4404
Asserted-Action	Florence est en train de préparer son mariage. Dans la matinée, elle coud sa robe.	3379	3739
Asserted-Action	Georges va bientôt jouer un match important. Pendant l'entraînement, il lance le ballon.	4351	4668
Asserted-Action	Patrick jardine et s'apprête à passer à table. Avant de manger, il savonne ses mains.	3589	4111
Asserted-Action	Clara a une routine matinale bien au point. Après le réveil, elle brosse ses cheveux.	3703	4060
Asserted-Action	Hélène se trouve en vacances chez ses parents. Pour le dîner, elle épluche des légumes.	3255	3686
Asserted-Action	Ryan doit envoyer un courrier. Dans la poste, il écrit l'adresse.	3220	3473
Asserted-Action	Justine rentre dans son nouvel appartement. Une fois chez elle, elle branche le téléphone.	3283	3666
Asserted-Action	Denise finit la vaisselle. Dans la cuisine, elle essore le torchon.	2738	3094
Asserted-Action	Jeanne est d'humeur plutôt taquine aujourd'hui. En jouant dehors, elle chatouille son frère.	3431	3939
Asserted-Action	Ce matin Victoria ne savait pas quoi mettre. Après son travail, elle lave son linge.	3722	4152
Projected-Action	Robert est occupé dans le salon. Il ne voit pas que Ghislaine lace ses chaussures.	3747	4103
Projected-Action	Martin est juste devant la maison, Steve ne s'aperçoit pas qu'il toque à la porte.	3190	3555
Projected-Action	Alex est au milieu du jardin. il ne voit pas que Jean-Baptiste claque la porte.	3271	3670
Projected-Action	Yannick est rentré dans la buanderie. Michel ne sait pas qu'il repasse sa chemise.	3305	3782
Projected-Action	Olivier cherche Gabrielle pour lui parler. Il ne voit pas qu'elle caresse son chat.	3352	3818

Projected-Action	François sent une forte odeur. Il ne réalise pas que Véro vernit ses ongles.	3414	3894
Projected-Action	Elias fête Noël avec Gabin. Il ne se rend pas compte que Gabin emballe un cadeau.	3697	4129
Projected-Action	Gérard se trouve au fond de la maison. Il n'entend pas que Romain scie du bois.	3219	3491
Projected-Action	C'est aujourd'hui l'anniversaire de Francis. Jacques n'observe pas qu'il déballe son cadeau.	3774	4239
Projected-Action	René montre le chemin de la forêt. Hugo ne réalise pas qu'il pointe du doigt.	3368	3754
Projected-Action	Tom est très étonné par le bruit. Il ne sait pas que Sylvie taille la haie.	2960	3356
Projected-Action	Par hasard Quentin a trouvé deux balles. Gautier n'observe pas qu'il jongle avec.	3290	3568
Projected-Action	Éric prépare un jus de fruit d'agrumes. Marc ne constate pas qu'il presse un citron.	3217	3535
Projected-Action	Louis confectionne une tarte aux pommes et aux poires. Yann ne sait pas qu'il aplatit la pâte.	3504	3989
Projected-Action	Aurore range des papiers administratifs. Antoine n'observe pas qu'elle agrafe des feuilles.	3550	4012
Projected-Action	Luce range la vaisselle accumulée dans l'évier. Jean-Pierre n'entend pas qu'elle casse un verre.	3368	3693
Projected-Action	Guy se trouve avec son patron. Thierry ne voit pas que Guy lui serre la main.	3295	3611
Projected-Action	Valérie se dispute avec son ami. Régis n'entend pas qu'elle giflé cet ami.	3337	3888
Projected-Action	Xavier est sous la douche. Il ne s'aperçoit pas que Timothée frappe à la porte.	3252	3702
Projected-Action	Sophie se déplace dans une autre pièce. Patrice ne remarque pas qu'elle ouvre une porte.	3543	3842
Projected-Action	Fabrice fait des travaux de couture. Daniel ne s'aperçoit pas qu'il recoud un bouton.	3316	3725
Projected-Action	Nadia joue dans sa chambre avec ses jouets. Alain ne sait pas qu'elle peigne sa poupée.	3412	3837
Projected-Action	Diana prend son petit-déjeuner sur le divan. Claude ne voit pas qu'elle étale la confiture.	3488	3872
Projected-Action	Louise termine victorieusement son match de boxe. Loïc n'observe pas qu'elle tend les mains à son adversaire.	3857	4123
Projected-Action	Agnès et Julie sont dans un champ. Agnès n'observe pas que Julie cueille des fleurs.	3392	3728

Projected-Action	Jean et Marin font un barbecue. Jean ne réalise pas que Marin allume le feu.	3235	3578
Projected-Action	Grégoire se désinfecte avant d'opérer. Noam ne voit pas qu'il frotte ses poignets.	3197	3569
Projected-Action	Aurélie répare des vêtements. Jonathan ne sait pas qu'elle coud sa robe.	2717	2997
Projected-Action	Jules vient d'intégrer l'équipe de basket. Tristan ne s'aperçoit pas qu'il lance le ballon.	3404	3754
Projected-Action	Eve et Jérôme sont à la maison. Jérôme ne constate pas qu'elle savonne ses mains.	3033	3526
Projected-Action	Isabelle est dans le salon. Elle ne remarque pas que Léonard brosse ses cheveux.	2733	3098
Projected-Action	Jim prépare le repas de midi. Élise ne constate pas qu'il épluche des légumes.	3245	3643
Projected-Action	Alexis prépare du courrier en retard. Richard ne remarque pas qu'il tamponne une lettre.	3513	4002
Projected-Action	La ligne de Stéphanie est déconnectée. Serge n'entend pas qu'elle branche le téléphone.	2798	3158
Projected-Action	Tara fait la vaisselle dans la cuisine. Ambre ne constate pas qu'elle tord le torchon.	3141	3423
Projected-Action	Christian entend rire au loin. il ne réalise pas que Corinne chatouille son frère.	3036	3495
Projected-Action	Bernard pénètre dans la buanderie. Il ne remarque pas qu'Angélique lave son linge.	3426	3786
Non-Action	Roland est un politicien rusé. Au cours du meeting, il berne l'assemblée.	3931	4349
Non-Action	Viviane est extrêmement rigoureuse. Avant l'expérience, elle teste son matériel	3330	3744
Non-Action	Samuel préfère de beaucoup la volaille. Pour le dîner, il souhaite du poulet.	2898	3371
Non-Action	Manon est une avocate renommée. Dans la négociation, elle conseille son cousin.	3348	3928
Non-Action	Rémy a une mentalité autoritaire. Pour le projet, il impose son avis.	3140	3699
Non-Action	La vieille maison de Juliette a pris feu. Après l'incendie, elle déplore les dégâts.	3316	3811
Non-Action	Bruno fait un stage dans la police. Après un accident, il questionne le témoin.	3190	3762
Non-Action	Irène met trop de temps à se maquiller. Pour le lycée, elle loupe le bus.	2923	3220
Non-Action	Philippe hésite à renforcer l'équipe. Après réflexion, il recrute un joueur.	3475	3988
Non-Action	Toni expose sa nouvelle théorie. Par son arrogance, il heurte l'auditoire.	3431	3817

Non-Action	Sarah veut avoir une explication franche. Devant son amie, elle situe le problème.	3488	3970
Non-Action	Laurent n'arrive pas à bien vendre pour Noël. Pour s'en sortir, il solde les guirlandes.	3760	4257
Non-Action	Sabine dirige une société immobilière. Pendant la crise, elle hausse ses tarifs.	3347	3677
Non-Action	Matthieu est secrétaire à l'université. Dans le bureau, il enregistre un étudiant.	3311	3946
Non-Action	Édith ne veut pas enfoncer son mari. Devant l'avocat, elle nuance ses critiques.	3066	3618
Non-Action	Florian cherche à écouler ses excédents. Sur le marché, il vend des légumes.	3240	3544
Non-Action	Léa est juge pour une épreuve de judo. Pendant le combat, elle compte les points.	3651	4079
Non-Action	Damien travaille pour sa thèse d'éthologie. Dans le marais, il scrute les oiseaux.	3663	4090
Non-Action	Zoé a toujours eu une chance incroyable. À la loterie, elle gagne le gros lot.	3162	3578
Non-Action	Pascal ne veut pas polluer avec sa voiture. Pour son travail, il part en train.	3511	3824
Non-Action	Élodie expertise le logiciel de paye. Dans le programme, elle détecte un problème.	3593	4104
Non-Action	Bénédicte adore les jeux de société. Au monopoly, elle plume son adversaire.	3296	3839
Non-Action	De chez lui Lucien a une très belle vue. Devant la fenêtre, il contemple le paysage.	3441	3999
Non-Action	Pauline a un BTS d'électronique. Pour la réparation, elle offre son aide.	3559	4109
Non-Action	Gilles rédige la version finale de sa thèse. Dans son travail, il cite ses articles.	3901	4448
Non-Action	Fabienne connaît sa toute première sélection. Pendant le match, elle étonne le public.	3583	4010
Non-Action	Lucas a très longtemps cherché une démonstration. Dans son livre, il prouve le théorème.	3949	4392
Non-Action	Catherine a un débat avec ses camarades. À cause d'une remarque, elle fâche une amie.	3433	3826
Non-Action	Didier n'a vraiment aucun scrupule en affaires. Dans le contrat, il roule son client	3424	3816
Non-Action	Roxanne est une excellente policière. Au cours du procès, elle démasque le coupable.	3480	3990
Non-Action	André fait des dépenses inconsidérées. Avec ses achats, il ruine sa famille.	3597	3927

Non-Action	Léonie a contracté un gros emprunt. Grâce à son frère, elle rembourse ses dettes.	3888	4425
Non-Action	Joachim a été accusé de corruption. Dans le journal, il dément la rumeur.	4148	4583
Non-Action	Héloïse s'est trompée dans le bilan comptable. Avec ses erreurs, elle fausse le résultat.	3403	3848
Non-Action	Maxime hésite à signer le contrat. Par son attitude il trouble ses partenaires.	3699	4150
Non-Action	Margot relocalise ses sociétés. Avec sa stratégie, elle relance son entreprise.	3869	4428
Non-Action	Mario a garé son camion en double-file. Par sa position, il gêne le trafic.	4079	4451

Concours photo du ministère de l'éducation nationale

Nos rêves

les plus belles choses ne demandent
pas trop d'attention,
sans qu'on s'y attende, elles entrent
dans la vie,
et font paraître les rayons du soleil plus
forts qu'ils ne le sont réellement.

Cette photo est la photo de l'original qui a été retenue pour représenter l'ENS de Lyon au concours organisé par le ministère de l'Éducation nationale en 2017. L'original a été pris vers le cratère Krafta en Islande. La photo illustrée sur cette page est la photo de l'original qui a été exposée sur les grilles extérieures de la rue de Grenelle.

