

Principal Applicant: Pascal M. Gyga

When perceiving the future closer than it is: a psycholinguistic investigation of the way we talk about the future

1. Summary of the research plan

Languages differ in the way their speakers talk about the future. In some languages, such as French, specific verb constructions are required. For example, to refer to the present action of eating, in French, one would say *je mange*, whereas to refer to the future action of eating, one would say *je mangerai*. Other languages, such as German, do not mandatorily require this kind of constructions. Namely, in German, one can use the same verb construction to refer to a present or a future event (given that the context sets the difference). In a linguistic relativity perspective (a weak version of it), such differences could influence the way speakers of these languages envision the future, or represent future events. French, by grammatically marking the future, makes the temporal dimension particularly salient, at least more salient than German, which does not habitually make the grammatical distinction. We argue that these language properties lead French speakers to construct a dichotomous, discontinuous representation of time (i.e., now and later) while German speakers construct a more continuous representation, and therefore less dichotomous. We even argue that speakers of both languages represent the future differently, according to the language in use when referring to future events.

In this project, we propose to examine this question by relying on psycholinguistic paradigms, some of which having been used to investigate the representations of past events. More specifically, we address two issues. First, we investigate the role of tense marking in the construction of representations of future events among speakers of languages using different verb tenses to express the future. Second, we investigate how future representations may change in speakers of two languages (differing in the way the future is habitually expressed) as a function of the language in use.

We present two sets of four experiments that essentially differ in the paradigms that will be used in order to shed light on different yet related processes involved in the construction of mental representations of the future. The first set of experiments will focus on the *accessibility* of future properties in mental representations while the second set of experiments will address the *perceptual nature* of mental representations of the future. In both sets of experiments monolingual speakers of French and German will be tested in order to establish a clear picture of the influence of tense marking on future representations in these languages. Bilingual speakers will then be tested in order to investigate potential shifts in future representations related to shifts in language use.

2. Research plan

2.1. Current state of research in the field

Speakers of different languages differ in how and when they have to signal that they are talking about the future. For example, while German speakers *can use* a verb in the present tense while making predictions about the future (a), French speakers, formally¹, have to use the future tense to express the same meaning (b).

(a) *Morgen regnet es.* (Literally: It rains tomorrow.)

(b) *Demain il pleuvra.* (Literally: It will rain tomorrow.)

Such differences in tense marking have been assumed to underlie differences in the way French- or German-speakers elaborate representations of the future, which could in turn affect their future-related behaviors (Chen, 2013). This idea is based

¹ Although formally the future tense has to be used, when talking about intentions (as detailed later on), the present tense can be used. Overall, it is still used in a much less frequent way than in German.

on the hypothesis that language structure and categories shape how speakers of different languages think, how they conceive reality (e.g., Slobin, 2003). Typically, by talking about future events in the present tense, German-speakers may consider the future to be closer than French-speakers would by using the future tense. However, no experimental evidence has yet been provided regarding the influence of the encoding of tense in verbal morphology on the actual mental representations of the future (i.e., the way we actually think about the future). In this project, we propose to examine this question by relying on psycholinguistic paradigms in order to (1) investigate the role of tense marking in the construction of representations of future events among speakers of languages using different verb tenses to express the future, and (2) investigate how future representations change as a function of the language in use, in French-German and German-French bilinguals.

Speaking about the future in European languages

The way European speakers talk about the future, in terms of linguistic properties, has been thoroughly investigated by the European Science Foundation's Typology of Languages in Europe (EUROTYP) group. As pointed out by Dahl (2000) in his overview of the findings of EUROTYP, the future has a very different semantic property from the present and the past, other than just being differently located on a time line. Whereas events in the past and present are already or currently experienced, events in the future have never been experienced. For this reason, people do not normally speak about facts or truths when talking about the future. They rather express intentions – when events are under control –, or predictions about the future – when things are not within the speaker's control or human control in general. This distinction between future time references (FTR) that are intention-based (*Tomorrow I'll take the train*) or prediction-based (*Tomorrow it will rain*) is important – especially for the present project –, because contrary to intentions that are treated in a similar way grammatically across languages, predictions differ in how they are expressed. In some languages, which can be considered *strong FTR* languages (following Chen, 2013), a prediction has to be expressed using the future tense (e.g., in French, Spanish, or English) whereas in weak FTR languages, it can also be expressed with a present verb tense (e.g., in German or Finnish). According to Dahl (2000), "whether FTR is overtly and obligatorily marked in prediction-based sentences can be used as one of the major criteria for whether it is grammaticalized in a language or not" (p. 2). Based on this distinction, different language families in terms of the verb tenses used to express the future can be defined, some languages even leaving FTR partly or totally ungrammaticalized (i.e., can be expressed with the present, unmarked, form). The absence of grammaticalized future is notably found in all Germanic languages with the exception of English. In this project, German will be one of the languages that will be investigated.

Relevant to the issue of grammaticalization is also the type of linguistic devices expressing a grammatical feature. When talking about the future, there are a lot of different ways to express it, depending on the subject of the sentence or on how close or how certain the future event is. In French – the second language under investigation in this project – for instance, the usual future verb tense is morphologically marked with a suffix (e.g., *je mangerai* [I will eat]). However, it is also possible in some situations to add the verb "aller" ("to go") to the main verb instead of conjugating it, as in "*Demain, je vais manger*" (which is close to "*Tomorrow, I am going to eat*"). As reported by Dahl (2000), the choice between the inflectional (e.g., French *je mangerai*) and the periphrastic (e.g., French *je vais manger*) constructions depends on stylistic and semantic factors. The combination of these factors show that the inflectional form is mostly found in the "prediction + 3rd person + remoteness" context, whereas the periphrastic form is preferred in the "intention + 1st person + immediateness" context. Still, in our project, the question remains whether the use, in French, of an inflectional or a periphrastic (i.e., with *je vais* in the present tense) construction has an influence on the way the future is represented.

As introduced earlier, the general question that stems from observing these differences concerns the way that the grammaticalization of the future can shape the way we represent or think about the future. The idea that language influences thought has received important empirical support in domains such as spatial relations (e.g., Bowerman & Choi, 2001), time (e.g.,

Boroditsky, 2001; Fuhrman & Boroditsky, 2010), grammatical gender (e.g., Sato, Gygas, & Gabriel, 2013; Konishi, 1993) or color perception (e.g., Roberson, Davidoff, Davies, & Shapiro, 2005). Recently, for example, Sato et al. (2013), showed that French-English and English-French bilinguals (depending on the second language proficiency) would represent gender differently depending on the language the task was in. Importantly here, Sato et al. directly tested the effect of language (i.e., asked participants to *read* words with grammatical gender) on cognition, framing their work on Slobin's *Thinking for Speaking* principle (e.g., 2003) to distance themselves from the cumbersome controversies of what constitutes or not a Whorfian effect. Slobin (2003) suggested the idea that because language provides only a limited set of options for encoding certain properties of objects, some linguistic forms may be bound to certain characteristics of these objects. In turn, when encountering these specific forms, our attention may be inevitably and excessively directed towards these underlying characteristics (even when not relevant). In other words, language shapes our mental representations, irrelevant of the comprehender's processing dispositions.

Coming back to the issue of grammaticalization of the future, a strong FTR language such as French may prompt its speakers to construct a dichotomous way to represent time (i.e., *now* and *later*). Consequently, speakers of strong FTR languages may consider future events more distant than speakers of weak FTR languages (German), when constructing representations of these events based on the present tense. In this project, we will take a psycholinguistic perspective to approach these issues, as it will allow us to directly and implicitly test readers' spontaneous mental representations of the future.

Mental representations and psycholinguistics

When reading a text – for example pertaining to different events in the present or the future –, people construct mental representations of the situation depicted in the text, composed of different levels of text representations (van Dijk & Kintsch, 1983). The higher level, the situation model (van Dijk & Kintsch, 1983) or mental model (Johnson-Laird, 1983), includes explicit information transmitted in the text as well as new information, i.e., inferences, deduced based on the information collected in the text and on general knowledge of the world. Hence mental models are constructed through a dynamic combination of background knowledge, explicit elements of the texts, and inferences that allow readers to comprehend the situation portrayed in and between the lines (Johnson-Laird, 1983; Kintsch, 1988). According to Zwaan and Radvansky (1998), mental models are primarily based on five dimensions: space, causation, motivation, protagonist, and time.

Among these dimensions, the temporal dimension has a special status because time has to be made explicit in the text, with the use of temporal adverbs (e.g., *Demain* [Tomorrow]) and/or morphological additions to the verbs (e.g., *je mangerai* [I will eat]), depending on the language in use. Unlike other dimensions that can be left to the readers to infer (e.g., the motivation to eat for a protagonist making a sandwich or the specific location where the protagonist is ice skating), temporal cues must be added to the text in order to specify the time when the action takes place. Without such additions, readers follow by default the *iconicity assumption* (Fleischman, 1990), and consider that the sequence of events reported in the text corresponds to their chronological order. Texts hence contain many lexical and morphological cues regarding the temporal organization of events, prompting readers to dedicate special attention to the time dimension when constructing their mental representations of the situation.

General examples of how we keep track of temporal relations

The fact that readers keep track of temporal relations during reading has been found in numerous studies. For example, Zwaan (1996) showed that reading times increase when processing long time shifts (e.g., *an hour later*) compared with short time shifts (e.g., *a minute later*). Regarding the information that readers include in their mental representations, Anderson, Garrod, and Sanford (1983) showed that people use their background knowledge about duration of events when constructing their representations of the situation. In their study, when asked about these concepts later in the discourse, readers had facilitated access to concepts preceding temporal shifts congruent with the situation (e.g., *one hour later at the restaurant*) than to those

preceding temporal shifts incongruent with the situation (e.g., *seven hours later at the restaurant*). Zwaan (1996) confirmed and generalized these findings by showing that readers have facilitated access to concepts as long as they are in the same time frame as the situation being currently described. In these different studies, time shifts were essentially manipulated through the use of linguistic cues such as time adverbials (e.g., *tomorrow* or *in six hours*).

Specific role of verb tense

However, crucially for the present project, the construction of mental representations is not only driven by adverbials. The influence of *verb tense* on mental representations has also received much attention (e.g., Becker, Ferretti, & Madden-Lombardi, 2013; Carreiras, Carriedo, Alonso, & Fernandez, 1997; Ferretti, Rohde, Kehler, & Crutchley, 2009; Madden & Zwaan, 2003; Magliano & Schleich, 2000). In Carreiras et al. (1997), for example, participants were presented with narratives containing an occupational role either (a) *currently* applying to the main character or (b) applying to that character *in the past* (see Table 1 for an example). Participants were asked to read each sentence of the text one at a time and were presented with a test word, appearing either immediately after the critical sentence, after a first filler sentence, or after a second filler sentence (at the end of the narrative). When seeing the test word, participants had to indicate if they thought the word had previously appeared in the narrative. Accuracy and time to respond were analyzed. The results showed that the participants responded to the test word faster when it followed a temporally associated occupational role (i.e., *currently* applying to the main character) than a disassociated one (i.e., applying to that character *in the past*). Moreover, as the distance between the critical sentence and the test word increased, participants were slower and less accurate to recognize the test word – there were no differences between the associated and dissociated conditions when the test word appeared after the second filler sentence. These results reveal that the temporal relation between a character and a property (here the occupational role of the character), corresponding in this study to the combination of verb tense and temporal adverbials, modulates how this property is encoded into the reader's mental representations.

Table 1. Example of a narrative used in Carreiras et al.'s (1997) study.

<i>Setting sentence</i>	Marta is a 45-year-old woman, and she is unmarried. She lives alone in a downtown apartment in La Coruna.
<i>Critical sentence</i>	(a) Now she works as an economist for an international company. (b) Sometime in the past she worked as an economist for an international company.
<i>Filler 1</i>	She visits her parents on weekends.
<i>Filler 2</i>	She loves underwater photography, and she likes to practice water sports.
<i>Test word</i>	economist

Mental models and their perceptual properties

Importantly, mental models are not amodal representations of the situation, but are perceptual by nature. This means that when reading, readers enter a simulation process in which they put themselves in the protagonist's shoes and in some way experience the situation described in the text (Barsalou, 1999; Zwaan, 2004; Zwaan & Rapp, 2006). In other words, readers may be considered as immersed experiencers (Zwaan, 2004) who access perceptual and action related representations of the described situation, when reading not only about concrete concepts such as performed actions (Glenberg & Kaschak, 2002; Zwaan & Taylor, 2006) or what objects look like (Stanfield & Zwaan, 2001; Zwaan, Stanfield, & Yaxley, 2002) but also about abstract concepts such as emotions (Havas, Glenberg, & Rinck, 2007), speed (Fecica & O'Neill, 2010; Speed & Vigliocco, 2014), space (Dudschig, Lachmair, de la Vega, De Filippis, & Kaup, 2012), and most importantly here, time (e.g., Boroditsky, 2000, Casasanto & Boroditsky, 2008).

Evidence for perceptual simulation of time

Perceptual simulation of time in text comprehension can be observed from the perspective of metaphor, as time is grounded in the perception of space and motion (Lakoff & Johnson, 1980, Boroditsky, 2000). Examples of the way we speak

about long or short durations in metaphors are numerous. Phrases such as *a tiny fraction of seconds*, *back in the age of dinosaurs*, or *she has a great career in front of her* illustrate well this notion (Nunez & Cooperrider, 2013). Even though the way time is mapped onto space differs depending on the speaker's culture and language, time can usually be conceptualized in many languages (e.g., English, French, German, etc.) along a back-front axis, in which the past is behind and the future is in front, or along a left-right axis in which the past is on the left and the future is on the right (Boroditsky, 2000; Casasanto & Boroditsky, 2008; Torralbo, Santiago, & Lupianez, 2006).

Evidence for the internalization of grounding of time in space has now been demonstrated in several studies (Bonato, Zorzi, & Umiltà, 2012; Casasanto & Boroditsky, 2008; Santiago, Lupianez, Perez, & Funes, 2007; Torralbo et al., 2006; Ulrich & Maienborn, 2010). Torralbo et al. (2006), for example, presented their participants with verbs and temporal adverbials appearing to the front or to the back of a silhouette, and asked them to judge whether the presented words referred to the past or the future. They showed that words referring to the past were judged faster when appearing to the back of the head and that words referring to the future were judged faster when appearing to the front of the head. In another study, Santiago et al. (2007) found that people are faster to respond to words about the past when they use their left hand or when the words are presented on the left, the opposite being true for words about the future. Similar effects have been shown for sentence comprehension, with faster response times with the left hand to sentences about the past and with the right hand to sentences about the future (Ulrich & Maienborn, 2010). However, and most importantly, such effects of spatial grounding of time in language comprehension have been shown to be largely dependent on the salience of temporal information. Ulrich and Maienborn's effects for example disappeared when the participants had to judge the sensibility of the sentence instead of its temporal location.

Our proposal

In sum, research on text comprehension has shown two related aspects of mental representations of time. Firstly, we know that people encode the dimension of time and use this dimension for the foregrounding of information. Secondly, we know that when understanding temporal information in discourse, people enter spatial and perceptual simulation processes. In relation to our project, these results suggest that the temporal distance elicited by different markers of the future in language should (1) be reflected in the accessibility of the related information, and (2) be simulated by the readers, and observable from a perceptual perspective. Crucially, and this is central to our project, such effects should be different depending on the FTR strength of the language in use.

In this project, we aim at studying mental representations of the future elaborated by speakers of weak and strong FTR languages (i.e., German and French). Essentially, our present project will enable us to better understand how future tense marking influences people's representations of the future. To do so, native speakers of both German and French will be tested on two sets of psycholinguistic experiments. These two sets will be complemented by a series of experiments on bilingual speakers to examine how language switches may influence the way a same individual represents future events in different languages. Together with the experiments on monolingual speakers, the experiments on bilinguals will give us a more exhaustive view as to the link between FTR strength and representations of the future.

Bilinguals and language switching

In general, bilinguals are considered to have competencies in two languages: a native, dominant language (L1) that is acquired from birth onwards, and a second language (L2) that is acquired subsequently or simultaneously. In L2 research examining thinking-for-speaking effects, bilinguals' abilities in the two languages are manipulated by examining the different performances in experimental tasks in each of the two languages. Generating inferences for example, may result in different language bound performance biases in each of the bilingual's language.

One line of evidence that supports the notion of bilinguals' processing shift associated with the language at hand comes from research examining change in categorization tendency according to the language applied to encode information. For instance, in studies investigating bilinguals' color categorization, Athanasopoulos (2009) examined how the color blue was cognitively represented in Greek-English bilinguals. While the Greek language differentiates blue into darker and lighter shades, a similar distinction is not characteristically made in English. Athanasopoulos (2009) found evidence suggesting that bilinguals' preference for color differentiation diverged from their L1 towards that of their L2 tendency. Furthermore, this effect in performance bias shifted in conjunction with the participants' level of bilingualism (determined by their acculturation level and length of stay in the L2). In a similar vein, Athanasopoulos and Kasai (2008) investigated how grammatical effects of number influenced categorization of novel objects in Japanese-English bilinguals, as the two languages diverge in their linguistic tendency to categorize objects. While in Japanese, speakers commonly categorize objects based on material, in English, there is a preference for object categorization based on shape. Japanese-English bilinguals presented in English categorization preferences similar to English natives, with L2 proficiency being a vital predictor of the extent of L2-preferences.

As reflected in these studies, although the influences of language on cognition *per se* are still subject to debate, in general, there appears to be a common agreement that language has a substantial impact on cognitive processes that incorporate both linguistic and nonlinguistic processing. Again, as introduced earlier when presenting Slobin's *Thinking for speaking* principle, these studies suggest that the activation of certain languages may emphasize particular language-specific characteristics for the perceiver, which in turn will highlight concepts that may influence subsequent processing. Regarding the way languages encode the future, processing a specific language may also activate relevant information that is linguistically associated (e.g., *now* and *later*). Interestingly, for bilinguals who maintain two languages as part of their language system, this means that the emphasis towards specific regularities will differ according to each language, and their diverging tendencies may pose shifts in mental representations to occur. However, the extent to which these language performance tendencies may influence further processes appears to be dependent on factors associated with the level in which language is rooted in the cognitive system (e.g., Athanasopoulos & Kasai, 2008; Athanasopoulos, 2009), in other words, bilinguals' *proficiency*.

Bilinguals' proficiency

While most laypersons may consider bilinguals as those with a native-like mastery of two languages, the definition in the present project applies a more general definition adopted in most bilingual research: *a person who regularly uses two languages*. Defining which L2 competencies constitute a bilingual is difficult, as the abstract notion of language competency spans a continuum. However, the notion of L2 proficiency has been inseparable from studies investigating linguistic processing in bilinguals, given that proficiency has direct effects on the performance in experimental tasks.

For example, Athanasopoulos and colleagues have provided a comprehensive picture of how L2 proficiency contributes to the impact of language on cognitive effects by using diverse evaluation methods. In their aforementioned studies examining color and object categorization, Athanasopoulos and colleagues (e.g., Athanasopoulos, Damjanovic, Krajciova, & Sasaki, 2011; Athanasopoulos & Kasai, 2008; Athanasopoulos, 2009) have consistently demonstrated that L2 performance matched specific linguistic regularities, with L2 proficiency being a good indicator of the magnitude of which these effects emerged. In their studies, L2 proficiency was gauged through different objective criteria, ranging from standardized tests (e.g., Oxford Quick Placement Test, Nation Vocabulary Test) and participants' individual language background such as the length of stay in an L2 speaking environment or frequency of L2 usage.

Together, these studies demonstrate that the extent to which language-specific processing biases take effect are heavily dependent on participants' language competence in the L2. With regard to the experiments planned in this project, we plan to test

only bilinguals demonstrating high proficiency in L2, in order to maximize the probabilities of observing and understanding the underlying processes of the effects that we will investigate.

Past studies employing bilinguals have administered various assessment tests for *objective* L2 evaluation. For instance, participants have been screened based on standardized test scores from the Oxford Placement Test (Clahsen, Balkhair, Schutter, & Cunnings, 2013), Nation's Vocabulary Test (Athanasopoulos et al., 2011; Athanasopoulos, 2009), Oxford Quick Placement Test (Athanasopoulos & Kasai, 2008), Peabody Picture Vocabulary Test (Prior & MacWhinney, 2010) and the verbal component of the SAT (Prior & MacWhinney, 2010). Many have also coupled these objective tests with participants' self-assessment data (Lehtonen & Laine, 2003). In particular, there has been a growing interest in the use of C-tests, a renewed format of a type of cloze test. In order to gauge our participants' L2 proficiency, we will combine proficiency questionnaires (specifically the Language Experience and Proficiency Questionnaire by Marian, Blumenfeld, & Kaushanskaya, 2007) and C-tests (as those used to evaluate French-German bilinguals in Sato, Gygax & Gabriel, 2016).

2.2. Current state of our own research

Pascal Gygax was trained in one of Europe's leading psycholinguistic laboratory, lead by Jane Oakhill and Alan Garnham, known for their grounding work on Mental Models. Pascal Gygax has been particularly prolific in unravelling the intricate relationship between text and general knowledge (term often (mis)used in the literature) when constructing mental representations. He has published a number of papers in the interdisciplinary field of Emotion & Cognition, most of them highly critical towards the conceptual grounding of past research as well as the methodological choices made (e.g., Gygax & Gillioz, 2015, and Gillioz & Gygax, 2015). Though Pascal Gygax can now be considered a leading figure on emotion inference research (he wrote in 2014, together with Christelle Gillioz an extensive textbook chapter on this topic), he was among the first (with Ute Gabriel) to experimentally and systematically show the propensity of grammatical cues to overrule any other possible information when grounding a mental representation of gender in grammatically gendered languages.

Christelle Gillioz (the post-doctoral fellow of the project) was trained in psycholinguistics by Pascal Gygax at the University of Fribourg, during an SNSF project on emotion inferences. After her PhD, Christelle Gillioz conducted research on the meaning of emotion words under the supervision of Klaus Scherer at the Swiss Center for Affective Sciences and has developed a long-term collaboration on the GRID project. She completed her training on a SNSF postdoc fellowship at the University of California, San Diego, focusing on the relationship between emotion and reading. In her different projects, Christelle Gillioz has explored new methodological and conceptual ideas, aiming at constructing true interdisciplinary research expertise. Currently, Christelle Gillioz has 5 papers published (one of them being a book chapter in a state-of-the-art handbook of *inferences during reading*), 1 paper in revision, and 4 papers in preparation. In all, Christelle Gillioz has both extensive experience and expertise in building most appropriate materials for the study of mental models (see Gillioz & Gygax, 2015 for a discussion on the importance of constructing appropriate materials). As such, she will be responsible for supervising all phases pertaining to the construction of the materials (i.e. the experimental narratives in Phase I and the experimental primes in Phase II). She will also be responsible for the methodological support to the PhD candidate, support complemented by the main applicant.

2.3. Detailed research plan

Methodological note

All the experiments presented in this project will be completed with a within-subject design. In order to obtain a clear picture of the influence of FTR-strength on representations of the future, we intend to test monolingual speakers of a strong-FTR language (i.e., French) and monolingual speakers of a weak-FTR language (i.e., German). In follow-up experiments, bilingual

speakers of the same languages will be tested in order to explore (1) whether knowing a language differing in FTR might alter L1 representations of the future and (2) whether switching language can result in changes in representations of the future. As mentioned earlier, only highly proficient bilinguals will be included in this project (as low proficient bilinguals may access their L2 via their L1, as recently suggested by Sato et al., 2013). In order to gauge our participants' L2 proficiency, we will use the French and German versions of the Language Experience and Proficiency Questionnaire (Marian et al., 2007) and C-tests – the German C-test administered by onDaF (www.ondaf.de) to test German proficiency and Coleman's (1994) C-test for French proficiency.

SET 1: Experiments on the influence of FTR strength on mental representations of future events when processing discourse

Introduction

The first set of experiments of this project aims at examining the extent to which FTR strength influences the representation of properties of future events when reading a text. Although no study, to our knowledge, has directly examined the impact of grammatical devices to express past or future time on readers' mental representations, our endeavor is inspired by the investigation of the influence of temporal attributions on mental representations (Carreiras et al., 1997).

A crucial presupposition on which this study is based is that, similarly to past aspects, properties of future events are less salient than present ones. However, properties of past and future events may still differ in their distance from the present to the extent that the past has already been experienced – and may not be needed anymore –, whereas the future is more salient, as it is still to be experienced. This may prompt readers to more strongly include properties of future events in their mental representations of the situation (i.e. less distance to the present), in case they would need to reactivate them. In order to test the strength of the mental representations of properties of future events (i.e. whether they are encoded in a more or less accessible way than properties about the present), we ran a pilot study². We based the experiment on Carreiras et al.'s (1997) study and tested, in French, the accessibility of occupational roles associated with fictional characters as a function of the verb tense used to describe them, i.e., future vs. present. Note that this pilot study constitutes the foundation of the present project.

For the pilot study, we constructed 42 5-sentence narratives in French, describing a character, and in which the third sentence was related to an occupational role, either now or in the future (see Table 2 for an example). Since French speakers can use the present tense to talk about future events in specific conditions (i.e., when talking about intentions), we also manipulated temporal adverbials used in the narratives. The combination of temporal adverbials and verb tenses lead to three conditions: present adverbial and present verb tense (i.e., present), future adverbial and present verb tense (future-present), and future adverbial and future verb tense (future). These conditions distinguish our pilot study from Carreiras et al.'s study, in that it allowed us to examine the respective roles of temporal adverbials and verb tenses on the accessibility of the character's property. As in Carreiras et al.'s study, participants read the narratives one sentence at a time and, when prompted by a single test word, indicated as rapidly as possible, whether they had or had not previously seen the test word (either immediately after the critical sentence, or after the first filler sentence).

Table 2. Example of a narrative used in our pilot study. The critical sentence appears only in one of three conditions: (a) present, (b) future-present, (c) future.

Sentence 1	Luca, un jeune homme de 28 ans, est toujours bien habillé [Luca, a 28 year-old man, is always wearing nice clothes].
Sentence 2	Il a commencé à étudier la musique et le solfège lorsqu'il avait 5 ans [He started taking music and music theory classes when he was 5 years old].

² We plan to submit this pilot study as a Short Research Note to the Journal of Cognitive Psychology as Gillioz, Dommann & Gyga

Critical sentence	(a) Aujourd'hui, Luca rejoint en tant que violoniste l'orchestre de la Suisse romande pour sa tournée en Asie [Today, Lucas <i>joins</i> as a violinist the Swiss orchestra for their Asian tour]. (b) Dans une année, Luca rejoint en tant que violoniste l'orchestre de la Suisse romande pour sa tournée en Asie [In one year, Lucas <i>joins</i> as a violinist the Swiss orchestra for their Asian tour]. (c) Dans une année, Luca rejoindra en tant que violoniste l'orchestre de la Suisse romande pour sa tournée en Asie [In one year, Lucas <i>will join</i> as a violinist the Swiss orchestra for their Asian tour].
Filler 1	Luca fait du sport pendant plusieurs heures chaque jour [Luca exercises for several hours every day].
Filler 2	Il est intolérant au gluten et ne peut pas manger de pâtes ou de pain [He is gluten intolerant and cannot eat bread or pasta].
Test word	violoniste [violinist]

If properties of future events are less accessible than properties of present ones, our results should mirror those of Carreiras et al. and we would expect slower decision times in the future than in the present condition. Regarding our intermediate condition (i.e., future-present), in which the future representation prompted by the future adverbial is in a certain way attenuated by the present verb tense, we would expect decision times in this condition to be somewhere in between the present and future conditions. As predicted, preliminary data showed that decision times linearly increased between the present and the future conditions, the present and future-present conditions generally leading to faster decision times than the future condition (see Figure 1).

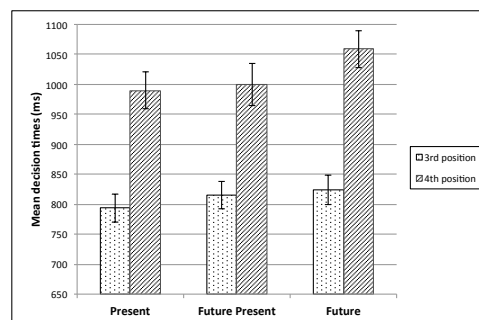


Figure 1. Mean decision times (ms) to job descriptions in the present, future-present, and future conditions, presented either after the 3rd sentence (i.e., critical) or the 4th sentence of the narrative.

This pilot study confirmed that the effects shown for the mental representations of past events also apply to the representations of future events, and that our manipulation is adequate to observe differences in mental representations people construct of the future. It further suggests that the difficulty of accessing properties of future events is more strongly related to the morphological suffix of the future than to semantic indications of the future transmitted in temporal adverbials. These results therefore support the hypothesis that speakers of weak-FTR languages, which do not mandatorily convey grammatical marks of the future, might elaborate different representations of the future than speakers of strong-FTR languages, when presented with similar sentences.

Experiment 1: Encoding future events in readers' mental representations of the text in French

Our pilot study demonstrated that future events are encoded in the reader's mental representations differently than present ones. In addition, the participants of our pilot study completed a questionnaire that explicitly asked them to reflect on the narratives, in terms of *clarity*, *complexity* and *readability*. Responses to this questionnaire revealed that some narratives were difficult to understand. Moreover, when explicitly asked about the future-present conditions, several participants expressed doubts regarding the wording of the narratives. These participants mentioned that the narratives would have been better if formulated in the 1st person. This perfectly corroborated Dahl's (2000) observations that the use of the present to speak about the

future is often favored when the 1st person (i.e. “I”) is used. The materials will therefore be modified for our first experiment, aimed at examining whether, in French, different ways of referring to the future may influence the difference between representations of future and present events.

Participants

For appropriate power, and based on our pilot study, we expect to test a total of seventy-two French-speaking participants in this experiment. Importantly, as we will also test bilinguals in this project, those participants will have to be monolinguals (i.e., knowing nothing or very little of German, or of another weak FTR language for that matter).

Materials

In this experiment, 42 experimental narratives will be constructed, based on those used in the pilot study, but written in the first person. Each narrative will be constructed as follows. The first two sentences of the narratives will describe properties of the main character (e.g., [I have been taking music classes for the last twenty years]). The next sentence, the critical one, will contain an occupational role associated with the main character now or in the future (e.g., [Today, I am hired as a violinist in the Swiss orchestra]). This critical sentence will appear in one of three conditions, depending on the combination of the temporal adverbial (e.g., [*today, in six months*]) and the verb tense (present or future). The combinations are: present, future-present (i.e., using the present tense to talk about the future), or future. For the purpose of this set of experiments³, temporal adverbials for the future-present and future conditions will set the temporal location of the property at a minimal time of 6 months (as in the pilot study), in order to maximize the differences between the conditions. Time settings between six months and a year (e.g., [*in six months, next December*]) will be alternated in the narratives, to ensure that participants will not get used to one time location. Finally, two filler sentences will be added after this critical sentence. The first filler sentence will be also part of an experimental manipulation (see below for details), whereas the second one will ensure that participants’ attention remains until the end of the narratives.

In each experimental narrative, participants will be presented with a test word corresponding to the occupational role described in the narrative (see below for the detailed procedure). Linguistic properties of these occupational roles that have been found to affect processing, such as length, lexical frequency, or number of orthographic neighbors will be controlled for. Crucially, the gender stereotypicality of the occupational roles associated with the characters will be kept constant. That is, only occupational roles that are considered to be neither stereotypically masculine nor stereotypically feminine will be used, based on the norms (for 422 occupational roles) provided in Misersky et al. (2014).

In addition to the 42 experimental narratives, three narratives will be used for practice, and 42 other narratives will be used as fillers. The filler narratives will be constructed in a similar way as the experimental narratives except for two aspects. First, the description of the occupational role associated with the character will be presented in different sentences (i.e., all but the third one) than in the experimental narratives. Second, these narratives will require either a “yes” (N = 7) or a “no” response (N = 35) to a target word not related to the occupational role associated with the protagonist. All items, experimental and filler, will be piloted for readability and complexity.

Note that participants will also complete a questionnaire on temporal focus based on the one used in de la Fuente, Santiago, Roman, Dumitrache, and Casasanto's (2014) study. This questionnaire contains 21 statements about the past (e.g., *Traditions and old customs are very important for me*, or *The young people must preserve the traditions*) and about the future (e.g., *I think that globalization is very positive*, or *Young people must think about the future, not in the past*). Participants have to indicate on a 5-point Likert scale the extent to which they agree with the statements. Items will be translated in French and in

³ We do plan to manipulate this factor in the follow-up of the present project

German. This questionnaire, used in an exploratory way in our project (hence we have no a priori hypotheses), aims at distinguishing the participants that are future-oriented from those that are past-oriented.

Procedure and design

Participants will read the eighty-four narratives, one sentence at a time. They will press on a button in order to move forward in the narrative. Reading time will be monitored for all sentences (i.e., the time it takes a participant to press the button after a sentence has appeared) as they may indicate reading difficulty, as well as reading attention. Reading times of the critical sentences and response times to the test words will be of prime interest (see below for the hypotheses). The participants that do not appropriately process the sentences and/or whose response accuracy to the test word is below 50% (i.e. chance level) will not be considered in the analysis.

As in Carreiras et al. (1997) and in our pilot study, participants will be presented with a test word (preceded by a fixation mark), either directly after the critical sentence or after the first filler sentence. Since Carreiras et al. did not show any effect after the second filler sentence, we will only test the first two test word locations. We will however keep the last filler sentence in order to ensure that participants stay focused until the end of the narrative. The occupational role described in the critical sentence will be chosen as the test word used in the recognition task. The participants will simply have to indicate as quickly and as accurately as possible if the test word was presented in the current narrative. At the end of the reading task, participants will fill in the questionnaire on temporal focus.

Since this experiment corresponds to a 2 (Location of target word: 3rd sentence vs. 4th sentence) X 3 (Future condition: present vs. future-present vs. future) experimental design, six lists will be constructed to ensure that all participants will see all conditions and that each narrative will appear in each condition. Responses will be collected with a button box that permits milliseconds accuracy.

Dependent variables and analyses

Reading times of the critical sentences, response times and accuracy for correct recognition of the target words will be measured and primarily analyzed.

Hypotheses

In this study, we expect both temporal adverbials and verb tenses to affect the content of the reader's mental representations. We first present the hypotheses related to reading times of the critical sentences before going on to accuracy scores and response times related to test words. Based on previous findings showing a slow-down in reading times associated with time shifts, we expect the reading times of the critical sentences to be slower in the future than in the future-present condition, in turn slower than in the present conditions. Regarding accuracy of responses to test words, though we do not expect any effect of the Future Condition, we expect an effect of the Location of the target word. In other words, we expect accuracy to diminish as the delay between the critical sentence and the test word increases. Regarding response times to test words, we first expect to see an increase in response times (i.e., slower response times) as the delay between the presentation of the critical sentence and the target word increases. More importantly, and in direct relation with the question investigated in this project, we expect occupational roles associated with the main character to be recognized faster in the present than in the future condition (as in the pilot study). This would reflect that properties of future events are less accessible than those of present events. Most crucially, we expect occupational roles in the future-present condition to be recognized faster than in the future condition. This difference, as well as the linear trend expected for reading times of the critical sentences, would show the major role played by grammatical devices on future representations. It would support the hypothesis that the way language encodes the future in its grammar plays a crucial role in the elaboration of representations of the future, even more so than temporal adverbials used to describe the future.

Experiment 2: Encoding future events in readers' mental representations of the text in German

Experiment 2 aims at investigating mental representations of properties of future events in a language that does not *mandatorily* encode the future as in French. In German, as speakers are always allowed to use the present verb tense when talking about the future, the use of the future tense (i.e., *werden* + infinitive) is much less common than the use of the future tense in French (Dahl, 2000).

Participants

As in Experiment 1, and for the same reasons, seventy-two German-speaking participants will be tested in this experiment. As we will also test bilinguals in this project, those participants will have to be monolinguals (i.e., knowing nothing or very little of French, or another strong FTR language for that matter).

Material, design, procedure, and dependent variables.

The 42 experimental narratives used in Experiment 1 will be translated into German. The same controls on linguistic properties of the materials as in French will be applied in German and occupational roles will be modified if needed, based on Misersky et al's (2014) norms. The same questionnaires as in Experiment 1 will be used. The experiment will follow the same design and procedure as in Experiment 1 and the same dependent variables will be analyzed. Note that a large amount of resources will be devoted to ensure comparability between Experiments 1 and 2, hence a large amount of time will be devoted to constructing and translating the materials used in Experiment 1.

Hypotheses

We expect the same effects as in Experiment 1 regarding the reading times of the critical sentences in the different conditions. We also expect an increase in response times and decrease in accuracy to the test words as the delay between the presentation of the critical sentence and the test word increases. Turning to response times to the test words, we expect a similar linear trend as the one hypothesized for French-speakers, with the difference that we expect German speakers to show a larger difference between the future-present and future conditions. Following the idea that an unmarked future makes the future appear closer to the present, being confronted with grammatical marks should make the distance between the present and the future (i.e., but not the future-present) more pronounced. In fact, we expect the future-present to be closer (or even similar) to the present, and conversely, the future to be further away from the present, than for French speakers. A comparison of the magnitude of the effects of this study with those from Experiment 1 should confirm these expectations (see Figure 2).

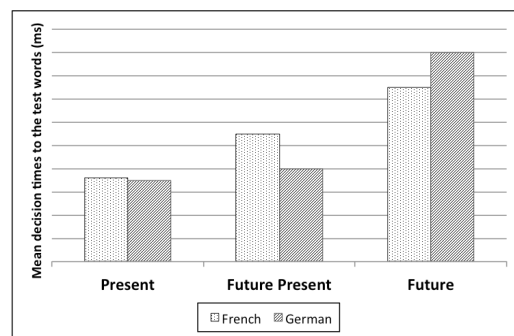


Figure 2. Expected main effect of temporality in German and French speakers.

Experiment 3: Encoding future events in readers' mental representations of the text in French – the special case of “je vais”.

In Experiment 3, we will use the same paradigm as in Experiment 1 and will examine a fourth temporal condition (i.e., future-periphrastic), reflecting the very frequently use of the verb "aller" to talk about the future (similar to the *going to* yet with a

slightly different in meaning). By doing so, we intend to explore the influence of a particular construction on mental representations of the future in French.

Participants

As in Experiment 1, we expect to test a total of seventy-two French-speaking participants in this experiment. Importantly, as we will also test bilinguals in this project, those participants will have to be monolinguals (i.e., knowing nothing or very little of German, or of another weak FTR language for that matter).

Material, design, procedure, and dependent variables.

Since the new future-periphrastic condition (e.g., *Dans 6 mois, je vais commencer comme violoniste* [In six months, I will/am going to start as a violinist]) will be tested in this experiment, 14 new narratives will be written and added to the experimental and filler narratives of Experiment 1. The same questionnaires and dependent variables as in Experiment 1 will be used.

Hypotheses

As in previous experiments, we expect an increase in response times and a decrease in accuracy as the delay between the presentation of the critical sentence and the target word increases. We also expect to observe a slow-down in the reading times of the critical sentences when temporal shifts occur in the sentences. Turning to response times related to the test words, we expect them to reflect the simultaneous influences of temporal adverbials, verb tense, and verb construction. Namely, we expect occupational roles associated with the main character to be recognized faster in the present than in the different future conditions. More importantly, if the influence of the verb is more important than that of temporal adverbials in the construction of future representations, we expect occupational roles in the future-present condition to be recognized faster than in the future-periphrastic condition, in turn faster than in the future condition. Again, these differences would illustrate the roles played by grammatical devices on future representations.

Experiment 4: Encoding future events in bilingual readers' mental representations of the text in French and German

This experiment aims at investigating the extent to which FTR strength influences representations of the future in bilingual of strong and weak FTR languages as a function of the language in use. In this experiment, unlike in Experiments 1 and 2, only the verb tenses most frequently used in both languages to refer to future events will be investigated, i.e., the future tense in French and the present tense in German.

Participants

For appropriate power, 72 French-German (N=36) and German-French (N=36) bilinguals will be tested in this experiment. As previously explained, only high L2-proficient participants will take part in the experiment.

Material, design, procedure, and dependent variables.

Only the present and future-present conditions will be used in German and only the present and future conditions will be used in French. Therefore, in both languages, we'll contrast *present vs. future focus*. The experimental design of this study corresponds to a 2 (Temporal location: Present vs. Future) X 2 (Test word location: 3rd sentence vs. 4th sentence). For the purpose of this experiment, the 56 French experimental narratives used in Experiment 3 will be used, 42 of which used in Experiment 2 (in German), and 14 remaining to be translated. The same filler narratives, questionnaires and dependent variables as in the other experiments will be used. Each participant will take part in the experiment in two sessions: once in L1 and once in L2. Half of the participants will do the first session in their L1 and the other half in their L2. Each experimental narrative will be presented in French and in German across the experiment, both in L1 and in L2.

Hypotheses

Regarding reading times of the critical sentences, we expect to observe the same effects as in Experiments 1 and 2, i.e., slower reading times for the future relative to the present condition. Regarding response times as well as accuracy scores related to the test words, we also expect to see an increase in response times and a decrease in accuracy as the delay between the presentation of the critical sentence and the target word increases.

In terms of the hypotheses regarding our central manipulation, we can expect the effects of Experiments 1 (French) and 2 (German) to be replicated, whether in L1 or L2. This would mean that L1-French speakers doing the task in German will have native-like representations of future events, and conversely, L1-German speakers will have native-like representations in French. This would illustrate a complete shift of representation influenced by a shift of language. However, two alternative hypotheses can be made. First, we could also expect both speakers of French and German to always build a representation of future events as in their L1, the representations of the future being mostly dependent of one's L1 (and frequent use of L1) (i.e., the no-shift hypothesis). Second, we could expect only L1-French speakers to shift representations in L2, as the use of the present is (though infrequently) possible.

SET 2: Experiments on the influence of FTR strength on the perceptual simulations of future

In this set of experiments, which sequence matches that in SET 1, we will examine the influence of FTR strength directly on perceptual simulations of future events, in native speakers of strong and weak FTR languages as well as in bilinguals. Perceptual simulations of the temporal dimension of texts have been shown to be grounded in space, readers relying on space-time metaphor when processing language related to time. In this set of experiments, as in the first set, we hypothesize that accessibility to properties of future events is more difficult because they are more distant to the protagonist than properties of present events, however, in this particular set of experiments, we hypothesize that the verb tense influences the actual *spatial distance* readers mentally encode between properties of present and future events. This hypothesis is based on a pilot study that we conducted to assess the perceptual representations of future events, as primed by the use of different forms, in French, to refer to future events (same forms as in the first set of experiments).

The influence of verb tense on actual spatial representations : The pilot study

In order to make sure that such spatial effects can be primed by temporal cues transmitted through verb tense, we ran a short pilot study aiming at observing time-space relationships. We presented 72 participants with 10 sentences describing an event happening in the future and explicitly asked them to place these events on a straight line with the label "Present" on the left and "Future" on the right. Half of the sentences were written with a present verb tense (e.g., *Dans le futur, je prends l'avion* [In the future, I take the plane]) and the other half was written with a future verb tense (e.g., *Dans le futur, je ferai un gateau* [In the future, I will bake a cake]), the tenses being counterbalanced between participants. Supporting our idea, people placed the events described in the sentences containing a future tense significantly further ($M = 46.2$ mm; $SD = 5.2$) on the line than the events described in sentences containing a present tense ($M = 32.0$ mm; $SD = 5.4$).

In the following experiments, we intend to shift to a less explicit task in order to shed light on the spontaneous and implicit processes involved in perceptual simulations of time when reading. In this task, participants will be presented with priming sentences describing present or future events (using different ways to talk about the future) before completing a spatial task. This spatial task is expected to mirror priming effects about temporal distance activated when reading the sentences. As in the experiments in the first set of this project, we will manipulate temporal adverbials and verb tenses in our materials in order to investigate how both types of cues influence simulations of the future. Essentially, the sequence used in Experiments 5-8 is the same as in the first set (i.e., French, German, French-FuturePeriphrastic, bilinguals), yet the task at hand will be different.

Experiment 5: Perceptual simulations of future events as a function of verb tense in a strong-FTR language: French

Participants

For appropriate power, we expect to test a total of seventy-two French-speaking participants in this experiment. Importantly, as we will also test bilinguals in this project, those participants will have to be monolinguals (i.e., knowing nothing or very little of German, or of another weak FTR language for that matter).

Materials

We will recycle the sentences used as critical sentences in the narratives of Experiment 1 for this experiment (e.g., [In six months, I will start as a violinist in the Swiss orchestra]). As in Experiment 1, these sentences will appear in one of three conditions, depending on the combination of the temporal adverbial and the verb tense, i.e., present, future-present, or future. The same temporal adverbials as in Experiment 1 for the future-present and future conditions will be used (see Experiment 1 for an explanation).

To examine the perceptual priming effect of the sentences containing the crucial information, we will use a task inspired by Casasanto and Borodistky (2008, Exp. 5). Imaginary lines drawn by a moving dot will be presented on a computer monitor (see Figure 4). Although the lengths of these lines (depending on the starting location) will vary, they will always end at a specific determined point, symbolized by a bold vertical line. In all trials, the moving dot will disappear before reaching the square (final location). The participants' task will be to imagine the dot continuing its course and to press a response key when they think the dot has arrived at the line, given that the pace is constant. Note that the moving pace of the dot will be manipulated in order to prevent our participants to become too “good” at the task. 6 line lengths will be fully crossed with 4 moving paces in order to produce 24 distinct trajectories, so that each participant will see the same trajectory only three times during the experiment (one time in each condition). We will monitor the time between the moment the dot disappears and the time the participants press the response key. To ensure that a potential effect of priming is attributable to *time*, as primed by the way we speak about the future, vertical lines (fillers) will also be tested. We do not expect any effect when the lines are vertically presented.

For exploratory purposes, the same questionnaire used in the first set of experiments will also be implemented in this experiment.

Procedure and design

Trials will be organized in blocks of 12 on the basis of the temporality condition of the sentence. In total, each participant will see 6 blocks (2 in each condition) in a pseudo-random order (in order to avoid the consecutive presentation of two blocks in the same condition). In each trial, participants will first read a sentence, and press on a button when they are finished. They will then be presented with a blank screen, on which a dot will appear and draw one of the 24 possible imaginary lines. After some time, the dot will disappear, and participants will have to imagine its trajectory and press on a set key when they think the dot should touch the target bold vertical line, given the pace of the dot remains constant. After the presentation of all 6 blocks, participants will fill in the questionnaires on personal future orientation and on grammatical competency.

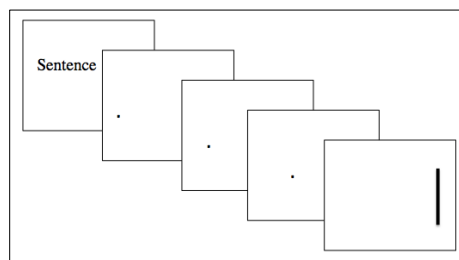


Figure 4. Example of a trial in Experiments 4, 5, and 6.

Dependent variables

The time between the disappearance of the dot and the participant's key press will be collected and compared against the reference time (i.e., the time that the dot should have taken to reach the end of the screen). As lines lengths and dot paces will be fully crossed, the reference time will be the same in the three conditions, allowing us to simply compare the mean times between conditions.

Hypotheses

Note that we do not assume that perception *per se* will be altered by our priming. In other words, we do not expect that participants *see* the dot moving as moving more slowly or more rapidly than it is. Such an interpretation would qualify for a common “El Greco” fallacy, extensively discussed in Firestone and Scholl (2014). Rather, we hypothesize that the *encoding* and *representation* of time will be altered by our priming procedure, which will be illustrated in the way participants imagine the *disappeared* dot moving. Put differently, when the dot has disappeared, the participants’ representation of the movement of the now-imaginary dot will be altered by the prime.

As to our specific hypotheses, we believe that if readers activate perceptual simulations of the future when processing the sentences containing different information about time, the consequences of this activation should be visible in our spatial task, mirrored in differences in the mean times between the three temporality conditions. Specifically, if readers simulate a greater distance when reading about the future than about the present, we would expect their response times to the dot-task to be longer in the future than in the present condition. Moreover, if both temporal adverbials and verb tenses guide perceptual simulations of the future (as they guided mental representations as hypothesized in Set 1), then we would expect response times to be longer in the future than in the future-present condition, in turn longer than in the present condition.

At this stage, we do not present constraining hypotheses as to the effects of the factors measured by our questionnaire, as they are mainly exploratory.

Experiment 6: Perceptual simulations of future events as a function of verb tense in a strong-FTR language: German

Participants

For appropriate power, we will test a total of seventy-two French-speaking participants in this experiment. Importantly, as we will also test bilinguals in this project, those participants will have to be monolinguals (i.e., knowing nothing or very little of French, or another strong FTR language for that matter).

Material, design, procedure, and dependent variables.

To construct this experiment, we will follow the same procedure as in Experiment 5, this time recycling some parts of Experiment 2. The design, procedure and dependent variables are the same as in Experiment 5.

Hypotheses

We expect to see the same linear increase in response times as the one hypothesized for French-speakers in Experiment 5, with the difference that we expect German speakers to show a greater difference between the future-present and future conditions. As in Experiment 2, following the idea that an unmarked (grammatically) future makes the future appear closer to the present, being confronted with grammatical devices should make the perceptual distance between the present and the future more patent. As in Experiment 2 (with Experiment 1), we plan to compare the results of this experiment with those of Experiment 5 and expect to find *a distance by language* interaction, namely a greater distance between present and future events in German than in French. Again, the additional questionnaire will be analyzed as exploratory measures.

Experiment 7: Perceptual simulations of the future in French speakers as a function of verb tense and verb mark - the special case of “je vais”.

Participants

For appropriate power, we will test a total of seventy-two French-speaking participants in this experiment. Importantly, as we will also test bilinguals in this project, those participants will have to be monolinguals (i.e., knowing nothing or very little of German, or of another weak FTR language for that matter).

Material, design, procedure, and dependent variables.

In this experiment, as in Experiment 3, we will explore the additional influence of the verb construction on mental representations of the future in French. We will use the same paradigm as in Experiment 5 & 6 and will examine a fourth temporal condition (i.e., future-periphrastic), reflecting the very frequent use of the verb "aller" to talk about the future (similar to the *going to* yet with a slightly different meaning). By doing so, we intend to explore the influence of a particular construction on the perceptual simulations of the future in French. The critical sentences used in Experiment 3 will be recycled and modified for the purpose of this experiment.

Hypotheses

As in Experiment 5, we expect the times taken by the participants to see the dot reach the target line to reflect the simultaneous influences of temporal adverbials, verb tense, and verb construction on their perceptual simulations of time. Specifically, we expect response times to be longer in the future conditions than in the present one. More importantly, and similarly to what we hypothesized in Experiment 3, if the influence of the verb is more important than that of temporal adverbials in the construction of perceptual simulations of the future, we would expect times in the future condition to be longer than in the future-periphrastic condition, in turn longer than in the future-present condition. Again, these differences would illustrate the roles played by grammatical devices on perceptual simulations of the future.

Experiment 8: Perceptual simulations of the future in bilinguals of languages differing in FTR (French and German)

Participants

For appropriate power, 72 French-German (N = 36) and German-French (N = 36) bilinguals will be tested in this experiment. Only high L2-proficient participants will be tested in this experiment.

Material, design, procedure, and dependent variables.

The critical sentences used in Experiment 4 will be recycled in this experiment. The same paradigm and dependent variables as in Experiments 5 and 6 will be used. The crucial difference between this experiment and previous experiments in Set 2 lies within the fact that participants will be presented with sentences in both their L1 and their L2 (in two sessions, with counterbalanced order).

Hypotheses

Similarly to what was hypothesized in Experiment 4, we can expect the effects of Experiments 5 (French) and 6 (German) to be replicated, whether in L1 or L2. This would mean that L1-French speakers doing the task in German will have native-like perceptual simulations of future events, and conversely, L1-German speakers will have native-like perceptual simulations in French. This would illustrate a complete shift of perceptual simulations influenced by a shift of language. However, two alternative hypotheses can be made. First, we could also expect both speakers of French and German to always activate perceptual simulations as in their L1, the perceptual representations of the future being mostly dependent of one's L1 (and frequent use of L1). Second, we could expect only L1-French speakers to shift their perceptual representations in L2, as the use of the present is (though infrequently) possible.

2.4. Schedule and milestones

Milestones throughout the project	When
Experiment 1: construction of materials and piloting *	October 2016
Literature review **	
Experiment 1: data collection ***	December 2016
Experiment 1: data analysis ***	January and February 2017
Experiment 2: Experiment 1's materials translation and piloting ***	January and February 2017
Experiment 2: data collection **	March and April 2017
Experiment 2: data analysis **	May 2017
Experiments 1 and 2: writing up ***	June to August 2017
Experiment 3: construction of additional materials and piloting ***	September 2017
Experiment 4: construction of additional materials and piloting ***	
Experiment 3: data collection ***	October 2017
Experiment 4: data collection ***	November and December 2017 March 2018
Experiment 3: data analysis and writing up ***	January and February 2018
Experiment 5-8: Setting up of experimental task *	
Experiment 5: data collection *	March and April 2018
Experiment 6: data collection **	
Experiment 7: data collection ***	May and June 2018
Experiments 5, 6, and 7: data analysis and writing up ***	July to September 2018
Experiment 8: data collection ***	October to December 2018
Experiment 8: data analysis and writing up ***	January and February 2019
Final report writing up *	March to September 2019
Papers submission and follow-up *	
Dissertation writing up **	
* Post doc; ** PhD student; *** Both	

2.5. Relevance and impact

In terms of fundamental research, this project aims at providing a better understanding of the concomitant roles of temporal adverbials and verb tense marking on readers' mental representations. Previous research in psycholinguistics has mainly addressed the role of *verb aspect* and *verb tense* on mental representations when elaborating representations of the *past* (e.g., Carreiras et al., 1997; Madden & Zwaan, 2003), leaving the respective roles of adverbials and verb tenses as well as the case of the future unexplored. In this project, we intend to complete this line of research and to offer a clear picture of the processes at stake when representing the future.

Moreover, on a bilingual level (or multi-lingual level), this project aims to provide evidence that individuals may change cognitive processes, here those associated to future-related representations, when switching languages. In the heated context of language policies in Switzerland, this project will also shed light on the diversity generated by mastering more than one language.

In the long run, understanding how language, and more precisely the different ways of talking about the future, influence future representations could be applied to related fields such as communication. It has indeed been demonstrated that representations of the future play a key role in health issues, such as obesity and smoking issues (e.g., Zhang & Rashad, 2008), pathological gambling (e.g., Hodgins & Engel, 2002), or risky driving (e.g., Zimbardo, Keough, & Boyd, 1997). Since health communication is devoted to increase the likelihood that people make better and adequate future-oriented choices (Orbell, Perugini, & Rakow, 2004), it could highly benefit from a better comprehension of the representations people construct when

hearing or reading health advices formulated in different linguistic realizations. This would complement the work already conducted by Pascal Gygax on health prevention (e.g., Gygax, Bosson, Gay, & Ribordy, 2010).

References

- Anderson, A., Garrod, S. C., & Sanford, A. J. (1983). The accessibility of pronominal antecedents as a function of episode shifts in narrative text. *Quarterly Journal of Experimental Psychology*, *35*, 427–440.
- Athanasopoulos, P. (2009). Cognitive representation of colour in bilinguals: The case of Greek blues. *Bilingualism: Language and Cognition*, *12*, 83–95.
- Athanasopoulos, P., Damjanovic, L., Krajcivova, A., & Sasaki, M. (2011). Representation of colour concepts in bilingual cognition: The case of Japanese blues. *Bilingualism: Language and Cognition*, *14*, 9–17.
- Athanasopoulos, P., & Kasai, C. (2008). Language and thought in bilinguals: The case of grammatical number and nonverbal classification preferences. *Applied Psycholinguistics*, *29*, 105–123.
- Barsalou, L. W. (1999). Perceptual symbol systems. *Behavioral & Brain Sciences*, *22*, 577–660.
- Becker, R. B., Ferretti, T. R., & Madden-Lombardi, C. J. (2013). Grammatical aspect, lexical aspect, and event duration constrain the availability of events in narratives. *Cognition*, *129*, 212–220.
- Bonato, M., Zorzi, M., & Umiltà, C. (2012). When time is space: Evidence for a mental time line. *Neuroscience & Biobehavioral Reviews*, *36*, 2257–2273.
- Boroditsky, L. (2000). Metaphoric structuring: Understanding time through spatial metaphors. *Cognition*, *75*, 1–28.
- Boroditsky, L. (2001). Does language shape thought?: Mandarin and English speakers' conceptions of time. *Cognitive Psychology*, *43*, 1–22.
- Bowerman, M., & Choi, S. (2001). Shaping meanings for language: universal and language-specific in the acquisition of spatial semantic categories. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development* (pp. 475–511). Cambridge: Cambridge University Press.
- Carreiras, M., Carriedo, N., Alonso, M. A., & Fernández, A. (1997). The role of verb tense and verb aspect in the foregrounding of information during reading. *Memory & Cognition*, *25*, 438–446.
- Casasanto, D., & Boroditsky, L. (2008). Time in the mind: Using space to think about time. *Cognition*, *106*, 579–593.
- Chen, M. K. (2013). The effect of language on economic behavior: Evidence from savings rates, health behaviors, and retirement assets. *American Economic Review*, *103*, 690–731.
- Clahsen, H., Balkhair, L., Schutter, J.-S., & Cummings, I. (2013). The time course of morphological processing in a second language. *Second Language Research*, *29*, 7–31.
- Coleman, J. A. (1994). Degrees of proficiency: Assessing the progress and achievement of university language learners. *French Studies Bulletin*, *15*, 11–16.
- Dahl, O. (2000). The grammar of future time reference in European languages. In O. Dahl (Ed.), *Tense and aspect in the languages of Europe* (pp. 309–328). Berlin: Mouton de Gruyter.
- de la Fuente, J., Santiago, J., Roman, A., Dumitrache, C., & Casasanto, D. (2014). When You Think About It, Your Past Is in Front of You: How Culture Shapes Spatial Conceptions of Time. *Psychological Science*, *25*, 1682–1690.
- Dudschig, C., Lachmair, M., de la Vega, I., De Filippis, M., & Kaup, B. (2012). From top to bottom: spatial shifts of attention caused by linguistic stimuli. *Cognitive Processing*, *13*, 151–154.
- Fecica, A. M., & O'Neill, D. K. (2010). A step at a time: Preliterate children's simulation of narrative movement during story comprehension. *Cognition*, *116*, 368–381.
- Ferretti, T. R., Rohde, H., Kehler, A., & Crutchley, M. (2009). Verb aspect, event structure, and coreferential processing. *Journal of Memory and Language*, *61*, 191–205.
- Firestone, C., & Scholl, B. J. (2014). "Top-down" effects where none should be found: The El Greco fallacy in perception research. *Psychological Science*, *25*, 38–46.
- Fleischman, S. (1990). *Tense and narrativity*. Austin, TX: UT Press.
- Fuhrman, O., & Boroditsky, L. (2010). Cross-cultural differences in mental representations of time: Evidence from an implicit nonlinguistic task. *Cognitive Science*, *34*, 1430–1451.
- Gillioz, C., & Gygax, P. M. (2015). The specificity of emotion inferences as a function of emotional contextual support. *Discourse Processes*. Advance online publication.
- Glenberg, A. M., & Kaschak, M. P. (2002). Grounding language in action. *Psychonomic Bulletin & Review*, *9*, 558–565.
- Gygax, P., Bosson, M., Gay, C., & Ribordy, F. (2010). Relevance of health warnings on cigarette packages: a psycholinguistic investigation. *Health Communication*, *25*, 397–409.
- Gygax, P. M., & Gillioz, C. (2015). Emotion inferences during reading: Going beyond the tip of the iceberg. In E. O'Brien, A. Cook & R. Lorch (Eds.), *Inferences during reading*. Cambridge: Cambridge University Press.
- Havas, D. A., Glenberg, A. M., & Rinck, M. (2007). Emotion simulation during language comprehension. *Psychonomic Bulletin and Review*, *14*, 436–441.
- Hodgins, D. C., & Engel, A. (2002). Future time perspective in pathological gamblers. *The Journal of Nervous and Mental Disease*, *190*, 775–780.
- Johnson-Laird, P. N. (1983). *Mental models*. Cambridge, MA: Harvard University Press.

- Kintsch, W. (1988). The role of knowledge in discourse comprehension: A construction-integration model. *Psychological Review*, *95*, 163–182.
- Konishi, T. (1993). The semantics of grammatical gender: A cross-cultural study. *Journal of Psycholinguistic Research*, *22*, 519–534.
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.
- Lehtonen, M., & Laine, M. (2003). How word frequency affects morphological processing in monolinguals and bilinguals. *Bilingualism: Language and Cognition*, *6*, 213–225.
- Madden, C. J., & Zwaan, R. A. (2003). How does verb aspect constrain event representations? *Memory & Cognition*, *31*, 663–672.
- Magliano, J. P., & Schleich, M. C. (2000). Verb aspect and situation models. *Discourse Processes*, *29*, 83–112.
- Misersky, J., Gygax, P. M., Canal, P., Gabriel, U., Garnham, A., Braun, F., . . . Sczesny, S. (2014). Norms on the gender perception of role nouns in Czech, English, French, German, Italian, Norwegian, and Slovak. *Behavior Research Methods*, *46*, 841–871.
- Núñez, R., & Cooperider, K. (2013). The tangle of space and time in human cognition. *Trends in Cognitive Sciences*, *17*, 220–229.
- Orbell, S., Perugini, M., & Rakow, T. (2004). Individual differences in sensitivity to health communications: Consideration of future consequences. *Health Psychology*, *23*, 388–396.
- Prior, A., & MacWhinney, B. (2010). A bilingual advantage in task switching. *Bilingualism: Language and Cognition*, *13*, 253–262.
- Roberson, D., Davidoff, J., Davies, I. R., & Shapiro, L. R. (2005). Color categories: Evidence for the cultural relativity hypothesis. *Cognitive Psychology*, *50*, 378–411.
- Santiago, J., Lupáñez, J., Pérez, E., & Funes, M. J. (2007). Time (also) flies from left to right. *Psychonomic Bulletin & Review*, *14*, 512–516.
- Sato, S., Gygax, P. M., & Gabriel, U. (2013). Gender inferences: Grammatical features and their impact on the representation of gender in bilinguals. *Bilingualism: Language and Cognition*, *16*, 792–807.
- Sato, S., Gygax, P. M., & Gabriel, U. (2016). Gauging the impact of gender grammaticization in different languages: Application of a linguistic-visual paradigm. *Frontiers in Psychology*, *7*:140.
- Slobin, D. I. (2003). Language and thought online: Cognitive consequences of linguistic relativity. In D. Gentner & S. Goldin-Meadow (Eds.), *Language in mind: Advances in the study of language and thought* (pp. 157–191).
- Speed, L. J., & Vigliocco, G. (2014). Eye movements reveal the dynamic simulation of speed in language. *Cognitive Science*, *38*, 367–382.
- Stanfield, R. A., & Zwaan, R. A. (2001). The effect of implied orientation derived from verbal context on picture recognition. *Psychological Science*, *12*, 153–156.
- Ulrich, R., & Maienborn, C. (2010). Left–right coding of past and future in language: The mental timeline during sentence processing. *Cognition*, *117*, 126–138.
- van Dijk, T. A., & Kintsch, W. (1983). *Strategies of discourse comprehension*. San Diego, CA: Academic Press.
- Winawer, J., Witthoft, N., Frank, M. C., Wu, L., Wade, A. R., & Boroditsky, L. (2007). Russian blues reveal effects of language on color discrimination. *Proceedings of the National Academy of Sciences*, *104*, 7780–7785.
- Zhang, L., & Rashad, I. (2008). Obesity and time preference: The health consequences of discounting the future. *Journal of Biosocial Science*, *40*, 97–113.
- Zimbardo, P. G., Keough, K. A., & Boyd, J. N. (1997). Present time perspective as a predictor of risky driving. *Personality and Individual Differences*, *23*, 1007–1023.
- Zwaan, R. A. (1996). Processing narrative time shifts. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *22*, 1196–1207.
- Zwaan, R. A. (2004). The immersed experiencer: Toward an embodied theory of language comprehension. In B. H. Ross (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. Vol. 44, pp. 35–62). New York, NY: Academic Press.
- Zwaan, R. A., & Radvansky, G. A. (1998). Situation models in language comprehension and memory. *Psychological Bulletin*, *123*, 162–185.
- Zwaan, R. A., & Rapp, D. N. (2006). Discourse comprehension. In M. J. Traxler & M. A. Gernsbacher (Eds.), *Handbook of psycholinguistics* (pp. 725–764). San Diego, CA: Elsevier.
- Zwaan, R. A., Stanfield, R. A., & Yaxley, R. H. (2002). Language comprehenders mentally represent the shapes of objects. *Psychological Science*, *13*, 168–171.
- Zwaan, R. A., & Taylor, L. J. (2006). Seeing, acting, understanding: Motor resonance in language comprehension. *Journal of Experimental Psychology: General*, *135*, 1–11.