The specificity of emotion inferences in text comprehension: The role of top-down and bottom-up processes

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Summary

The aim of this thesis was to investigate the influence of individual differences and the nature of the information presented to readers on emotion inferences in text comprehension, in particular on the specificity of these emotion inferences. Research on emotion inferences has led some researchers to suggest that emotion inferences made during reading are specific (e.g., Gernsbacher et al., 1992) whereas others (e.g., Gygax et al., 2007) proposed that readers do not need to elaborate a complex representation of emotions but preferentially infer some components of emotion (like behavioral information), stereotypical of emotion responses.

The present thesis investigated the conditions under which readers may go further than the component level and reach complex emotion representations. Results presented in Chapter 3 demonstrate that top-down processes related to readers' individual differences (i.e., empathy and working memory) or to reading strategies (i.e., simulation, elaboration time) do not fully explain the under-specificity of emotion inferences found in previous research (e.g., Gygax et al., 2003, 2004; Molinari et al., 2009).

However, bottom-up processes, examined in the second part of the thesis, in terms of the relevancy of emotion information (i.e., emotion components) conveyed in the narratives, better account for the specificity of emotion inferences. To investigate this issue, an *optimal congruent vs. moderate congruent* paradigm (as opposed to the habitual *match vs. mismatch* paradigm) was developed. In this new paradigm, the emotional content of the narratives was manipulated based on the number of emotion components and on their typicality regarding the intended emotion. Chapter 5 presents three experiments suggesting that when the narratives convey highly typical emotion information, readers are very likely to *integrate* specific emotion inferences into their mental models of the text. When the narratives convey less typical emotion information (but still matching the intended emotion), readers may only *map* the incoming emotion information onto their representations of the texts.

Although highly critical as regard to the materials used in previous studies on the matter (e.g., Gygax and colleagues, 2003, 2004 and 2007), this thesis brings further support for Gygax et al.'s (2007) claim that emotion inferences are elaborated in a

constructive manner. Chapter 5's experiments actually showed that emotion inferences are based on emotion components (as defined in the emotion literature), which are activated and integrated incrementally in readers' mental representations. Importantly this thesis shows that a shift of paradigm and an interdisciplinary approach were needed to further our understanding of the processes underlying emotion inferences when comprehending text.

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1. Introduction

> *« So Alice set to work, and very soon finished off the cake. […] Just then her head struck against the roof of the hall: in fact she was now more than nine feet high, and she at once took up the little golden key and hurried off to the garden door. Poor Alice! It was as much as she could do, lying down on one side, to look through into the garden with one eye; but to get through was more hopeless than ever: she sat down and began to cry again. »* (Lewis Carroll, 1869, p. 16-17)

When reading this passage of Carroll's *Alice in Wonderland* and even if no explicit emotion is attributed to Alice, readers may know that at this moment, Alice is *desperate* of not being able to go through the garden door. This additional information, called an inference, can be deduced based on the information collected in the text and on general knowledge of the world. By combining inferences and explicit elements of the text, readers construct mental representations of the text that allow them to comprehend the situation portrayed in and between the lines (Graesser, Singer, & Trabasso, 1994; Johnson-Laird, 1983; Kintsch, 1988).

Inferences are made in order to connect adjacent or distant parts of the text and are related to various aspects of it such as referents of nouns or pronouns in sentences (e.g., Garrod & Sanford, 1985), spatial relationships between objects (e.g., Glenberg, Meyer, & Lindem, 1987) or temporal relations (e.g., Anderson, Garrod, & Sanford, 1983). Importantly, the mental representations of a text are elaborated in an incremental way (Garnham & Oakhill, 1996), by adding new information and making new inferences as the text unfolds, thus confronting the readers to an increasing number of possible inferences. As the readers' processing capacities are finite (van den Broek, Young, Tzeng, & Linderholm, 1999), not all inferences can be drawn online (i.e., during the course of comprehension) and only some of them are generated during reading.

This thesis focuses on the online construction of emotion inferences, which correspond to the deduction of the protagonist's emotion in the situation portrayed by the text. Importantly, emotion inferences relate to the cognitive representations of the protagonist's emotion and not to the emotion felt by the readers during reading,

although this felt emotion may play some role in the comprehension of the fictional characters' state (as will be discussed later).

The generation of emotion inferences during reading has been debated in the literature as well as the extent to which readers include a specific emotion word in their representations of the text. Regarding *Alice in Wonderland*'s passage for example, it may be possible that readers infer Alice's emotions during reading, but it may also be possible that they do not need to infer her emotion, as some emotional cues (e.g., sat down, began to cry) are already given in the text and are maybe sufficient for comprehension. If, after all, readers infer an emotion and attribute it to Alice, the question of interest regards the specificity of the emotion label included in their mental representations (i.e., a specific emotion such as *sad* or *desperate* or a broader emotional feeling such as *being in a bad state*).

The first issue (i.e., the online deduction of emotion inference) directly relates to the construction of mental representations and to the different models explaining the process of comprehending a text. Various studies have showed that readers infer some emotion information during reading (e.g., Gernsbacher, Goldsmith, & Robertston, 1992; de Vega, León, and Díaz, 1996) and this thesis aims at determining the specificity of this inference. The view that specific emotion representations can be reached during reading has been challenged by previous studies (e.g. Gygax, Garnham, & Oakhill, 2004; Gygax, Oakhill, & Garnham, 2003) showing that under normal conditions of reading, readers do not seem to differentiate between similar emotions. A possible explanation for the under-specificity of emotion inferences was proposed by Gygax, Tapiero, and Carruzzo (2007). They argued that readers do not need to integrate a specific emotion label into their mental representations of the protagonist's emotion but may rather deduce some basic emotion information (e.g., the valence of the emotion or typical behavioral response associated with it) shared by different related emotions. In this latter case, emotion inferences would neither be specific nor totally unspecific.

In this thesis, it is first claimed that some individual characteristics may influence reading and consequently the elaboration of emotion inferences. If this thesis does not aim at investigating the influence of the text on the readers' emotion experience, it may be argued that this emotional experience can modulate the readers' involvement in the narrative and the richness of the constructed mental representations. Consequently, the readers' tendency to transpose themselves in the narrative as well as

their empathy capacity may impact their emotion representations. Another individual factor that may play some role in inference generation relates to the readers' processing capacities. As comprehension of written texts requires various processing, from the decoding of letters, their transposition into words, to the integration of propositions to higher representations, some factors such as the readers' memory capacities may impact the elaboration of mental representations. Similarly, the time allocated to readers to process the text may have an influence on these high level processes. Experiments 1 and 2 aimed at investigating the role of these individual factors on the specificity of emotion inferences. These experiments' results did not challenge Gygax et al.'s (2007) findings regarding the under-specificity of emotion inferences, but they brought new insight on the role played by the individual factors under scrutiny.

The second part of this thesis investigates the role of the characteristics of the experimental material used so far. In text comprehension research, most studies have used experimental narratives created by researchers. As will be developed in Chapter 4, researchers on emotion inferences may have neglected to consider the nature of emotion as defined in emotion research when constructing their experimental narratives. It is widely accepted that emotions correspond to reactions to an event, leading to responses in the different systems of the organism, those responses being considered as the components of emotion (e.g., Davidson, 2003). If Gygax et al. (2007) initiated the idea that readers may elaborate emotion inferences by inferring some core emotion components in a constructivist manner, the material used in their studies (as well as in all other studies) may have failed to assess the importance of those emotion components during online inference processing. In addition, the usual paradigm used to study inferences (i.e., the match vs. mismatch paradigm described later) might not be adequate to study the specificity of emotion inferences. In Chapter 4, a new method to construct experimental emotional narratives based on emotion research is described. In Chapter 5 and 6, the specificity of emotion inference is investigated with these new emotional narratives, using an *optimal congruent vs. moderate congruent* paradigm. The results of Experiments 3 and 4 presented in Chapter 5 revealed that readers, when provided with relevant and complete information about the emotion felt by the protagonist are very likely to reach specific emotion representations. Moreover, they suggest that different processes are in play when reading emotional information in a text and that previous research on inferences may have failed to disentangle deep processes

of information integration from shallower processes of information mapping. Finally, the results support a constructionist view of emotion inference elaboration, based on different emotion components identified in emotion research.

In order to fully comprehend the experimental part of this thesis, the following chapter provides the relevant literature background regarding text comprehension, emotion inferences and the different factors investigated in this thesis.

2. Literature Review

Text comprehension

When comprehending a text, readers elaborate mental representations of the situation depicted in the text. Mental representations are composed of different levels of text representations, as defined by Kintsch and van Dijk (1978). The primary level corresponds to the surface code, with the exact wording and syntax of the sentence. The intermediate level, the textbase, is composed of text propositions transmitting the meaning of the text but not in the exact words and syntax that readers encountered. The higher level, the situation model (van Dijk & Kintsch, 1983) or mental model (Johnson-Laird, 1983), includes the explicit information transmitted in the text as well as the inferences made based on the readers' general knowledge (Graesser et al., 1994; Kintsch, 1988). The mental model of the text is therefore a representation of what the text is about, rather than the text itself. This representation is image-like and has some perceptual qualities (Glenberg et al., 1987; Johnson-Laird, 1983).

Importantly, text comprehension follows from the constant interaction between the text and the readers' general knowledge in order to draw relevant inferences as to maintain coherence. All models of text comprehension agree on the role played by the information transmitted in the text as a source of text processing. Information in the text activates associated information in the readers' knowledge stored in long-term memory. As the text is processed, the activation of different concepts in the text and consequently in the reader's memory fluctuates (Graesser et al., 1994).

The Structure Building Framework (Gernsbacher, 1997) illustrates the cognitive processes involved in text comprehension. According to this model, three main components play a role in text comprehension: the foundation process, the mapping of information and the shifting into another foundation. First, the stimuli coming from the text activate memory nodes and form a structure on which, in a second step, the subsequent stimuli are mapped if they are coherent with the memory nodes already activated. If the incoming information does not activate the same memory nodes, then a foundation for a new structure is elaborated. The three components involved in structure building are driven by two mechanisms directly linked to the activation of memory nodes. When the activation of memory nodes is necessary for the structure being built, a

mechanism of enhancement increases the activation of these memory nodes as well as the activation of related memory nodes. On the contrary, when the information represented by memory nodes is no longer needed for the structure being built, a process of suppression diminishes those memory nodes' activation.

The possible representations elicited by a given text are infinite, given that they may activate numerous memory nodes, in turn depending on readers (and their aim, as discussed later). Hence, mental models never contain all possible information about a given situation (Garnham, 1992). Consequently, and as introduced before, all possible inferences are not made during the course of reading (i.e., online) and some of them are only elaborated after the reading is completed (i.e., offline). The different views of text comprehension do not present the same predictions regarding the inferences that are made online, notably emotion inferences. However, a comprehensive presentation and discussion of the different views is not the purpose of this thesis. As will be demonstrated later, emotion inferences have been proved to occur during online comprehension of the text. For this reason, the following paragraphs only present the constructionist view of text comprehension as it enables us to make relatively clear predictions as to the online production of emotion inferences.

The constructionist view of text comprehension

According to the constructionist view of text comprehension, readers are not passive during reading but are engaged in a *search-after-meaning* process (Bartlett, 1932, cited in Graesser et al., 1994). The search-after-meaning process depends on three main assumptions. The first assumption concerns the readers' goal when reading. It is assumed that the readers' goals (e.g., learning, entertainment or aesthetic pleasure) may vary depending on the text genre or on the task, hence influencing the resources allocated to the different comprehension levels. For example, Schmalhofer and Glavanov (1986) asked participants to read a short programmer's manual in order to either briefly summarize it afterwards or perform a knowledge acquisition task. They showed that the second group of participants (who were asked to perform the knowledge acquisition task) elaborated a more complete situation model than the first group, which focused their comprehension on a textbase level.

The second assumption states that readers are motivated to construct a mental model that reaches coherence at both local and global levels. Coherence on the local level is achieved by connecting close constituents of the text whereas coherence on the global level requires the connection of distant constituents of the text and depends on deeper features. In the *Alice in Wonderland*'s passage presented earlier, for example, the connection between the first two sentences can be made by linguistic cues such as *her* that refers to *Alice*. Another example of achieving local coherence could come from the inference that she is *desperate* in order to connect the fact that she cannot get through the door with the fact that she sits and cries. In this example, the achievement of a global level of coherence is of primary importance as it is not a usual thing to grow after eating a cake. Nevertheless, by tracking the central theme of the narrative and knowing that they are confronted with a fairy tale, readers are able to connect the different pieces of information presented in the text. Inferring that Alice is *desperate* may additionally be considered as a way to achieve global coherence by offering a framework into which one can understand subsequent actions and event (Graesser et al., 1994).

The third assumption concerns the readers' need for explanation when processing the different parts of the text. According to this assumption, readers constantly try to make sense of the different information transmitted in the text, via the use of *why-questions*. Readers are therefore considered as active when reading.

However, the *search-after-meaning* process is not accomplished in all conditions of reading. If the text lacks coherence or if the background knowledge necessary to understand the content of the text is not accessible to the readers, then it is very likely that readers do not engage in the search-after-meaning process. In a similar fashion, if the readers' goal does not require the elaboration of a mental model (for example when proofreading a text), the *search-after-meaning* process is not relevant (Graesser et al., 1994).

If the constructionist view of reading generated interesting studies on the content of the readers' representations of text, its structure, or form has never really been central. In this thesis, we argue that research on the way information is represented may give us some valuable insight into the way emotion inferences are constructed. More specifically, we believe that embodied accounts of representations may shed some light into emotion inferences.

Embodiment and text comprehension

According to the embodied cognition account (Barsalou, 1999b), which might be essential when looking at emotion inferences, cognitive processes are not *amodal* (i.e., symbolic) but are grounded in modality-specific systems. This means that when experiencing a situation, one captures the perceptual, bodily, motor and introspective states related to this situation and stores them as perceptual symbols. Later, when accessing knowledge about the situation, one reactivates through simulation these perceptual entries previously acquired through experience.

Embodied accounts of text comprehension assume 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, 1999a; 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. The same neural and bodily systems used for perception and action are then used to fully comprehend language (Glenberg, 2011).

As an illustration, Zwaan, Stanfield, and Yaxley (2002) proposed that amodal representations of the sentences *The ranger saw an eagle in the sky* and *The ranger saw an eagle in its nest* would not totally reflect the readers' representations. When reading the first sentence, readers are very likely to picture the eagle with its wings outstretched. This should not be the case when reading the second sentence, as an eagle in the nest probably has its wings folded. In order to test this hypothesis, Zwaan et al. (2002) presented their participants with sentences implying different shapes of the same object (e.g., the eagle's wings *outstretched* or *folded*). After the presentation of the sentences, the participants were presented with a picture presenting the object either in the same shape as in the sentence or in a different shape. The participants were asked to decide if the object on the picture corresponded to the object mentioned in the preceding sentence. Zwaan et al.'s (2002) participants were more accurate and faster to recognize the pictured object when it was in the same shape as that implied in the sentence compared to when it was in a different shape. These results supported the view that perceptual information is automatically activated during reading, contradicting accounts of amodal representations of the text.

There is large evidence supporting the fact that readers include perceptual representations in their mental model of the text (for reviews, see Fischer & Zwaan, 2008; Glenberg, 2007). Crucially, perceptual representations are activated when reading not only about performed actions (e.g., Glenberg & Kaschak, 2002; Zwaan & Taylor, 2006) or perspectives (e.g., Borghi, Glenberg, & Kaschak, 2004) but also about abstract concepts such as emotions.

Havas, Glenberg, and Rinck (2007) found that emotion simulation occurs when processing emotion related sentences. They presented participants with sentences describing a pleasant (e.g., *You and your lover embrace after a long separation*) or an unpleasant event (e.g., *Your supervisor frowns as he hands you the sealed envelope*) and asked them to identify the valence of the sentences. While performing the valence identification task, the participants had to hold a pen in their mouth. This manipulation developed by Strack, Martin and Stepper (1988) has been proved to induce a negative or positive emotional state among the participants according to the position of the pen. Holding the pen using only the teeth produces a smile on the participants' face whereas holding it using the teeth and the lips produces a frown. In the smile condition, the participants are in a congruent state with the pleasant sentences and in an incongruent condition with the unpleasant sentences. That is, the muscles implied in the comprehension of pleasant sentences, but not of unpleasant sentences, are the same as those activated by the pen (i.e., smile). The reverse is true for the second condition. Havas et al. (2007) found that readers were faster to judge the emotional valence of the pleasant sentences when they were smiling than when they were prevented to smile and vice versa for the unpleasant sentences. More interestingly, in a second experiment, Havas et al. (2007) asked the participants to judge if the same sentences were hard or easy to understand. By changing the instructions, they wanted to ensure that the simulation of the sentence's content was related to comprehension per se and not to other processes potentially coming from the valence judgment task. In this second experiment, the results were similar as those found in the first experiment. Moreover, as demonstrated in two further experiments, the pen manipulation had no impact on a word-to-word priming task. In all, Havas et al.'s (2007) results strongly suggest that emotion simulation is involved in the comprehension of emotion-related language. Crucially, this simulation occurs at the sentence processing level and is not directly related to the processing of positive or negative isolated valenced words.

Embodied accounts of text comprehension offer a framework for the processes at play when elaborating mental representations of the text and also more specifically when comprehending texts involving emotional information. Although these accounts are receiving increased attention in the study of emotion language at the lexical or sentence level, they have received little consideration in the study of emotion language at the discourse level. Chapters 4, 5, and 6 partly aim at rectifying this predicament by examining the detailed processes at stake in the representation of emotion during text (i.e., narratives) comprehension.

Fundamentally, embodied accounts of cognition, as well as the aforementioned constructionist view of text comprehension, assume that readers track the protagonist's emotion during reading. Before describing the experimental findings supporting this assumption, however, one critical issue related to the link between emotion and text comprehension needs to be addressed briefly: the role of tracking emotion in text processing (i.e., why would we need to infer emotions).

Emotion in text comprehension

Emotion is considered to have a special importance in text comprehension. Supporting this claim, Miall (1988) showed that sentences mentioning affective states are generally judged as more important than other sentences and elicit more motivation for readers to process the text. This special status may follow the idea that readers keep track of the protagonist's emotion during reading in order to draw a coherent model of the text regarding spatiality, causality and temporality (Zwaan, Magliano, & Graesser, 1995). When processing a text, people are likely to rely on their usual mode of understanding social situations and events (Miall, 1988). That is, relying on the characters' emotional state offers a framework to interpret their goals and actions, which are central in the construction of text representations (Graesser et al., 1994).

In addition, emotion monopolizes the readers' attention and consequently motivates them to focus on the link between actions and expected or especially unexpected results (Oatley, 1999). In this sense, representing the protagonist's emotion[1] could play a central role in text comprehension by focusing the reader's attention on

[1] Note that some authors (e.g., Miall, 1988 ; Oatley, 1999) were not always clear as to the difference between *representing* and *feeling* the emotion.

certain types of information. Therefore emotion may support deep cognitive processes needed to resolve ambiguity when the text may lack coherence (Kneepkens & Zwaan, 1994).

Given the apparent primary importance of the emotional content in text comprehension, relying on emotional cues during reading and hence elaborating a representation of the emotion depicted in the text should be quite automatic. The following paragraphs describe the research background related to emotion inferences before presenting the issues linked to the processes underlying emotion comprehension.

Activation of emotional knowledge during reading

Gernsbacher et al. (1992) were the first to investigate if emotion inferences were part of the readers' mental model of the text. They presented participants with short narratives depicting one protagonist involved in a situation with another character. Table 1 presents an example of Gernsbacher et al.'s (1992) narratives. The described situation was intended to elicit an emotion in the protagonist. Crucially, the emotion felt by the protagonist of the narrative was not made explicit in the text but was implied by the context. All narratives ended with a target sentence mentioning either the intended emotion or a mismatching emotion. In Experiment 1, the matching emotion words were paired with their perceived complementary opposite, resulting in 12 emotional pairs (e.g., *sad-joyful*, *guilty-proud*, *callous-caring*). The matching and mismatching emotion words differed in valence but were similar along other dimensions described by Frijda (1986) (e.g., intensity, duration, relevance to self versus others).

TABLE 1. *Example narrative and target sentences in Gernsbacher et al. (1992).*

Joe worked at the local 7-11, to get spending money while in school. One night, his best friend, Tom, came in to buy a soda. Joe needed to go back to the storage room for a second. While he was away, Tom noticed the cash register was open. From the open drawer Tom quickly took a ten dollar bill. Later that week, Tom learned that Joe had been fired from the 7-11 because his cash had been low one night.
Matching target sentence: It would be weeks before Tom's *guilt* would subside.
Mismatching target sentence: It would be weeks before Tom's *pride* would subside.

The participants were asked to read the narratives at their own pace. The reading times of the target sentences were recorded and compared between the two conditions (matching vs. mismatching). The idea behind this paradigm is that the reading time mirrors the closeness between the content of the readers' mental model and the content of the sentence. In other words, if readers have previously inferred some emotional information on the basis of the narrative, they should read the matching target sentence faster than the mismatching target sentence. This is exactly the pattern of results found by Gernsbacher et al. (1992) in Experiment 1. These results support the view that some emotional information is included in the readers' mental model.

However, as stressed by the authors, it may be possible that readers do not infer the protagonist' emotion but rather infer a positive or negative affect related to the protagonist. To rule out this interpretation of Experiment 1's results, Gernsbacher et al., in Experiment 2, presented their participants with the same narratives as in Experiment 1 and changed the emotion words presented in the mismatching target sentences. Instead of manipulating the emotional valence, they chose emotions of the same valence as the target emotion but unlikely to occur in the situation portrayed in the narrative (e.g., *sad-envious*, *guilty-shy*, *callous-desperate*). The results showed that readers were still faster to read the matching target sentences than the mismatching ones, and if the difference between the two conditions was less important than in Experiment 1, it still permitted to conclude that emotion inferences are not just based on emotional valence.

In Experiment 3, Gernsbacher et al. (1992) raised some methodological issues related to the self-pace reading paradigm used in their first two experiments. They claimed that presenting readers with a target sentence containing the intended emotion may trigger an inference that had not been reached yet. In other words, it is possible that readers do not represent the protagonist's emotion during reading but only when they are forced to (i.e., when they encounter the target sentence). In the latter case, the reading times associated with the target sentence would mirror the ease of mapping the incoming information. Gernsbacher et al. used a naming task in order to test this hypothesis. This task simply consists of pronouncing a target word as fast as possible. It has been proposed that this kind of task only mirrors what is already activated in the reader's representation and not the ease of information mapping (Potts, Keenan, & Golding, 1988). Participants of this experiment read the same narratives as in previous experiments but were not presented with the target sentences. Instead, they had to

pronounce test words as fast as possible (one test word after each narrative). The test words were the same emotion words as in Experiment 1 and appeared at the end of the narrative, either matching or mismatching the protagonist's emotion. The results of the naming task were similar to the results found in previous experiments. The participants pronounced the target emotion faster when it matched than when it mismatched the intended emotion. In all, these experiments of Gernsbacher et al. (1992) support the claim that readers activate knowledge about emotions when reading and that this activation stimulates them to infer the protagonist's emotion. In addition, Gernsbacher et al. (1992) demonstrated that readers infer more than just valence.

In a further study, Gernsbacher, Hallada, and Robertson (1998) investigated the automaticity of these emotion inferences. They argued that if emotion inferences are automatic and consequently drawn without cognitive effort, their elaboration should not be impaired by a concurrent task to reading. In order to test this hypothesis, they presented participants with the original narratives described above and asked them to perform a concurrent attention task in parallel to the reading task. In the first experiment, the participants performed a tone-identification task (i.e., determine whether the majority of five tones corresponded to high or low pitched tones). The results revealed that the participants slowed their reading times when performing the concurrent task, which can be considered as evidence for the participants' divided attention. Regarding the inference processes, the difference in reading times between the matching and the mismatching conditions replicated previous findings. Interestingly though, the difference between the reading times of the matching and mismatching sentences was smaller during the concurrent task. Although this effect did not reach significance, it still hinted that diminishing the processing resources attributed to reading comprehension may affect the construction of emotion inferences. In this first experiment, the concurrent task may have been too easy to demonstrate this effect.

In their second experiment, Gernsbacher et al. (1998) used a memory-load task, which is more demanding than the tone-identification task. While reading the narrative, the participants had to remember four consonants presented at the beginning of each sentence and verify if a string of four consonants presented at the end of the sentence matched the ones to be remembered. The participants still read the matching target sentences faster than the mismatching ones. Gernsbacher et al. (1998) interpreted these

results as support for the automaticity of emotion inferences, since their elaboration was again not (significantly) disrupted by a concurrent attention task.

In their third experiment, Gernsbacher et al. (1998) enhanced the level of attention required by the concurrent task in order to ensure that the automaticity of emotion inferences demonstrated so far still remained under a high memory-load task. This time, they presented the participants with one consonant at four random points of the narrative. While reading the narratives, the participants had to keep the consonants in memory and determine at the end of the narratives if a sequence of consonants matched the one they had to remember. As in the two previous experiments, the reading times of the matching target sentences were faster than the reading times of the mismatching target sentences.

In their final experiment, Gernsbacher et al. (1998) directly assessed the accessibility of readers' knowledge about the emotional state of the protagonist. They proposed to compare the processing of the target sentences in two conditions. In the first condition, the narratives were the same as in previous experiments: they implied that the protagonist was feeling an emotion but did not specify this emotion. In the second condition, the narratives explicitly stated the emotion felt by the protagonist. This information was included in an additional sentence put at the beginning of the narratives. Hence, in this second condition, readers knew the emotional state of the protagonist before reading all the narrative. If emotional knowledge is automatically activated during reading, the target sentences in the first condition should show the same match-mismatch effect as the target sentences in the second condition. This hypothesis was confirmed by the results, which was also revealed previously that the matching target sentences were read faster than the mismatching ones in both conditions. Crucially, there was no main effect or interaction effect in relation with the implicit-explicit manipulation. In all, Gernsbacher et al. (1998) completed the findings regarding emotion inferences by demonstrating that this kind of inferences is likely to be made in an automatic manner during reading.

Updating emotion representations during reading

Following Gernsbacher et al.'s (1992) primary results on the representations of emotion during reading, de Vega et al. (1996) investigated the readers' capacity to update their representations of the protagonist's emotion in response to a change of context at some point of the narrative.

De Vega et al. (1996) presented their participants with short narratives describing a situation intended to induce a mental representation of the protagonist's emotion. The short narratives were divided into two parts, each followed by a target sentence containing a matching or a mismatching emotion term. In the cumulative context condition, the first part of the narrative induced the representation of the protagonist's emotion and the second part of the narrative conveyed information strengthening this representation. In the shifting context condition, the second part of the narrative was incongruent with the emotion induced in the first part and conveyed information about the opposite emotion. In this case, the matching emotion term corresponding to the first part of the narrative was mismatching the second part of the narrative. As in previously presented studies, de Vega et al. (1996) focused on the reading times of the target sentences. In the cumulative context condition, the participants were faster to read the matching target sentences than the mismatching ones. Moreover, the match-mismatch effect was greater for the target sentences following the second part of the text than for the target sentences appearing before the second part, suggesting that increasing contextual information related to emotion facilitates the accessibility of the described emotion. In the shifting context condition, the matching target sentences were read faster than the mismatching ones when they followed the first part of the narrative. This effect was reversed for the target sentences appearing after the context shifted. This meant that readers were able to update their mental representations of the protagonist's emotion regarding the information conveyed in the narrative.

In an additional experiment, de Vega et al. (1996) controlled for what they called the *local context hypothesis*. According to this hypothesis, the reverse mismatch effect found in the shifting condition may result from working memory limits rather than from the updating of the readers' representation. It may be possible that readers did not have access to the first representation because this representation may have

vanished as readers processed the second part of the text. In order to test this hypothesis, de Vega et al. (1996) included neutral sentences (i.e., not conveying any emotional information) after the first (emotion conveying) part of the narratives, before the target sentences. The second part of the narratives used in Experiment 1 was excluded from the narratives in this experiment. If the local context hypothesis were true, no mismatch effect should occur for the target sentences following the filler part (i.e., neutral sentences). Contrary to this prediction, the matching target sentences were read faster than the mismatching ones.

In their last experiment, de Vega et al. (1996) found that representations of the protagonist's emotion are elaborated even in the absence of explicit emotion terms. In this last experiment, the same narratives as in Experiment 2 were used. The target sentences explicitly stating the character's emotion were replaced by sentences mentioning overt behaviors, matching or mismatching the intended emotion. The same pattern of results as in previous experiments was found, namely in that the matching target sentences were processed faster than the mismatching ones.

The specificity of emotion inferences

As presented above, Gernsbacher and colleagues' as well as de Vega et al.'s findings suggest that readers track the protagonist's emotions when constructing mental models of the situation pictured in the text. In other words, readers infer the protagonist's emotions. In addition, they are able to modify this representation and adapt it to the shifts of context occurring in the text. However, the extent to which readers include a specific word such as *compassion* or *hate* in their mental models of the text remains unclear. This line of research was initiated by Gygax et al. (2003) who focused on the readers' ability to infer a specific emotion during online comprehension.

Gygax et al. (2003) actually proposed that readers infer some general information shared by different emotions when reading an emotional narrative. In an offline experiment, the participants were presented with Gernsbacher et al.'s (1992) narratives (without the target sentences) and had to generate words to complete the following last sentence: [Main character] felt … The participants generated a great amount of different answers for each narrative. This suggested that a narrative intended to induce a certain emotion is compatible with different emotion labels, some of them

not being synonymous. In their second experiment, Gygax et al. (2003) investigated if readers considered that different emotions were likely to be felt by the protagonist of Gernsbacher et al.'s (1992) narratives. The participants were asked to read the same narratives as above and judge the likelihood of several emotion terms. These terms were the intended emotion term investigated by Gernsbacher et al. (1992), eight terms chosen among the most mentioned terms in the preceding experiment and three terms corresponding to opposite emotions. The results showed that for each narrative at least three emotion terms were likely to correspond to the protagonist's emotion.

In their last experiment, Gygax et al. (2003) investigated the reading time patterns associated with the different emotion terms. They manipulated the emotion word presented in the target sentences at the end of the narratives. The first emotion word (Matching) corresponded to the original emotion of Gernsbacher et al. (1992) (e.g., *depressed*). The second emotion word (Matching Synonym) was a synonym of the original emotion (e.g., *miserable*). The third emotion word (Matching Similar) shared valence and several other components with the original emotion without being synonymous to it (e.g., *useless*). The last emotion word was the perceived opposite of the matching emotion (e.g., *happy*). When comparing the reading times of the different target sentences, the authors found that the matching, matching synonym and matching similar target sentences were read faster than the mismatching target sentences. However, no difference between the different matching conditions was demonstrated, supporting Gygax et al.'s (2003) claim that readers do not differentiate between similar emotions during reading.

Gygax et al. (2004) explored possible conditions under which a specific emotion may be inferred. They first proposed that the content of the emotional narratives used in previous research may have not been sufficient to activate the different components of emotion needed to reach a specific emotion representation. As will be developed further in this thesis, emotions are traditionally considered as being constituted of different components. Although most theorists agree with a componential definition of emotion, the number of components is still a matter of debate. However, three components mark a consensus among theorists: physiological arousal, motor expression and subjective feeling. Moreover, dimensional theories of emotions suggest that emotions are composed of different general dimensions. The number and the nature of those dimensions are variable but all models agree to include *evaluation-pleasantness* and

activation-arousal as two essential dimensions (Fontaine et al., 2007; Ortony, Clore, & Collins, 1988; Osgood, May, & Miron, 1975; Russell, 1980). In addition to this first claim, Gygax et al. (2004) argued that the lack of emotion components in the experimental narratives may also have impaired simulation processes at stake during reading, in reason of inappropriate context information.

In order to resolve this issue (i.e., the lack of emotion information in the narratives), Gygax et al. (2004) focused on the length of the experimental narratives. They doubled the number of sentences of each emotional narrative. In an offline completion task, they presented the participants with the same four different emotion words as in Gygax et al.'s (2003) third experiment and asked them to choose the most appropriate emotion. They found a higher agreement regarding the intended emotion term in the long version of the narratives (63%) than in the short versions (49%). This result supported their hypothesis that the under-specificity of emotion inferences may result from insufficient emotion context. However, when testing the online elaboration of emotion inferences with the long version of the narratives, the results were exactly the same as in Gygax et al. (2003). That is, if the matching, matching synonym and matching similar target sentences were read faster than the mismatching sentences, there was again no difference in the reading times of the target sentences between the different matching conditions.

In a second experiment, Gygax et al. (2004) tried to compel the readers to draw specific emotion inferences. They based their hypothesis on the *why-questions* described by the constructionist view of text comprehension as one of the conditions to establish text coherence. As a reminder, the readers generally attempt to maintain local and global coherence and therefore try to answer why-questions throughout the text. By altering their narratives and rendering the emotion inferences necessary to establish local coherence, Gygax et al. (2004) forced the readers to put more effort in the resolution of the why-questions that may be at the basis of emotion inferences. Similar to the offline results found with the longer narratives, the *ambiguous* narratives elicited a higher consensus concerning the intended emotion (62%) than the original narratives. However, testing the specificity of online emotion inferences with the ambiguous version of the narratives did not change the reading patterns showed in previous studies.

In the aforementioned studies, Gygax and colleagues claimed that readers do not reach a specific emotion representation during reading. They argued that instead of

inferring an emotion *per se*, readers may infer some core components of this emotion that can be shared by similar emotions. In other words, the lack of difference between the different matching conditions may result from the fact that readers included some stereotypical information (e.g., the valence of the emotion or a behavior associated to it) in their mental models of the text but did not need to infer a specific emotion word.

Gygax et al. (2007) further developed this idea and focused on the behavior associated to the emotion as a possible representative of stereotypical information related to the emotion. They added two target sentences based on a typical behavioral reaction to the emotion target sentences. For example, a typical behavioral reaction for anger could be *to clench one's fist*. They hypothesized that if readers include such stereotypical information in their mental representations of the text, the mismatch effect linked to behavioral sentences might be more important than the mismatch effect linked to emotional sentences. In addition, they discussed the interpretation of the mismatch effect usually considered as an indicator of an inference to be drawn. When considering Gygax et al.'s (2004) results, it appears that the reading times of the matching sentences in the different conditions were significantly different from the reading times of the mismatching sentences. However, given the fact that the reading times of the different matching sentences were not different, the authors concluded that no specific emotion inferences had been made. This can appear quite contradictory, as the same difference may be interpreted as mirroring specific or non specific emotion. Gygax et al. (2007) argued that a mismatch effect might mirror not only an inference process but also a mapping process. That is, as long as the incoming information does not contradict readers' current mental representations, it can quite easily be integrated in these representations. In order to control for what they called the *context integration effect*, Gygax et al. (2007) included a control condition in their experimental material. In this control condition, the second sentence of some filler narratives was manipulated so as to convey easy-to-map information or unexpected information. For example, the first sentence of the narrative described a girl going to the gym. The following sentence in the *easy-to-map* condition explained that this girl enjoyed the time spent at the gym. In the *unexpected* condition, the second sentence stated that she did not like going to the gym. At this stage of reading, it is very unlikely that readers have entered a process of inference. Consequently, any difference in the reading times of the context matching

and context mismatching sentences would reflect a context integration process rather than an inference process.

Gygax et al.'s (2007) found that readers were faster to read the matching target sentences than the mismatching ones in all conditions. However and most importantly, the mismatch effect linked to the behavioral sentences was greater than that related to the control sentences, which in turn was no different to the mismatch effect linked to the emotion sentences. These results strongly suggested that readers base their representations of the protagonist's emotions on behavioral information related to emotions rather than on emotions per se. Gygax (2010) further showed that behavioral inferences related to emotions are not to be confounded with any predictive behavioral inferences (i.e., what the protagonist is going to do). In Gygax (2010), readers were presented with the same narratives as in Gygax et al. (2007) and with narratives intended to activate a predictive inference of the protagonist's behavior. These last narratives did not transmit emotional information and highly encouraged the readers to infer the protagonist's behavior (e.g., *picking* a shiny coin on the floor). Like the emotional narratives, these narratives ended with a matching behavior sentence or a mismatching behavior sentence. When comparing the difference in the reading times of the matching and mismatching target sentences, this difference was higher in the emotional behavior than in the behavior condition, supporting the claim that processing behavioral information related to emotion was different than processing behavioral information in general.

According to these results, specific emotion inferences seem not to be needed during online comprehension. Nevertheless, this does not mean that readers do not include some kind of information related to the protagonist's emotion during reading but it suggests that emotion information might be better thought in terms of stereotypical reactions than in terms of a specific emotion word, supporting the idea that text comprehension might be based on *good-enough* representations (Ferreira, Bailey, & Ferraro, 2002). That is, the readers' representations might not be detailed enough to differentiate between similar emotions but may be detailed enough to reach a totally satisfying comprehension.

Factors potentially influencing emotion inferences

The literature review of the previous research of emotion inferences suggests that, generally, readers do not include a specific emotion representation in their mental models of the text. However, it may be the case that under certain circumstances, readers reach specific representations of the protagonist's emotion. This thesis aims at investigating those conditions under which emotion inferences may be specific.

Empathy and simulation

The first factor that may influence emotion inferences directly relates to the processes readers undertake to understand the protagonist's emotion. Different explanations have been proposed regarding how readers comprehend this emotion, in regard to their personal involvement.

According to Oatley (1999), comprehending fictional emotions can result from different processes. The first process, termed *identification*, assumes that readers identify with the character and adopt their goals and plans during reading. As a result, they comprehend the protagonist's emotions when their goals and plans are achieved or missed. The second process refers to the readers' sympathy for the character and states that readers attribute emotions to the characters and experience sympathetic emotions towards them (see also Tan, 1994). The third process is related to autobiographical memory. When readers are confronted to fictional events, they may reactivate past experiences and emotional states that derived from these experiences, hence comprehending the protagonist's emotion by re-evocating their own emotion. This process is similar to Gernsbacher et al.'s (1992) explanation for the activation of emotional knowledge during reading. Gernsbacher et al. (1992) claimed that when participants faced similar situations to the ones described in a narrative, they experienced emotional reactions. These emotional reactions became memory traces. When reading about similar situations, these memory traces are activated and brought upon the processing of the text. Importantly, the three different processes are interrelated, sympathy and memories of proper experiences deriving from the readers' identification to the protagonist (Oatley, 1999).

Besides identification, sympathy and memory activation processes, Goldie (1999) assumes that there must be some additional empathic and simulation processes

in order to comprehend others' emotions. These two processes differ in the perspective taken by the readers. In Goldie's terms, empathy involves imagining what emotion a situation would elicit in the protagonist from their point of view. In this sense, his definition concurs with the Theory of Mind definition. That is, people are able to attribute motivations, emotions, actions and thoughts to other people as well as reasoning about others' own mental states (Baron-Cohen, Leslie, & Frith, 1985). When empathizing with others, according to Goldie (1999), one keeps an observer position. One certainly has to understand what may happen inside the other, but one does not transfer their own values, interpretations or feelings to the other.

Contrary to empathy in which readers keep an external perspective, simulation processes require them to take an internal perspective via *in-his-shoes imagining*. In transposing themselves into the other's shoes, readers put together their own and other's internal feelings (Goldman, 2001). This is not to say that readers confound the protagonist's emotion with their own emotion when reading narratives. De Vega, Díaz and León (1997) indeed showed that readers are able to infer the protagonist's emotion by relying on perspective taking and not on their own perspective of the narrative. De Vega et al. (1997) manipulated the content of the narrative, by specifying that the protagonist was either aware or not aware of an information that may influence his or her emotional state. For example, a female protagonist is waiting for her boyfriend to come but he does not arrive. The readers then learn that the protagonist knows (or *does not know* in the *uninformed* condition) that her boyfriend is actually spending time playing poker with his friends. In the informed condition, if readers do not take the protagonist's perspective, they should infer that she is *furious*. However, de Vega et al.'s (1997) results revealed that readers consider only the information available to the protagonist during reading and infer the protagonist's emotion by relying on a perspective-taking process.

Simulation processes have also received considerable attention from the embodied accounts of comprehension (Barsalou, 1999a, 1999b, Glenberg, 1999). As introduced earlier, embodied theories of comprehension consider that simulation of action, physiological and subjective states are required to comprehend emotional language (e.g., Glenberg, Havas, Becker, & Rinck, 2005). Thus, to understand a sentence about, let us say *anger*, one has to simulate a state of anger, including the relevant motor actions (e.g., to clench the fist), physiological reactions (e.g., the heart

beating faster) and subjective feelings (e.g., feeling restless). In other words, the core component of understanding a narrative describing an emotional situation is the re-enactment of the described emotion. Very importantly, this re-enactment is rarely a full-blown, conscious simulation. If it may conduct to changes in the systems of the organism implied in simulation, it may also stay at an unconscious level (Barsalou, Niedenthal, Barbey, & Ruppert, 2003).

If simulation is quite automatic during reading, Barsalou (1999a) nonetheless claimed that varying richness of simulation explains minimal versus rich inferences during comprehension. When the reader invests minimal effort to engage in simulation processes, the resulting representations may stay at a minimal level. On the contrary, when the reader is motivated to construct a detailed simulation, their mental representations may contain richer inferences.

It is important to note that the distinction between empathy and simulation varies in the literature. Whereas some authors differentiate the two processes (e.g., Goldie, 1999), others argue that empathy works through simulation (e.g., Decety & Grèzes, 2006; Goldman, 2005; Preston & de Waal, 2002). The view that empathy may be entirely cognitive has been replaced by an agreement concerning its multifaceted aspect (i.e., cognitive and emotional). As a matter of fact, the instruments dedicated to the assessment of empathy are based on four complementary facets, i.e., perspective taking, fantasy, empathic concern and personal distress.

In this thesis, both empathy and simulation processes have been investigated simultaneously (see Chapter 3). In regard to Gygax et al.'s (2007) results, and assuming that readers do not automatically engage in deep simulation processes, compelling them to do so may enhance behavioral related inferences. In addition, we hypothesized that high-empathy readers may infer more specific emotion than low-empathy readers. This last hypothesis was based on Komeda and Kusumi's (2006) study. These authors investigated the influence of the readers' engagement on the construction of text representations. In their study, the participants were asked to read emotional narratives describing relief- or worry-related situations. In half of the narratives a shift related to the described emotion appeared in the middle of the text whereas in the other half the whole narratives were consistent with the described emotion. After each narrative, the participants were asked to rate how similar to and empathic they felt towards the protagonist. These offline responses were meant to assess their level of engagement in

the narratives. Komeda and Kusumi (2006) showed that readers highly engaged in the narratives (as reflected by offline responses concerning empathy or felt similarity with the protagonist) were more sensible to shifts in the text. The fact that high-empathy readers may have more dispositions to attribute emotion to others also supports this second hypothesis.

If empathy and simulation are potentially influencing emotion inferences by affecting the way readers comprehend the protagonist's emotion, other factors related to more general processes implied in text comprehension might also have an impact on emotion inferences.

Processing limitations: Working memory and time to elaborate

Processing text and elaborating mental models are demanding processes. Different limitations may impact the construction of mental models by influencing the amount of processing capacities available to the readers. Two factors that are directly related to the manipulation of mental representations are examined in this thesis: working memory and processing time.

Working memory corresponds to a cognitive mechanism that is responsible for the storage and computation of currently activated mental representations (Baddeley, 1996; Daneman & Carpenter, 1980; Just & Carpenter, 1992). As previously introduced, the different models of text comprehension postulate that incoming information is encoded in working memory. In parallel, related information corresponding to recently processed information and/or information in long-term memory (based either on the text or on the readers' general knowledge) are activated and combined to the incoming information in order to develop coherent mental representations of the text (Masson & Miller, 1983). In this sense, working memory is highly involved in the maintenance of text coherence, by monitoring and manipulating its content, rejecting or accepting the retrieved information, maintaining cues for information in long-term memory and encoding the products of retrieval (Mar, 2004). Crucially, a maximum amount of representations can be simultaneously activated, processed and stored by working memory. For this reason, it seems relevant to hypothesize that high- and low-working memory readers may differ regarding their text comprehension skills, especially in terms of emotion representations complexity (i.e., specificity).

The capacity of working memory is often assessed with the Reading Span Task (Daneman & Carpenter, 1980), which aims at testing the processing and storage functions of working memory simultaneously. In this task, participants read strings of sentences aloud (i.e., processing function) and have to remember the last word of each sentence (i.e., storage function). After each string of sentences, the participants try to recall the maximum of retained words. Working memory capacities, as measured by the Reading Span Task, have been shown to be related to text comprehension measures such as the ability to answer questions about the text (Masson & Miller, 1983).

Regarding the influence of working memory on inference elaboration, the ability to construct bridging inferences (i.e., needed to connect new information to the current model) is highly correlated with the readers' working memory level (e.g., Singer, Andrusiak, Reisdorg, & Black, 1992). To connect new propositions to prior propositions, readers must indeed identify the referent related to the new propositions. This referent may be more easily available for readers with high working memory capacities (Singer et al., 1992). In a similar fashion, when there is increasing distance between a pronoun and its referent, inferences construction is highly correlated with the readers' reading span score (Daneman & Carpenter, 1980).

Estevez and Calvo (2000) focused on another group of inferences that are called elaborative. This kind of inferences, contrary to bridging inferences, are not necessary to directly link the sentences, but are elaborated in order to complete the text representation by adding some information related to the global interpretation of the text. Depending on the context, emotion inferences may be considered as elaborative. If inferring a broad emotional state may act as a bridging inference because it allows linking different parts of the text (e.g., a physical reaction to an event), inferring a specific emotion is likely to correspond to an elaborative inference because it adds extra but not needed information to the text representation. Estevez and Calvo (2000) investigated the influence of working memory capacities on one particular class of elaborative inferences, predictive inferences, which correspond to anticipations of future events according to the explicit information in the text (McKoon & Ratcliff, 1986). For example, readers might infer that the protagonist is going to study after having read that they went to the library, looked for a separate table and opened their book (from Estevez & Calvo, 2000)

Estevez and Calvo (2000) selected high- and low- working memory participants and presented them with short passages either predictive or non-predictive of a target word. The passages were followed by confirming or disconfirming target words. In addition, the authors manipulated the Stimulus Onset Asynchrony (i.e., the time between the end of the passage and the presentation of the target word) in order to determine the time course of the inferences. The difference in the latency to pronounce the confirming target words between predictive and non-predictive passages is considered to reflect a facilitation effect mirroring the degree of activation of the inference. Estevez and Calvo's (2000) results revealed that both high- and low- span readers were able to draw predictive inferences online, yet high-span readers needed less processing time and were more efficient than low-span readers.

In this thesis, we hypothesized that depending on their reading span, readers might elaborate more or less specific emotion inferences. That is, low-span readers may not construct their representation of the protagonist's emotion so as to infer a specific word, in reason of limited processing capacities. On the contrary, specific emotion inferences may occur among high-span readers. In addition, as demonstrated by Estevez and Calvo (2000), high-span readers are likely to draw specific inferences in less time than low-span readers. In a typical reading task, sentences are separated by 500 milliseconds. In this time condition, emotion inferences should be facilitated for the high-span readers. If the time between the two sentences is extended (e.g., to 1000 milliseconds as in Experiment 2 of this thesis), low- and high-span readers' inferences may be identical regarding their specificity, as enough time to process would be allocated for the low-span readers.

On a related note, and as introduced earlier, mental models of the text can be considered as perceptual simulations of the meaning of the text (Glenberg et al., 1987; Zwaan, 2004). This particular status of mental models may require the involvement of perceptual processes that could be notably related to the readers' visuo-spatial working memory in addition to their general working memory capacities. Fincher-Kiefer (2001) and Fincher-Kiefer and D'Agostino (2004) indeed showed that readers engaged in a concurrent task recruiting visuo-spatial processes present disrupted comprehension for elaborative inferences (i.e., predictive inferences) compared with readers performing a concurrent verbal task. For this last reason, the influence of the visuo-spatial span on emotion inferences was also studied in this thesis.

If readers' individual differences (i.e., top-down processes) might explain the under-specificity of emotion inferences, bottom-up processes, namely text characteristics may also influence readers' emotion representations. Unlike previous studies investigating emotion inferences, we explored more deeply the literature on emotion construct so as to directly investigate the role of emotional information provided to the readers on the specificity of emotion inferences.

Characteristics of the emotion construct in the narratives

In this thesis, we assumed that the emotion content of the narratives used in previous studies did not allow the readers to infer specific emotions. In regard to the issues raised by Gygax et al. (2007), it is likely that readers construct their mental representation of an emotion by inferring core components of emotion. In regard to the embodied theories of text comprehension, readers simulate the emotion concepts that contain information about the experiential states associated to emotion. In order to define emotion as well as those experiential states and core components needed for an emotion to occur, we directly relied on emotion research.

A variety of conceptualizations of emotion have been proposed since the first attempts of Plato and Aristotle. A consensus has however been reached that considers emotion as a change in the functioning of the organism following a triggering event, either internal or external (Scherer, 2000). Crucially, the triggering event must have significance for the organism. Emotion is thus caused by, and adapted to, the relevance of the stimulus events, evaluated with respect to their meaning for the organism (Scherer, 2000).

The amount of changes as well as the systems concerned by the changes in the organism for an emotion to appear is nevertheless still a matter of debate. If the majority of theorists agree on a “reaction triad of emotion” (Scherer, 2000, p. 138) composed of physiological arousal, motor expression and subjective feeling, some authors consider additional motivational components of emotion as essential. These motivation components correspond to action tendencies and to cognitive processes implied in the evaluation of the event at the basis of the situation (Ellsworth, 1991; Frijda, 1986; Scherer, 1984, 2005).

The different views on emotion have been combined in the componential theory of emotion proposed by Scherer (1984, 2005). According to this theory, an emotion is

"an episode of interrelated, synchronized changes in five components in response to the evaluation of an external or internal stimulus event as relevant to major concerns of the organism" (Scherer, 2005, p. 697). The components are related to the different systems of the organism and are the following: the appraisal, psychophysiological, motivational, motor expression and subjective feeling components. These will be described more thoroughly in Chapter 4 and 5. Scherer's model assumes that there are as many different emotion episodes as there are different appraisals and changes in the organism, but also acknowledges the existence of some frequently occurring patterns conducting to emotions universally shared like happiness or disgust. Crucially, in Scherer's theory, changes must happen in all components to trigger emotion. Consequently, it may not be possible to differentiate between emotions by relying on changes in only some components.

The under-specificity of emotion inferences revealed by Gygax et al. (2003) as well as Gygax et al. (2004) may directly result from the issue that readers may require all the emotion components in the text, or inferred for that matter, to activate a *specific* emotion (and in these experiments, readers were not provided with these). Molinari, Burin, Saux, Barreyro, Irrazabal, Bechis et al. (2009) actually showed in a study investigating emotion inferences specificity, that emotions belonging to the same family (according to the cognitive structure of emotion by Ortony et al., 1988) were not differentiated during the reading of emotional narratives. This idea can be applied to Gygax et al. (2004) in which they showed that when reading a narrative about a man who lost his job, for example, readers similarly activated concepts such as *depression*, *sadness* and *uselessness*. In this thesis (Chapters 4, 5 and 6) we argue that the narratives that were used in previous studies on emotion inferences as well as in the first two experiments of this thesis did not qualitatively allow readers to reach specific emotion inferences.

Now that we have summarized the theoretical background at the base of our hypotheses, the next chapters present the experimental parts of this thesis.

3. Individual Differences and Emotional Inferences during Reading Comprehension

In this chapter, two experiments investigating readers' representations of the main protagonist's emotional status in short narratives, as well as several mental factors that may affect these representations are presented. General and visuo-spatial working memory, empathy, simulation and time to elaborate were investigated as potential individual differences in generating emotional inferences**.** Participants were confronted with narratives conveying information about the protagonist's emotional state. We manipulated each narrative's target sentence according to its content (emotional label vs. description of the behavior associated to the emotion) and to its congruence to the narrative (matching vs. mismatching). The time to elaborate was manipulated between experiments: In Experiment 1 the sentences were separated by 500 milliseconds whereas this time was extended to 1000 milliseconds in Experiment 2. The results showed that globally the difference between reading times of congruent and incongruent target sentences was bigger in the behavioral than in the emotional condition. This pattern was accentuated for high visuo-spatial working memory participants when they were asked to simulate the narratives. When extended elaboration time was offered to the participants, no preference for behavioral information or emotion per se occurred.

These results support the idea that mental models may be of a perceptual nature and may more likely include behavioral elements than emotion labels per se, as suggested earlier by Gygax et al. (2007).

Experiment 1 presented in this chapter was published:

Gillioz, C., Gygax, P., & Tapiero, I. (2012). Individual differences and emotional inferences during reading comprehension. *The Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, *66*, 239-250.

Experiment 1:

Simulation, empathy, working memory and emotion inferences

Research on reading comprehension has shown that readers build mental models (Johnson-Laird, 1983) or situation models (Kintsch & van Dijk, 1978) of a scene depicted in a text that comprise both explicit and implicit elements. The latter are based on *general knowledge* and are referred to as *inferences*. Inferences generated during reading are often considered necessary to allow readers to maintain a certain local as well as global coherence of the text (Graesser, Singer, & Trabasso, 1994). Those establishing or maintaining local coherence connect adjacent constituents of the text, whereas those establishing or maintaining global coherence connect most constituents of the text by deeper features such as the theme of a narrative. The construction of a mental model is incremental, as readers continually update their representations with new information, either explicit or implicit (Garnham & Oakhill, 1996). If mental models can be relatively complex, they are nonetheless most likely tributary to readers' limited processing capacities (e.g., Baddeley, 1996), which may limit possible inferences as the text is being processed (i.e., online). Not surprisingly, research on inferences has repeatedly tried to identify which inferences are made online, and which are not, leading to a certain controversy on the actual *need* to make certain inferences.

In this chapter, we focus on the mental representation readers construct of the affective state of the protagonist in short narratives, which has typically been subject to controversy as to whether it was inferred online or not. If some theories suggest that this type of inference may not be drawn during reading (e.g., the *minimalist* view of reading from McKoon and Rattcliff, 1992), others consider it essential for global coherence, giving it an online status (e.g., the *constructionist* view of reading by Graesser et al., 1994). Although of prime concern in early research on the matter, the relevance of these theories has been questioned with regards to the complexity of the processes involved in emotional inferences (e.g., Gygax, Tapiero, & Carruzzo, 2007). Most importantly, and this chapter furthers this idea, individual differences may well modulate the actual integration and complexity of the protagonist's emotional status in readers' mental models.

Gernsbacher, Goldsmith, and Robertson (1992) were among the first to conduct a series of experiments investigating readers' ability to mentally represent the

protagonist's emotional status described in short narratives. In their first two experiments, presenting participants with different narratives portraying emotion-eliciting situations, they found that target sentences were read significantly faster when they contained matching emotion terms than when they contained mismatching emotion terms of opposite valence (Experiment 1) or similar valence (Experiment 2). Gernsbacher et al. (1992) concluded that readers do integrate specific emotions in their mental models while reading. These findings have been further supported by other studies investigating readers' inclusion of the protagonists' affective status in their mental models (Gernsbacher, Hallada, & Robertson, 1998; Gernsbacher, Robertson, Palladino, & Werner, 2004; de Vega, Leon, & Diaz, 1996).

Using short narratives based on Gernsbacher et al. (1992), Gygax, Oakhill, and Garnham (2003) and Gygax, Garnham, and Oakhill (2004) questioned the assumed notion of *specificity* (i.e., readers infer a *specific* emotion label and differentiate between similar emotions *or* merely infer a broader feeling). They showed that although participants were sensitive to congruence manipulations of target sentences containing emotion words (i.e., they read sentences containing congruent target emotion words faster than incongruent ones), they were equally fast when reading target sentences containing (a) Gernsbacher et al.'s initial emotion words (e.g., *depressed*), (b) emotion words synonymous to the original ones in Gernsbacher et al. (e.g., *miserable*) and (c) emotional terms that were merely similar to them (e.g., *useless*). Most importantly, these findings were independent of the length of the narratives, reflected in the amount of information given about the main protagonist's emotional status (Gygax et al., 2004).

Gygax et al. (2007) tried to give an explanation to account for such a seemingly non-specific representation of the protagonist's emotional status. Their core argument was that *most* readers, under *normal* conditions, may only include part(s) of the emotion construct in their mental models. By emotion construct, the authors referred to Scherer's (e.g., 1984, 2005) definition of an emotion as a process of coordinated changes in the five *organismic subsystems* (information processing, support, executive, action, and monitoring), resulting from the appraisal of an event, internal or external. Each subsystem is associated with a particular *component* of emotion (i.e., cognitive, psychophysiological, action tendency, motor expression, or subjective feeling), the sum of all component changes resulting in a specific emotion. Although a more detailed account of this theory goes beyond the scope of this chapter, as the construction process

is dynamic and cumulative (Ellsworth & Scherer, 2003), Gygax and colleagues (2003, 2004, 2007) suggested that when reading about emotional situations, readers may well build a representation of emotion in an incremental manner but not inevitably reach some specific emotion (or specific emotion label such as *sad* or *happy*). The latter stage only appears if all necessary components are presented in the text or implied by it, or under critical conditions, some of which are examined in the present study. Under normal reading conditions, and if the text is rather under-specified, readers might only include the core and easy-to-represent elements of the main protagonist's emotional response. Among these elements, *valence* may be a good candidate, although not on its own (Gernsbacher et al., 1992), as well as *behavioral responses* (i.e., similar to Scherer's action tendency or motor expressions) elicited by the emotional situation. By behavioral responses the authors referred to any movement, or reference to movement in response to the emotion-eliciting situation. For example, someone might clench their fist in response to a frustrating situation or freeze in response to a scary one. Gygax et al. (2007) suggested that behavioral responses were easier to infer, at least easier than a fairly complex and abstract representation of emotion.

TABLE 2 *Example of an experimental narrative used in Gygax et al. (2007) and in Experiments 1 and 2.*

Narrative:
Suzanne came back from her regular visit to the nursing home. She walked slowly from the nursing home to her place. She thought of the days with her grandmother with a heavy heart. She had trouble holding back her tears when thinking of her grandmother alone in her room.
Target sentences:
Matching emotion: As you could expect, Suzanne was feeling sad.
Mismatching emotion: As you could expect, Suzanne was feeling happy.
Matching behavior: She sat on her settee, wrapped in a blanket.
Mismatching behavior: She danced all night, as she was always the one to show others how to party.

To test this, they presented participants with narratives in which the protagonist was experiencing an emotion-eliciting situation. The final target sentence of each narrative comprised either an emotion word, congruent or incongruent, as in previous research, or some congruent or incongruent information about the physical behavior of the protagonist (see Table 1 for an example).

Results indicated a significantly larger congruence effect in the behavior condition compared to the emotion condition, suggesting faster processing of congruent behavioral information as well as slower processing of incongruent one. Gygax et al. (2007) added a specific control condition for what they called the *context integration* problem. In short, they argued that differences between reading times of sentences containing congruent information and sentences containing incongruent information might not necessarily mirror inferential processes, as previously assumed. When reading the sentence *The weather is nice*, readers might infer that the *sun is shining*, but it is unlikely, under normal circumstances, that they infer some information about, let's say, *taking the train*. However, Gygax et al. (2007) argued that after the sentence *The weather is nice*, the sentence *John is taking the train* should still be read faster than *It is very dark* (which is incongruent), maybe in the same way that congruent emotions are read faster than incongruent ones. The former effect (i.e., *John is taking the train* vs. *It is very dark*), although similar to effects that have led researchers to believe in inferential processes, might just mirror integration processes, meaning that as long as the sentence does not contradict the context, readers maintain a fast reading pace (see Gygax et al., 2007 for a more complete argumentation). Table 3 shows an example of the control condition.

The results of the control condition were very similar (i.e., congruence effect) to the ones found in the emotion label condition, but much smaller than the difference found in the behavioral condition, hinting at the idea that emotion labels were not necessarily included in readers' mental representations of emotions, and that some behavioral information was likely included in readers' mental representations. Gygax et al. (2007) further suggested that such information was connected to what could be referred to as an emotion construct. In essence, readers construct a representation foundation, formed of stereotypical, or common information (i.e., behavioral reaction) associated with the emotion realm. This last point is particularly important, as Gygax (2010) showed that such a behavioral inference was not to be mistaken with *any*

behavioral inference, independent of emotional content. They showed that although readers do generate behavioral inferences such as *picking up* after the sentence *John saw a penny on the floor*, they still showed higher congruent vs. incongruent effects in the emotion behavioral condition.

TABLE 3. *Examples of control narratives used in Gygax et al. (2007) and in this experiment. In the first narrative, the second sentence is the congruent neutral target sentence and in the second narrative, the second sentence is the incongruent neutral target sentence.*

Narrative 1: Neutral matching
Georges was writing and preparing for a conference in the East. *He wanted to make the most out of his trip*. He therefore planned several visits to his friends and to the people he knew on the way. He was taking his time to prepare for the trip and had been preparing since spring.
Narrative 2: Neutral mismatching
Cindy had just finished work and was going to her gym. *She thought that going to the gym was individualistic and preferred volleyball*. But after a knee injury, she could not play volleyball anymore. After changing, she entered the gym, which was empty and dark. That's strange, she thought as she was warming up.

In all, these results suggest that (a) readers do infer emotional information during reading, but (b) the components included in readers' mental models are only a part of a more complex emotion construct. Given this idea of complexity, it seems reasonable to assume that there might be individual differences that may affect the construction of more elaborate emotional inferences. In the present chapter, we tested this idea by specifically focusing on factors that could lead readers to form a more complex and abstract representation of emotions. Specifically, we attempted to identify three factors that may affect the elaboration of complex representations of emotions: (a) *simulation,* (b) *empathy* and (c) *processing limitations* (i.e., working memory). The first two, although based on different constructs (e.g., Tan, 1994), are directly associated with the possible ways people understand emotions, and the last one is related to more general cognitive functions. We do not have any strong evidence to assume interactions between these factors. For example, to our knowledge, the link between empathy and

working memory has been quite difficult to establish (e.g., Hansen, 2011). We therefore only present specific predictions as to their respective effects on emotional inferences.

Simulation and empathy

In this chapter, we embrace the idea, introduced by Oatley (1994), that through simulation (to differentiate from *empathy,* as discussed later), readers identify with the characters and dynamically adopt their goals and actions through their own planning process. This is a creative process by which readers map their own emotional responses onto those of the characters. It also mirrors Goldie's (1999) suggestion that people can understand emotion through *in-his-shoes* imagining, projecting their own beliefs and thoughts onto the character.

Simulation processes have been shown to be relevant in psycholinguistics, as the way individuals perceive real-world situations may have a large effect on word interpretation (Johnson-Laird, 1983). Situation models may hence be defined as experiential (perception and action) simulations of described situations (Barsalou, 1999a; Zwaan, 2004). Recent empirical evidence converges in suggesting that comprehenders can be viewed as *immersed experiencers*: readers experience information as if they were participating in the activity described (Zwaan, 1999a, 1999b, 2004; Zwaan & Rapp, 2006).

We believe that forcing an *experiential way* of reading may reinforce the behavioral component of the emotional inference generated during reading. More specifically, we expect the congruency difference (i.e., congruent faster than incongruent) between the emotional and the behavioral component conditions found in Gygax et al. (2007) to be more pronounced under simulation enforcement than under no specific simulation instructions. To evaluate this issue, we enforced readers in simulation processes by giving participants explicit instructions to simulate the narratives, i.e., to put themselves in the protagonist's shoes.

However, if we believe that enforced simulation processes could result in a more pronounced representation of behavioral information, empathic readers may construct complex representations of emotions including more specific emotional labels, regardless of simulation processes.

Tan (1994) suggested that through empathy, which does not require the readers to share similar feelings as the protagonist (i.e., which they do when simulating), readers easily understand and imagine the main protagonist's emotional status. If, according to Goldie (1999), readers can maintain a certain observer's position when involved in empathic processes, they still anticipate how the main protagonist is going to behave and how he or she is going to feel. Some researchers on emotional inferences have strongly suggested that empathy was an important factor in the representation of emotions during reading (e.g., Komeda & Kusumi, 2006). More empathic readers may therefore build complex representations of emotions. Again, by *complex,* we essentially mean that the mental models built by readers incorporate more elements of the emotion construct (i.e., not just behavioral elements) the sum of which may even activate specific emotional labels. If empathy has a role in the complexity of readers' mental representation of the main protagonist's emotional status, we expect that a measure of empathy (e.g., Interpersonal Reactivity Index; Davis, 1980, 1983) should enable us to associate different levels of empathy with differences in the complexity of emotional inferences. In essence, compared to the low empathic readers, we expect the more empathic ones to show an increased congruency effect in the emotion condition (i.e., more specifically emotion label inference) even to the extent of resembling the strong congruency effect in the behavioral condition.

Inherently, however, the very notion of disparity in the elaboration of mental models also raises issues of processing capacities, independent, or in conjunction with the empathic or simulation processes that readers may trigger.

Processing limitations: Working memory capacities

Although this issue was never explicitly explored, the unspecific nature of emotional inferences suggested by Gygax and colleagues (2003, 2004, and to a certain extent 2007) could have been an artifact of readers' limited working memory capacity. This assumption relies on the critical idea that the mental representation of a text is partly computed and stored in working memory (Just & Carpenter, 1992). In fact, Estevez and Calvo (2000) found that the time it took participants to generate elaborative inferences (i.e., inferences that are not essentially needed for coherence) depended on their working memory capacity. As readers with poor working memory capacity

encounter new sentences or group of sentences, they may not have enough time to generate the inferences attached to the preceding sentences. Accordingly, readers do not always generate these elaborative inferences. If they do so, the inferences might be neither strong nor specific. In the same line of thinking, van den Broek, Young, Tzeng, and Linderholm (1999) suggested that readers have a limited amount of possible activation available. This means that the number and specificity of possible inferences made while reading is limited. Even if readers make the appropriate inferences, the specificity of some previously activated inferences might still diminish as readers encounter new words, sentences or propositions.

If one considers that readers, as suggested earlier, engaging in an experiential way of reading may have an accentuated representation of behavioral elements, we could hypothesize that both general working memory and visuo-spatial working memory may play a role in the elaboration of these inferences, though a different one.

On the one hand, visuo-spatial working memory limitations may hinder a representation of behavioral elements, because both visuo-spatial working memory and the conceptual representation of sensory elements share the same sensory space (Vermeulen, Corneille & Niedenthal, 2008). This is of course based on the premise that behavioral elements of emotional inferences are sensory based. Interestingly, except for research focused on spatial text processing (Meneghetti, Gyselinck, Pazzaglia & De Beni, 2009), the impact of visuo-spatial working memory capacities on reading comprehension has not received much support (e.g., Oakhill, Yuill & Garnham, 2011). Still, we believe that to transpose themselves in the protagonist's shoes and experience each situation, readers might activate different visual and spatial processes relying on their visuo-spatial working memory capacities. Those with higher visuo-spatial working memory scores may therefore show an accentuated prominence of behavioral information, reflected in an even more pronounced congruency effect in the behavioral condition compare to the emotional one.

On the other hand, better general working memory scores may result in a more elaborate and complex representation of emotion (i.e., readers have more resources to process all emotion components), signaled by an increased congruency effect in the emotion condition (i.e., more specific emotion label).

Method

The present experiment was composed of three phases. The first phase comprised the main experiment (self-paced reading task), divided in two parts corresponding to the two different simulation conditions. In Part I, no specific instructions except that of reading the texts at a natural pace were given to the participants. In Part II, participants were asked to simulate, that is to *imagine themselves in the protagonist's shoes*. Each participant did both parts. The second phase was aimed at the evaluation of each participant's working memory capacities, both general and visuo-spatial working memory capacities. In the third and final phase, we evaluated each participant's level of empathy.

Participants

Eighty-six students (57 women and 29 men) from the University of Fribourg took part in this experiment for course credits. All participants were native French speakers. Due to unusually aberrant long reading times (i.e., several reading times above eight seconds for three- to four-words sentences), three participants were removed from the analyses. They obviously did not understand the instructions.

Materials

Experimental narratives

Twenty-four narratives, in French, from Gygax and Tapiero (2003) were used in this experiment. To construct these narratives, Gygax and Tapiero (2003) tried to distance themselves from the habitual way narratives are set up in this line of research. Most often, these narratives are created by having researchers initially write (intuitive) narratives that involve the main protagonist in some emotion triggering situation and then asking judges to agree on whether the narratives rightly encompass the emotional situations (e.g., Gernsbacher et al., 1992; de Vega et al., 1996). This procedure offers researchers a certain control over linguistic factors such as frequency or syntactic properties of the sentences they create, although the content of the narratives may not encompass the most complete, or salient description of emotions (or emotion

situations), at least not for the population under scrutiny. Instead of creating the narratives themselves, Gygax and Tapiero (2003) directly asked 30 students to each generate 24 narratives focused on specific given emotions. A categorical analysis of participants' responses enabled the authors to construct 24 stereotypical narratives using the most recurrent categories and the most salient wording. Although it meant that the control over certain linguistic factors was more difficult, the resulting narratives corresponded – semantically as well as in the particular wording of the constituent sentences – more accurately to the population under investigation (see Table 1 for an example narrative).

As others have done (e.g., Gernsbacher et al., 1992; Gygax et al., 2003, 2004), in our materials, each emotion (i.e., each narrative) was paired with it's opposite (*sad - happy*). Each narrative was present in four different versions, depending on the target sentence. The target sentence contained a matching emotion, a mismatching emotion (from its opposite narrative), a matching behavioral description or a mismatching behavioral description (from its opposite narrative). Eight lists were constructed, to ensure that each participant would see all conditions without (Part I) and with (Part II) simulation instructions, and that each passage was present in each simulation condition across the experiment. This means that in four lists, a particular passage appeared in Part I and in the other four lists in Part II. In each of these four lists, it appeared with a different target sentence. A participant was presented with one of the eight lists and saw a narrative only once.

Filler narratives

Twenty-four filler passages from Gygax et al. (2007) were also used. Out of the twenty-four filler narratives, twelve were used to test the neutral match/mismatch question mentioned earlier. Six of these narratives had a matching second sentence and six had a mismatching second sentence. In the latter case, the rest of the narrative was written so as to clarify the ambiguity raised by the presence of mismatching information (see Table 3 for examples of control narratives). We used the second sentence as the target sentence to ensure that the matching neutral information was unlikely to have been incorporated in readers' mental representations of the text (i.e., after just one sentence). A pilot study (in Gygax et al., 2007) ensured that the matching neutral

sentences were indeed neutral and that the mismatching sentences were considered mismatching given the context.

In total, forty-eight passages were presented to each participant. In each simulation part of the experiment, there were twelve experimental narratives, six *experimental* filler narratives and six normal filler narratives. For each participant, these were presented in a random order.

The narratives were presented on a Power Macintosh 4400 using Psyscope Software (Cohen, MacWhinney, Flatt, & Provost, 1993). Responses to the target sentences of each narrative were collected using a response button box attached to the computer, which permits millisecond accuracy.

Working memory tests

Two working memory tests were used in this study. First, participants' general working memory was evaluated with Daneman and Carpenter's (1980) French version of the Reading Span Test (RST) (Delaloye, Ludwig, Borella, Chicherio, & de Ribaupierre, 2007). Second, participants' visuo-spatial working memory was assessed using a standardized version of Corsi Block-Tapping Task (Kessels, van Zandvoort, Postma, Kappelle, & de Haan, 2000). In this task, the experimenter presents participants with a small platform composed of nine blocks. The experimenter then taps particular sequences of blocks, which participants have to reproduce. The initial sequence is composed of only two blocks. If participants reproduce correctly one of two sequences of the same length, they are presented with a sequence in which one block is added. If none is reproduced correctly, the number of correct blocks reproduced last is taken as a measure of participants' visuo-spatial working memory span. The total score is the product of the span and the number of correct trials.

Empathy scale

Each participant's level of empathy was assessed with a French version of the Interpersonal Reactivity Index (IRI)[2] of Davis (1980, 1983). Composed of twenty-eight items, this questionnaire measures four components of empathy: Empathic Concern, Perspective Taking, Fantasy and Personal Distress. The Perspective-Taking scale and

[2] Free translation, not validated, available from Stephanie Braun (sbraun@ulb.ac.be), ULB – Erasme Hospital, Brussels, Belgium.

the Fantasy scale represent the cognitive facet of empathy and respectively measure the tendency to adopt the psychological point of view of others and the tendency to transpose themselves into the feelings and actions of fictitious characters. The Empathic Concern scale and the Personal Distress scale represent the emotional facets of empathy and measure other-oriented and self-oriented feelings. The total score of empathy was calculated by summing the Empathic Concern, Perspective Taking and Fantasy scales, as proposed by Pulos, Elison and Lennon (2004). The higher the score, the more empathic a participant is.

Procedure

Each narrative was presented one sentence at a time. As in Gygax et al. (2007), participants were instructed to read each sentence at a normal reading speed, as if they were at home, reading a magazine. They were asked to press the *yes* button when they finished reading a sentence, resulting in the next sentence appearing on the screen after 500 milliseconds. To make sure that participants read the narrative carefully, some narratives (n = 16) were followed by a question related to the text. Participants answered the question by pressing either the *yes* or *no* button. After the presentation of a passage, participants were prompted with the message *Are you ready?* followed by the next passage. Before the actual experiment, participants underwent a practice session made up of three passages.

After completion of Part I (no specific instructions to simulate), participants were asked to rate, on an 8-point scale (*0 = no simulation at all* to *7 = totally engaged in a simulation process*), the extent to which they tried to *naturally* simulate the narratives. After completing the scale, they were informed that similar narratives would appear on the screen, but this time, they were explicitly asked to mentally simulate the situations presented to them. More specifically, we told them to make an effort to put themselves in the protagonist's shoes, as if they were living the narrative from the inside. At the end of Part II, participants filled the 8-points scale again, to ensure that participants complied with the instructions.

The order *no instructions to simulate* → *instructions to simulate* was fixed, as the reversed order would have made little sense, as any resulting lack of effect would be imputable to a spill-over effect. Conversely, a fixed order has the disadvantage of confounding a possible order effect by which a particular condition might be altered

whereas another one might not. To ensure that this would not be the case, we examined Gygax et al.'s (2007) data by splitting them into two parts. As shown in Figure 1, both parts showed the exact same pattern in terms of the central conditions (Emotion and Behavior) and in terms of the differences in (residual) reading times between congruent and incongruent information, ruling out any confounding order effect that have had targeted the central conditions differently. Participants' working memory capacities were then evaluated with the RST followed by the Corsi Test. Finally, participants filled in the IRI questionnaire.

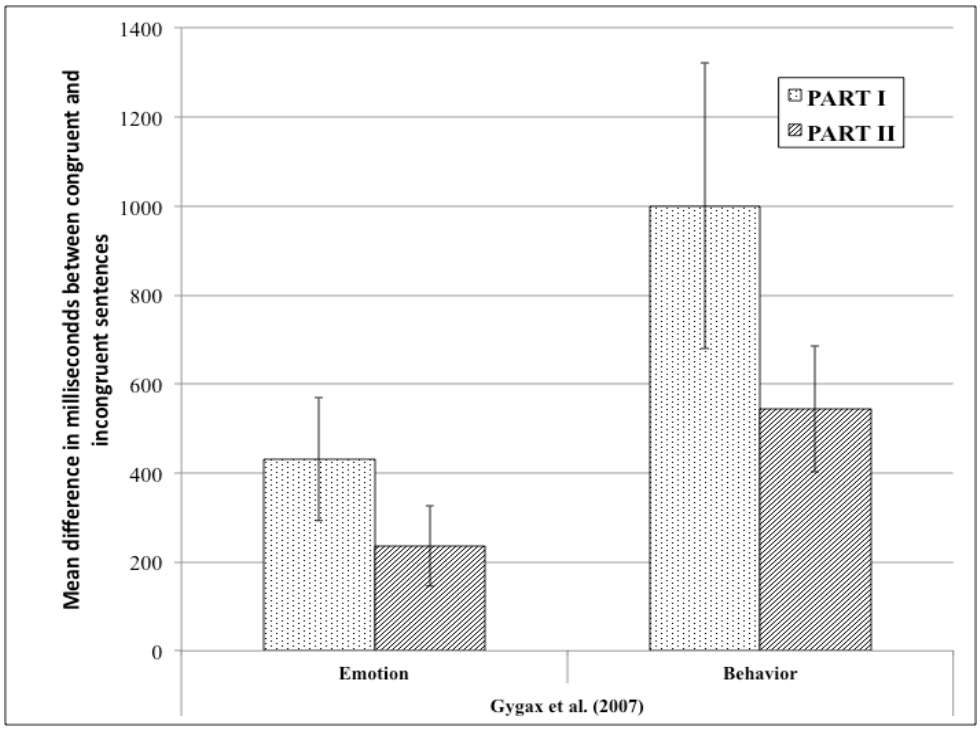

FIGURE 1. *Mean differences in reading times between congruent and incongruent Emotion and Behavior information in Gygax et al. (2007). The slight decrease in reading time differences between Part I and Part II is independent of the conditions under investigation and reflects a certain habituation to the task by the participants.*

Results

Data transformation

Reading times collected in the self-paced reading task were first transformed in order to allow for individual differences in *reading speed* as well as to allow for the fact that all target sentences were not in the same *position* in the text nor of the same *length*. The transformation procedure was inspired by Trueswell, Tanenhaus, and Garnsey (1994) and Gygax et al. (2007). For each participant, a regression equation of time (i.e., reading time) against length (i.e., number of characters in the target sentence) was produced, separately for the 2nd (control condition) and 5th (experimental conditions) sentences. Residual reading times were calculated by subtracting the actual reading times from the reading times predicted by the regression equation. A negative residual time means that the reading time was longer than expected. Figure 2 shows the residual reading times for the different conditions (without considering individual differences). Two emotion target sentences and two behavior target sentences were removed from the analyses as they showed an awkward reverse congruence effect, hinting that their content was considered highly ambiguous by our participants.

We present the analyses in two parts. We initially present a first model that is comparable to Gygax et al. (2007). In essence, as Gygax et al. (2007) did not account for individual differences, we wanted to match our data to theirs first. We then present analyses that take individual differences into account. As this experiment was exclusively concerned with individual differences, all analyses were conducted considering participants as random factor. In all analysis sections, when the main or interaction effects are not reported, it means that they were not significant.

Inference elaboration – First model

A general 2 (Simulation: With vs. Without Simulation) X 3 (Nature: Emotion vs. Behavior vs. Control) X 2 (Congruence: Congruent vs. Incongruent) repeated measures ANOVA on the residual reading times showed a main effect of Congruence, $F(1, 82) = 105.37$, $p < .001$, congruent sentences being read on average 450 milliseconds faster than incongruent ones, and an interaction effect of Nature by Congruence, $F(2, 164) = 7.52$, $p < .001$. There was no other main or interaction effect. Our simulation manipulation did not produce any of the expected effects, even if the participants

reported having simulated much more in Part II (M = 5.51) than in Part I (M = 2.96), $t(80) = 13.62, p < .01$.

We explored the source of the Nature by Congruence interaction effect - the main focus of Gygax et al. (2007) - in separate follow-up ANOVAs. In all follow-up analyses, F-values were calculated using the original model error term (Kirk, 1995). Degrees of freedom were adapted accordingly. All p-values were also converted to account for multiple comparisons (i.e., Bonferroni corrections). In the first follow-up we compared the emotion and behavior conditions in terms of congruency.

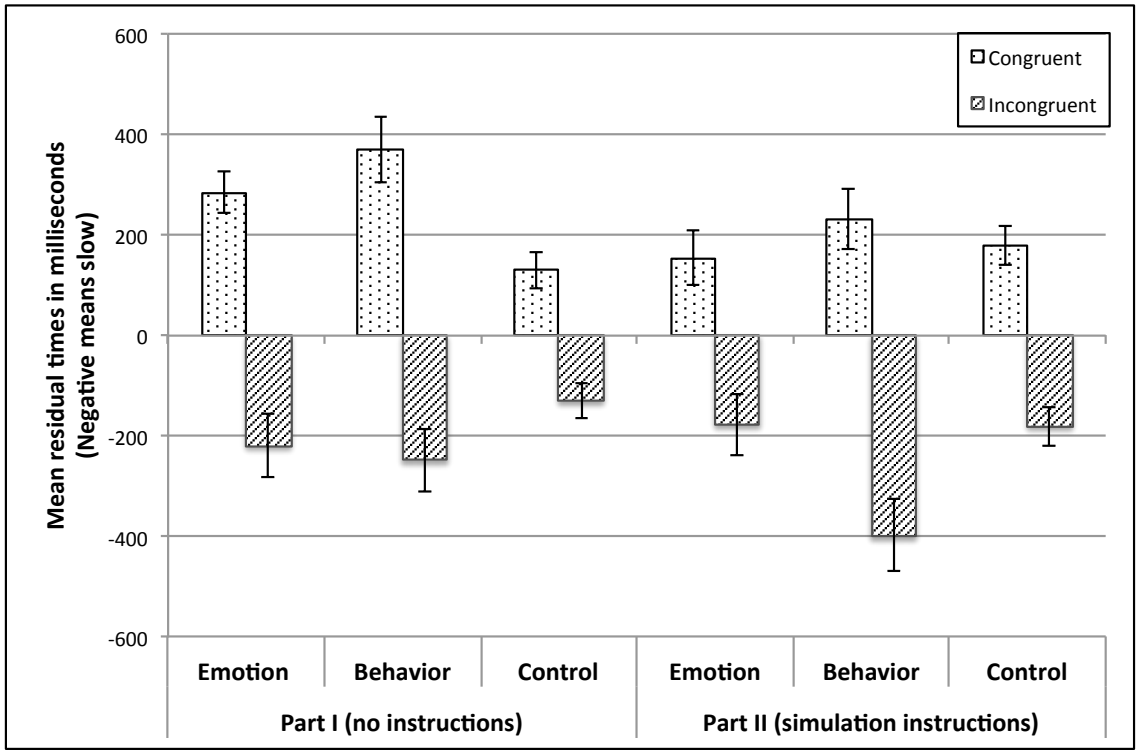

FIGURE 2. *Mean residual times in each emotion content and simulation condition in Experiment 1, without considering individual differences. Negative residuals mean slower reading times (as predicted by each participant's regression of time by number of letters).*

For this purpose, we examined the interaction of Congruence with respect to two of the three values of the Nature variable. A 2 (Nature: Emotion vs. Behavior) X 2 (Congruence: Congruent vs. Incongruent) repeated measure ANOVA showed a significant interaction effect, $F(1, 164) = 6.30, p < .017$. A second follow-up ANOVA showed a significant 2 (Nature: Control vs. Behavior) X 2 (Congruence: Congruent vs.

Incongruent) interaction effect, $F(1, 164) = 14.56$, $p < .017$. Finally, there was no 2 (Nature: Emotion vs. Control) X 2 (Congruence: Congruent vs. Incongruent) interaction effect, $F(1, 164) = 1.70$, $p = .19$. This means, as shown in Figure 2, that the difference between reading times of congruent and incongruent sentences was greater in the behavior condition (624 ms) than in the Control (310 ms) and the Emotion condition (416 ms). These results perfectly matched those found by Gygax et al. (2007). This is true even to the extent of the slight numerical difference between the emotion and the control condition (which will be most apparent when examining the visuo-spatial individual differences). No further post hoc analyses were performed on each condition's simple congruence effect. Essentially, they would all be significant. The crucial comparison is between the experimental conditions' congruence effects and the control condition's congruence effect, the latter representing a simple context yet non-inferential effect (as stressed by Gygax et al., 2007).

Further analyses were done in order to reveal any influence of participants' characteristics on emotional inference elaboration. Since we did not expect them to interact in the influence that they may have on emotional inference elaboration, each variable related to participants' characteristics was added individually to the main 2 (Simulation: With vs. Without Simulation) X 3 (Nature: Emotion vs. Behavior vs. Control) X 2 (Congruence: Congruent vs. Incongruent) analysis. Different models were tested, each by running separate ANOVAs.

Inference elaboration - Individual differences

To investigate the role of individual differences, we explored the data by conducting hierarchical clusters on each of our measures using Ward's Method (see Table 4 for a summary of all individual differences scores). This method enabled us to classify participants in a meaningful way - more than with a manual split at least, where participants have to be shifted relatively subjectively to one of the group -, as it maximizes similarity of members of a group according to the scores of each individual on a particular scale. Ward's method is distinct from all other clustering methods because it uses an analysis of variance approach to evaluate the distances between the clusters. Basically, a score is entered into a cluster if it results in a minimal increase of the error sum of squares. In sum, Ward's method minimizes the total within-cluster variance whilst maximizing the between-cluster variance (Ward, 1963). Subsequent

analyses were tested with two groups, except if stated otherwise. All cluster analyses are briefly presented, but only significant impact to the initial 2 (Simulation) X 3 (Nature) X 2 (Congruence) analysis are presented.

TABLE 4. *Mean scores (and standard deviations in brackets) of each individual differences score, after splitting our sample using the Ward method. In our sample, RST scores ranged from .25 to .94 (the total score is the product of the span and the number of correct trials), Corsi scores from 24 to 104 and IRI scores from 33 to 95.*

	High Group	Low Group	Mean
General working memory	.76 (.1)	.46 (.1)	.61 (.09)
Visuo-spatial memory	78 (9.5)	49 (11.4)	63 (10.5)
Empathy	80 (6.3)	62 (8.0)	71 (7.1)

General working memory

The cluster analysis on the proportion of RST correct items revealed two uneven groups, reflecting a skewed distribution (supported by a -.70 skewness value): a higher RST group (n = 63) with a mean of .76 (SD = .09) and a lower group (n = 20) with a mean of .46 (SD = .09). The two groups were significantly different (Ws = 210, z = -6.77, $p < .001$). When introduced in the initial model as an independent variable, no effect other than those found without the variable was apparent. Due to its particular distribution and uneven sample sizes, we extracted the lower group participants and conducted another classification procedure. If this latter did improve sample sizes, with a higher RST group (n = 31) with a mean of .84 (SD = .04) and a lower group (n = 32) with a mean of .68 (SD = .05), both group were quite similar (.3 SD under and .6 SD above the standard score). Therefore, and although significantly different, $t(61) = 13.76$, $p < .001$, their inclusion to the model did not affect it[3].

[3] To ensure that the null results were not due to our categorization procedure, we also performed extra analyses adopting different strategies: (a) we used three clusters and (b) we split the data into quartiles and compared high and low quartiles. None of these bore any consequence on the analyses presented in this chapter. These different strategies were also adopted with other variables when relevant. For the Empathy scale, we also tested each of its four sub-components separately, but nothing came of these different analyses. We also ensured that the null results were not due to a questionable reliability of the IRI sub-scales. This was not the case, all Cronbach's α being higher than .7.

Visuo-spatial working memory

The cluster analysis on total scores revealed a high Corsi group (n = 33) with a mean of 78.61 (SD = 9.50) and a low Corsi group (n = 50) with a mean of 49.14 (SD = 11.43) bearing significant difference (W_s = 1275, z = -7.74, $p < .001$). When introduced in the initial model as an independent variable, there was an additional 2 (Simulation) X 3 (Nature) X 2 (Congruence) X 2 (Corsi) interaction effect, $F(2, 162) = 4.59$, $p < .05$ (see Figure 3).

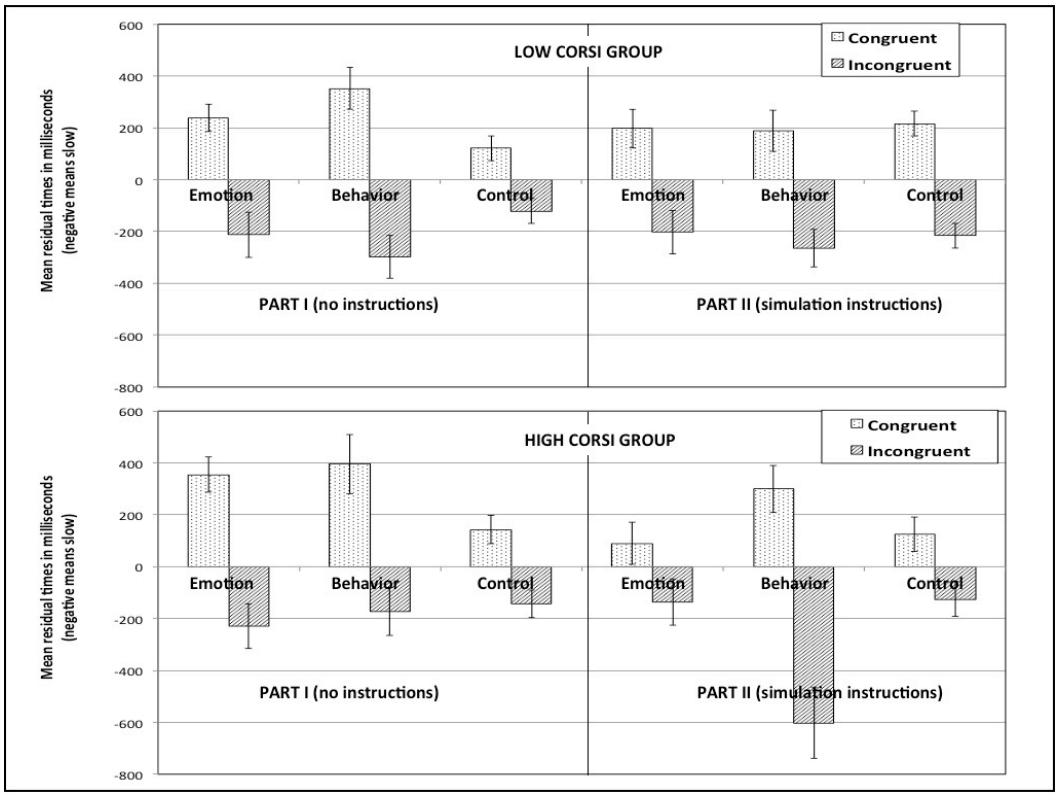

FIGURE 3. *Mean residual times in each emotion content and simulation condition as a function of Corsi scores. Negative residuals mean slower reading times (as predicted by each participant's regression of time by number of letters).*

Interestingly, when conducting two follow-up ANOVAs to examine individually the two Corsi groups, the low Corsi group was only affected by congruence, as shown by a significant Congruence effect, $F(1, 81) = 59.36$, $p < .025$, but no other main nor interaction effect. On the other hand, and compared to the first model analysis, the high Corsi group showed an additional Simulation by Nature by Congruence interaction effect, $F(2, 162) = 4.27$, $p < .025$. When examining this interaction more closely in a

follow-up ANOVA, there was a Nature by Congruence effect only significant in Part II, $F(2, 162) = 8.64$, $p < .025$, qualified by a Nature (Behavior vs. Emotion) by Congruence interaction effect, $F(1, 162) = 13.41$, $p < .017$, and a Nature (Behavior vs. Control) by Congruence interaction effect, $F(1, 162) = 12.51$, $p < .017$, but no Nature (Emotion vs. Control) by Congruence interaction effect.

The Simulation manipulation seems to have affected the two groups differently. If the low Corsi group seems to have been mainly affected by congruence, independent of the conditions, the high Corsi group seems to have been influenced by the manipulation in our central conditions (Emotion and Behavior). Although no nature by congruence effect was apparent in the first part of the experiment, it changed in the second part, the congruence effect being much bigger in the Behavior condition in the second Part (901 ms) than in the first Part (568 ms), and than in the Emotion condition (227 ms). This is in line with the idea that situation models include perceptual components (Glenberg, 1999; Glenberg, Meyer, & Lindem, 1987; Johnson-Laird, 1983) and that the ability to integrate elaborative and predictive inferences during reading depends upon visuo-spatial resources (Fincher-Kiefer, 2001; Fincher-Kiefer & D'Agostino, 2004). Readers' situation models are perceptual in nature, and readers build them on the basis of their own perceptual analogous experiences. As in our experiment, when simulating, high visuo-spatial span participants may have relied on a greater capacity to embody themselves in the narratives, thus leading them to a stronger representation of behavioral elements.

Still, note that in the Emotion condition, the congruence effect actually decreased from Part I to Part II (i.e., from 584 to 227 ms) for the high Corsi group. In fact, the source of this effect is mainly in Part I, where the Emotion congruence effect is similar to the Behavior one. This might explain the general trend of a slight global numerical difference between the Emotion and the Control condition.

Empathy level

The cluster analysis revealed two groups: a higher Empathy group ($n = 45$) with a mean of 80.84 ($SD = 6.30$) and a lower group ($n = 38$) with a mean of 62.05 ($SD = 7.96$). Although both quite high, hinting as for the RST at a skewed distribution (supported by a -.51 skewness value), they were significantly different ($W_s = 741$, $z = -7.82$, $p < .001$). When introduced in the initial model as an independent variable and

contrary to our expectations, no effect other than those found without the variable was apparent. As for the RST measure, different splitting strategies were adopted, none bearing any different pattern of results.

Discussion

Gygax et al. (2007) found evidence that when reading narratives about a protagonist in an emotion eliciting situation, readers tend to build a representation of the main protagonist's emotional response which favors behavioral information (over emotions per se). In this experiment, we wanted to further their findings by examining circumstances that would intensify or reduce this process. We were particularly interested in individual differences that could account for the results found in Gygax et al. (2007). More specifically, we investigated whether the elaboration of emotional inferences was associated to particular *identification* processes, as defined by simulation or empathy, or to processing limitations, as defined by different types of working memory limitations.

If our results supported the idea that readers were in general more likely to include behavioral information than emotions per se in their mental representations of the text (as previously shown), we only found limited contributions from the different factors under scrutiny. In other words, the processes identified by Gygax et al. (2007) may well be stable and generalizable across a wide range of readers and reading strategies (e.g., simulation). If null effects are often delicate to interpret, we would still like to propose a discussion of the underlying processes that might explain the general lack of influence of these factors. This discussion may set the very foundations of future investigations on emotional inferences and may direct researchers interested in the matter towards most relevant issues.

Before entering into the heart of this discussion, it is important to present the one factor that seemed to explain part of the variance of our *simulation* manipulation. More specifically, if our simulation manipulation did not show the expected general pattern, and this will be discussed later, our measure of visuo-spatial working memory showed that this general trend was not stable across participants with different visuo-spatial working memory capacities. Most importantly, the behavioral component of high visuo-spatial span participants' mental model seemed to have benefited from our simulation

manipulation, whereas this was not the case for low visuo-spatial span participants. When asked to simulate, high visuo-spatial span participants showed increased sensitivity to target sentences containing behavioral elements. This supports the idea that simulating text increases the likelihood of including behavioral elements in readers' mental model, even if this only seems to be true for high visuo-spatial span readers. It also supports the broader notion that visuo-spatial capacities are crucial when generating elaborative inferences (e.g., Fincher-Kiefer, 2001; Fincher-Kiefer & D'Agostino, 2004) and that, at least for some participants, when compelled to be actors in the text (i.e., in our study through a simulation manipulation), perceptual and motor information may show access and encoding facilitation (Ditman, Brunyé, Mahoney, & Taylor, 2010). Note that the present data cannot truly disentangle the detailed processes that influence visuo-spatial working memory, but at least they suggest that visuo-spatial working memory is a serious candidate when examining processes at stake in emotional inferences and reading comprehension.

Even though low- and high- visuo-spatial participants showed differential simulation effects, the main Nature by Congruence effect remained, suggesting that low visuo-spatial span participants still favored behavioral information to emotions per se (i.e., regardless of simulation). This strongly suggests that readers transpose themselves in the protagonist's shoes during reading, even when no specific instructions to do so are given to them, leading to a stronger behavioral representation of the situation. In a sense, this is not surprising, considering that to understand a text and the main protagonist's mental states, readers automatically lay upon their own psycho-physiological resources to imagine themselves living the same narrative and performing the same actions as the protagonist (e.g., Glenberg & Kaschak, 2002; Goldman, 2002; Mouilso, Glenberg, & Havas, 2007; Zwaan, 2004; Zwaan & Taylor, 2006). By simulating, readers substitute their own feelings for those of the protagonist (Goldman, 2005) and can access knowledge of what is described in the text and elaborate a mental representation based on this knowledge. Niedenthal, Winkielman, Mondillon, and Vermeulen (2009) and Havas, Glenberg, and Rinck (2007) further argued that the process of simulation is necessary to access emotional meaning and elaborate mental representations of emotional texts.

In some respects, one could argue that the general lack of effect of our simulation manipulation reflects a ceiling effect, all participants being more or less

already engaged in simulation processes. This is compared with research suggesting that even passive reading of action-related words already activates motor- and premotor-associated brain regions (e.g., Hauk, Johnsrude & Pulvermüller, 2004), implying rather spontaneous simulation processes.

A ceiling effect might also exist for both our empathy and our general working memory measures. Low- and high-empathy participants, as well as low- and high-general working memory participants showed all relatively high scores, at least compared to standards scores. In addition to this, empathy might be connected to simulation processes, some authors arguing that empathy and simulation are difficult to disentangle (Decety & Grèzes, 2006; Goldman, 2005; Preston & de Waal, 2002). If our results suggest that working memory and empathy may not be accountable for the relative lack of elaboration, it should be stressed that the groups of participants were quite similar.

These probable ceiling effects raise two crucial issues. First, they raise the pertinence of a constant reliance on university students as participants. Some measures may not be most appropriate with regard to undergraduate students' characteristics. Second, and on a more conceptual level, they do support the fact that complex elaboration of emotions might not be present when inferring emotions, even for participants with relative high levels of empathy, simulation processes and working memory. According to Gygax et al. (2007), the apparent dominance of behavioral information in readers' mental models can be explained by different factors, all based on the perspective that behavioral elements are more easily activated and included in readers' mental models. First, they argued that readers do not need to construct elaborate and complex representations to attain a reasonable understanding of the text. This is in line with the idea found in research on text comprehension that *underspecified representations* of text are often perfectly acceptable (e.g., Sanford & Graesser, 2006), and that *good enough representations* (Ferreira, Bailey, & Ferraro, 2002) may in the long term be beneficial in terms of cognitive load. In essence, it might even be counterproductive for readers to automatically integrate elaborate and complex representations of the main protagonist's emotional status, as any potential shifts may involve a large amount of cognitive processing. Second, if one considers the main function of emotions to prepare the body for the appropriate actions (Frijda, 1986; Scherer, 1982), readers, through simulation, will most likely activate neural areas that

are implicated in actions associated with the described emotions (Havas et al., 2007). Such an activation, in turn, will lead readers to the construction of mental representations mostly composed of behavioral characteristics.

Although these two explanations coincide with our results, we still believe that some situations may elicit more elaborate representations of emotions. If behavioral elements are well-suited candidates for the representation of the protagonist's emotional status, as explained above, there may still be textual elements that elicit elaborate emotions. These textual elements have in fact been difficult to explore, as the narratives used in the present study, as well as in studies of others, although more or less ecological, were never structured in a consistent manner regarding the quality and quantity of emotional information they conveyed. Typically, Scherer and his colleagues (e.g., 1984, 2005) identified different emotion sub-components which combination is necessary to produce specific emotional responses. In this experiment, as well as in most research on emotional inferences, we may not have paid enough attention to the emotion components that the passages contained. The present results may be, in terms of the lack of specific emotional inferences, the direct result of such an issue, which may also have impacted upon the relatively moderate effects of our individual differences. We are currently investigating this very issue in our laboratory.

On a different yet related methodological note, the present experiment, as others before, was based on the habitual *match vs. mismatch* or *congruent vs. incongruent* paradigm. Fundamentally, this could be the cause of some of the null effects found in this experiment for two main reasons. First of all, in case of a *match vs. mismatch* effect, it is always difficult to know if the effect is mainly associated with the incongruent information (i.e., as you often find in EEG studies on the N400, for example) or with the congruent one. Second, in self-paced reading experiments, *match vs. mismatch* effects are often quite important in terms of milliseconds (e.g., 200 milliseconds minimum), suggesting that the paradigm may not be sensitive to small changes of processes, as they may have appeared in this experiment.

Finally, we cannot exclude the fact that the null effects reported here result from a lack of statistical power. Our results would benefit from a replication with a greater sample, as the differences between the conditions examined in this experiment may have been too subtle to be demonstrated given the relative small number of participants

(still higher than most of the studies on the topic) and the different variables under observation.

In conclusion, this experiment confirmed previous findings (e.g., Gygax, 2010) on the unspecific nature of emotional inferences and on the prevalence of behavioral elements in readers' mental models of emotions. It also showed that visuo-spatial memory capacities might influence such predominance, but that general working memory, empathy capacities and reading preference were not of prime importance in those inferential processes.

Experiment 2:

Individual differences and time to elaborate

In Experiment 1 we presented evidence supporting Gygax et al.'s (2007) findings that readers were more inclined to construct representations of emotions composed of behavioral elements than of emotion labels per se. Although we expected some external variables to account for the lack of specificity of emotion inferences, most of our results tended to show that variables mediate behavioral inferences more than they do so for specific emotion inferences.

We expected that working memory limitations, as measured by the RST, would at least explain a higher reliance to behavioral concepts, those being more easily activated and integrated in readers' mental models. This was not the case. On the other hand, visuo-spatial working memory did play a role in our measures of inferential processes, high-span visuo-spatial working memory participants showing heightened sensitivity to behavioral information when asked to simulate. These results suggest that working memory may not be accountable for the relative lack of elaboration, as suggested in earlier research. On the contrary, some elements pertinent to visuo-spatial working memory may even facilitate behavioral representations, especially when participants engage in a simulation process during reading.

Gygax et al. (2007) raised the issue that behavioral elements were easily and rapidly accessible, hence their inclusion in readers' mental models was given preference to more elaborate elements such as emotions. One aspect inherent to such a concept is the time participants have to elaborate more complex representations. If our experiment was a self-paced reading experiment, we did encourage participants to read the passages at a normal pace, as if they were reading a magazine, and time between sentences was always at 500 milliseconds. Estevez and Calvo (2000) demonstrated that predictive inferences take longer to elaborate and even longer for low memory span participants (i.e., in their experiment at least 550 milliseconds after the crucial information). It may be the case that participants in our experiment were forced to activate easily retrievable information by the rather short interval between the presentations of our sentences. We therefore decided to conduct a second experiment by increasing the time intervals between sentences to 1000 ms to evaluate whether the results of Experiment 1 were dependent upon elaboration time.

Method

Participants

Eighty-nine (16 men and 73 women) from the University of Lausanne participated in this experiment. All participants were native French speakers.

Materials and procedure

The same materials and procedure as in Experiment 1 were used in this experiment. The only difference between the two experiments consisted of time between each sentence in the self-paced reading task. In this experiment, the time between the two sentences was extended to 1000 milliseconds.

Results

Before conducting the analyses, reading times were transformed to residual reading times as in Experiment 1. Residual reading times that were more than 2.5 *SD* above or below each participant's overall mean were replaced in the analyses by the cut-off values (2.4%).

Inference elaboration - First model

As in Experiment 1, a general 2 (Simulation: With vs. Without Simulation) X 3 (Nature: Emotion vs. Behavior vs. Control) X 2 (Congruence: Congruent vs. Incongruent) repeated measures ANOVA on the residual reading times showed a main effect of Nature, $F(2, 176) = 12.57$, $p < .001$, the emotion sentences being read on average 85 milliseconds slower than the control sentences and the behavior sentences being read on average 150 milliseconds slower than control sentences and a main effect of Congruence $F(1, 88) = 81.66$, $p < .001$, reflecting that readers were on average 320 milliseconds slower to read the incongruent target sentences compared to the congruent sentences. Figure 4 shows the residual reading times for the different conditions (without considering individual differences).

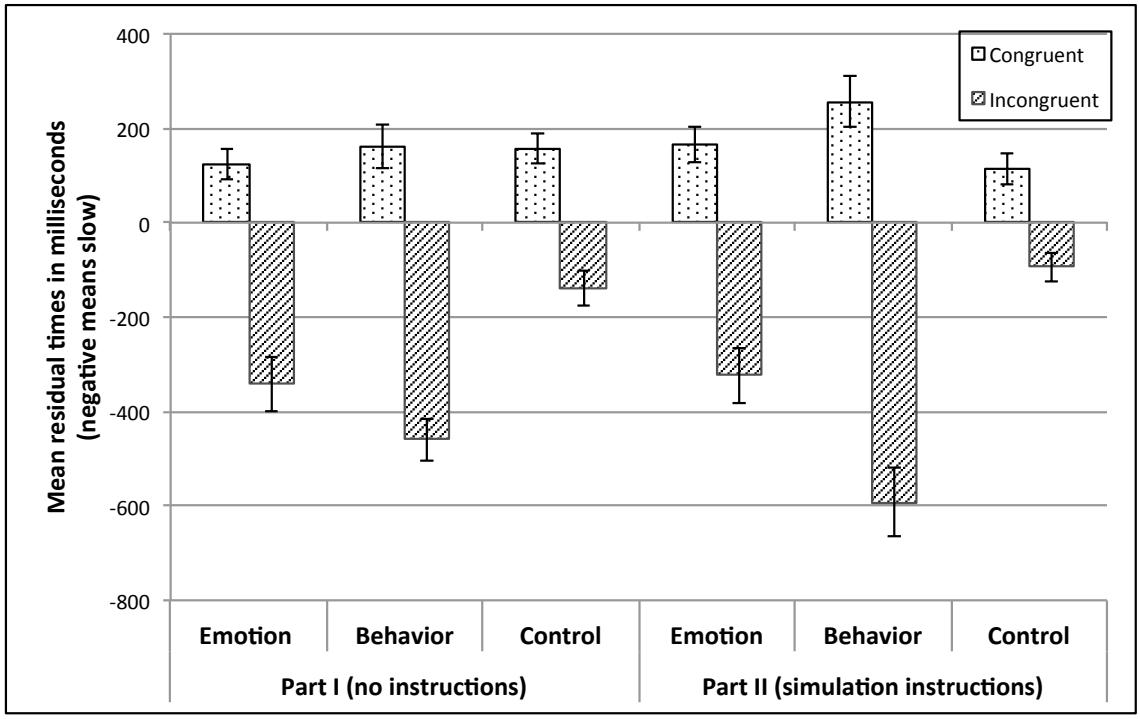

FIGURE 4. *Mean residual times in each emotion content and simulation condition, without considering individual differences in Experiment 2. Negative residuals mean slower reading times (as predicted by each participant's regression of time by number of letters).*

As in Experiment 1, these two main effects were qualified by a Nature by Congruence interaction effect, $F(2, 176) = 95.55$, $p < .001$.

We investigated the Nature by Congruence interaction effect by running separate follow-up ANOVAs, calculating the F-values using the original error tem and with adapted degrees of freedom. We also used Bonferroni correction in order to account for multiple comparisons. Contrary to the results found in Experiment 1, there was no 2 (Nature: Emotion vs. Behavior) X 2 (Congruence: Congruent vs. Incongruent) interaction effect, $F(1,176) = 5.12$, $p = .025$. However, the 2 (Nature: Emotion vs. Control) X 2 (Congruence: Congruent vs. Incongruent) interaction effect was significant, $F(1,176) = 19.69$, $p < .001$, as was the 2 (Nature: Behavior vs. Control) X 2 (Congruence: Congruent vs. Incongruent) interaction effect, $F(1,176) = 44.92$, $p < .001$. These results mean that contrary to what was previously found, participants did not show a preference for the behavioral information associated to emotion but were as likely to integrate an emotion label or behavioral information related to emotion in their mental representations of the text.

In order to reveal an influence of Elaboration Time, we conducted a general 2 (Elaboration Time: 500 ms (Experiment 1) vs. 1000 ms (this chapter)) X 2 (Simulation: Without vs. With Simulation) X 3 (Nature: Emotion vs. Behavior vs. Control) X 2 (Congruence: Congruent vs. Incongruent) mixed ANOVA, with Simulation, Nature and Congruence as within-factors and Elaboration Time as a between-factor which showed a main effect of Nature, $F(2, 340) = 4.21$, $p = .02$, a main effect of Congruence, $F(2, 340) = 253.95$, $p < .001$, and a Nature by Congruence interaction effect, $F(2, 340) = 30.72$, $p < .001$, but no main or interaction effect implying Elaboration Time, indicating that readers' preference for behavioral components inferences was not influenced by elaboration time. For this reason, analyses focusing on individual differences were done only on this experiment's data, without including the data presented in Experiment 1.

Inference Elaboration - Individual differences

General working memory

The cluster analysis on the proportion of RST correct items revealed two uneven groups: a higher RST group ($n = 53$) with a mean of .77 ($SD = .07$) and a lower group ($n = 35$) with a mean of .53 ($SD = .10$). The two groups were significantly different ($W_s = 630$, $z = -8.01$, $p < .001$). As in Experiment 1, when introduced in the initial model as an independent variable, no effect other than those found without the variable was apparent.

Visuo-spatial working memory

Two groups were determined by the cluster analysis on the Corsi total scores: a higher Corsi group ($n = 28$) with a mean of 75.21 ($SD = 7.39$) and a lower Corsi group ($n = 61$) with a mean of 48.13 ($SD = 11.82$). The two groups were significantly different ($W_s = 1891$, $z = -7.60$, $p < .001$) but contrary to the results found in Experiment 1, their inclusion in the initial model did not change the inference pattern.

Empathy level

A lower Empathy group ($n = 48$, $M = 64.73$, $SD = 4.12$) and a higher Empathy group ($n = 41$, $M = 50.56$, $SD = 5.58$) were revealed by the cluster analysis. These two groups were significantly different ($W_s = 861$, $z = -8.11$, $p < .001$). When introduced in

the initial model as an independent variable and contrary to our expectations, no effect other than those found without the variable was apparent.

Discussion

In this experiment, the time between the sentences was extended to 1000 milliseconds. We expected this manipulation to favor the elaboration of specific emotion inferences by allocating enough time to the readers to construct complex text representations. In addition and following Estevez and Calvo's (2000) results, low working memory participants were expected to benefit more from the extended time than high working memory participants.

The results obtained in this experiment support the idea that readers need time to reach specific emotion representations. The difference between emotional and behavioral sentences was not replicated in this experiment suggesting that more time to process the text may diminish the readers' preference to rely on core components of emotion when constructing emotion inferences. When enough time is available, readers seem to construct richer emotion inferences.

In this experiment, contrary to Experiment 1, our potentially mediating variables had very little effect on the inferential processes that we identified. It is tempting to suggest that the extended time between sentence presentations may have acted as an individual differences inhibitor. In this case, low visuo-spatial working memory span participants may have benefited from the greater elaboration time leading to a similar pattern to that of high-span participants.

However, it may also be the case that the extended time induced a non-natural reading situation leading to peculiar inferential patterns.

In all, even if the results presented here support the fact that under certain circumstances, readers show an equal tendency to include emotional and behavioral information in their mental representations of the protagonist's emotion, the specificity of the inferred emotion word is still not clear. This issue will be further developed in the following chapters.

4. Constructing Adequate Emotional Narratives to Investigate Emotion Inferences: Reconciling Emotion and Text Comprehension Research

In this chapter, we present and discuss different issues related to the materials and the methodology used so far when investigating emotion inferences during text comprehension. We argue that insufficient control over the very construct of emotions has been achieved in most, if not all, of the experimental narratives that have been used in previous studies. We also argue that the *match vs. mismatch* effect typically used in inference research may not be adequate to assess deeper processes involved when readers construct mental models. Consequently, we first advocate for a better method to elaborate relevant emotional narratives – based on emotion research – and, second, for a different approach to the match vs. mismatch method.

Reading comprehension and emotion inferences

When comprehending a text, readers elaborate a mental representation of the situation portrayed in the text. This mental representation is based on explicit elements described in the text and implicit elements deduced during reading through an inference process (Graesser, Singer, & Trabasso, 1994). As reading processes are quite fast and as readers have limited processing capacities regarding working memory, all possible inferences are not made online (i.e., *during* the reading), with some only being elaborated offline (Graesser, Millis, & Zwaan, 1997). Inferences can relate to different aspects of the text, such as spatial relationships, referents of nouns and pronouns, consequences of an event, or characters' emotion, the latter being the focus of this thesis. For example, when reading, *Sarah walked slowly from the nursing home to her place. She had trouble retaining her tears when thinking of her grandmother alone in her room* readers may draw different inferences, one of which could relate to Sarah's emotion (i.e., sadness). Different studies have shown that readers infer the main protagonist's emotional state during reading (e.g., de Vega, Leon, & Diaz, 1996; Gernsbacher, Goldsmith, & Robertson, 1992; Gernsbacher, Hallada, & Robertson, 1998), yet the specificity of these inferences have not received unanimous support (e.g., Gygax, Garnham, & Oakhill, 2004; Gygax, Oakhill, & Garnham, 2003).

Most of the research on inferences and consequently on emotion inferences has been based on the *match vs. mismatch* paradigm. For example, typically, small narratives intended to trigger an emotional inference are presented to readers. At a certain point in the narrative, an emotion label is presented, either matching or mismatching the intended emotion, and researchers are interested in the time it takes readers to process the sentence including the emotional label. This paradigm relies on the notion that the time to read the target sentence mirrors the closeness between the emotional target and the content of the reader's mental model. If a reader has previously inferred the information included in the target sentence, they will read this sentence faster than a sentence related to information not previously included in their mental model (Graesser et al., 1997).

Although the self-pace reading paradigm has been widely used in inference research, the process to which faster or slower reading times are really linked is still a matter of debate. Gernsbacher et al. (1992) pointed out that faster reading times might

not indicate that information has already been included in the reader's mental models but might indicate that this information is easily integrated into them. Similarly, Gygax, Tapiero, and Carruzzo (2007) differentiated the inference process from a context-integration process. They argued that faster reading times of the target sentences may indicate an inference process but may also be related to the fact that the presented information is consistent with the representation being elaborated, although it does not mirror a previously made inference. Consequently, when comparing the processing time of mismatching versus matching sentences, one can identify which information is closer to that contained in the readers' mental models but one cannot truly determine if the information contained in the matching sentences has already been inferred.

When investigating the specificity of emotion inferences, this limitation is of prime importance regarding the conclusions that may be drawn. For example, Gernsbacher et al. (1992) presented readers with target sentences containing a matching emotion (e.g., sad) or a mismatching emotion that was either of opposite (e.g., happy) or of same valence (e.g., shy) as the matching one. They showed that readers were faster to read the matching emotion sentences than the mismatching emotion sentences. According to these results, they concluded that readers include some emotional knowledge in their mental models of the text and that this emotional knowledge is more specific than valence. The specificity of such emotional knowledge was further investigated by Gygax et al. (2003, 2004), who decided to compare different matching emotion labels and, consequently, to investigate if readers constrain their representations of emotion so as to infer one emotion label (i.e., specific representations) or if their representations are more likely to match different related emotion labels (i.e., underspecified representation). In the first case, differences in reading times of target sentences containing a matching emotion (e.g., sad), a synonym emotion (e.g., depressed) or a similar emotion (e.g., miserable) should arise when confronted with emotional texts. This difference never occurred during online reading comprehension, even when readers were encouraged to constrain their representation (by using longer or ambiguous texts). Gygax et al. proposed that these results might reflect that readers do not need to access a specific emotion representation during reading but may rather include more general emotion information in their mental models of the text. This claim was further investigated by Gygax et al. (2007), who focused on the behavioural reaction associated with the emotion as a better indicator of

emotion inferences. They compared target sentences containing a matching or mismatching emotion label and target sentences containing a matching or mismatching behavioral reaction to the emotion described in the narrative. In order to control the match vs. mismatch issues introduced above, Gygax et al. proposed to implement a context-integration condition in addition to the usual matching vs. mismatching inference conditions. They presented their participants with control narratives and varied the information transmitted early in these narratives. In the control congruent condition, the second sentence was congruent with the first one whereas in the control incongruent condition the second sentence was incongruent. At this moment of the reading process, no inference regarding the narrative is likely to be made. Then, any mismatch effect is related to a context-integration process and not an inference process. In their experiment, Gygax et al. compared the amplitude of the mismatch effect linked to the control condition with the one linked to the emotion or the behavior conditions, revealing that, contrary to the emotion sentences, the difference between the matching and mismatching behavior sentences was greater than the difference between the matching and mismatching control sentences.

Overlooked methodological issues in past studies

Match vs. mismatch: A misleading path

In this chapter, we propose that experiments conducted by Gygax et al. (2004) may have failed to assess the specificity of emotion inferences, mainly due to the fact that the small expected differences between the various matching conditions were very probably hidden by the huge incongruence effect linked to the mismatching sentences. In other words, their results actually showed small differences between the three matching conditions that may not have reached significance due to their comparison to the mismatching condition. In addition, if we agree that Gygax et al.'s (2007) context-integration condition brought new control on the measure of the inference process, the authors again compared opposite emotion labels and may have missed subtle processes at play during emotion inference elaboration. We also consider that better control can be applied to the match-mismatch effect, as will be presented later in this chapter.

The control over the emotion construct in the narratives: Two crucial issues

In addition to the limitations directly linked to the use of the match vs. mismatch paradigm, we claim that the texts used so far in emotion inference research may have not allowed readers to reach a specific emotion representation. In inference studies and as introduced before, participants are confronted with texts intended to transmit a representation of the main protagonist's emotion. In some studies, the experimental texts are segments of narratives written by professional writers (as in Brunyé, Ditman, Mahoney, & Taylor, 2011; Dijkstra, Zwaan, Graesser, & Magliano, 1994; Molinari Marotto, Barreyro, Cevasco, & van den Broek, 2011). Although using such naturalistic texts has the advantage of investigating emotional inference in an ecological context, it has to deal with the issue that no control can be applied to the different properties of the text that are known for their influence on reading times (e.g., syntax, word frequencies, sentence complexity or length of the text) (Graesser et al., 1997). For this reason, research on inferences has mainly been conducted using texts, called textoids, created by the experimenters in order to control those variables. The textoids are typically short narratives describing an episode intended to induce an emotional state in the protagonist, without explicitly wording the emotion. They are written with the aim to mirror natural text on the first hand and to control for the text characteristics on the second hand. If the textoids used in previous studies have controlled the text properties quite well on a basic level (i.e., the words and syntax used in the target sentences), they have attributed little control over the emotion labels used in the target items (Issue I) or on the emotional content of the narratives (Issue II). However, the specificity of emotion inferences is directly related to what we define as an emotion. If one wants to determine if emotion inferences are specific or not, one has to precisely define what exactly is grouped under the term emotion.

Target emotion labels

Let us consider the first issue, namely the number and the variety of emotional terms investigated in previous studies. Although several authors selected a wide range of emotional states (e.g., de Vega et al., 1996; Gernsbacher et al, 1992; Molinari et al., 2009), others focused on a very small sample of emotional states (e.g., Komeda & Kusumi, 2006). For example, Gernsbacher et al. (1992) worked on 24 emotion labels

and de Vega et al. (1996) included 48 emotion labels in their research. These emotion labels covered a wide range of emotional states, from emotions traditionally considered as primary (e.g., sadness, joy) to moods (e.g., depression, anxiety) or personality traits (e.g., shyness, confidence, bravery). On the contrary, Komeda and Kusumi (2002) only investigated the representation of emotion with narratives intended to elicit representations of *worry* or *relief*, emotional states that may also more define mood than emotion. It may be possible that inferences related to emotional states such as mood, emotions or personality traits are drawn in a same way. However, simulation accounts of reading comprehension (e.g., Barsalou, 1999a; Glenberg, 1999; Zwaan, 2004) propose that readers enter a simulation process in which they put themselves in the character's shoes during reading. By doing this, readers reactivate previous information acquired while experiencing a similar situation in order to comprehend the situation pictured in the narrative. Regarding the basic differences between emotions, moods and personality traits, we doubt that the simulation processes implied in the comprehension of mood are as vivid as the ones related to the comprehension of emotion. This follows on from the idea that emotions are produced in reaction to a stimulus that is relevant to the organism, in order to mobilize resources and respond to this stimulus. Emotions are intense and have a short duration contrary to moods or personal traits, which are of low intensity, are not directly linked to a cause and can last for a long time (Frijda, 1986; Scherer, 2005). From this point of view, moods or personal traits have fewer defining characteristics that can be simulated. Consequently, the process of inference surrounding such emotional states may be different from the process of inference regarding emotions, given the relative lack of salience associated to moods or personal traits. Investigating emotion inferences using such various emotional states may then have lead to confound inference processes directly related to real emotions with inference processes related to more general emotional states.

Emotion content of the narratives

The second issue concerns the lack of control over the emotion construct described in the narratives and consequently, its relevancy regarding the emotion intended to be inferred. Researchers have created their experimental material by selecting emotion labels and writing narratives they estimated would match them, but few details on the exact emotional content of the narratives are available in the

literature. For example, de Vega et al. (1996) wrote two sets of 24 emotional narratives describing situations that are relevant to students, such as going on a date or passing an exam. In a first normative study, they identified the three most relevant emotion labels for each narrative. Then, they asked a sample of students to choose from these emotion labels the one that best matched the narrative. They selected the emotion label most frequently chosen for each narrative and obtained 24 pairs of emotions of opposite affective valence.

Gernsbacher et al. (1992) constructed emotional narratives involving two characters and describing concrete actions, relationships and settings, sometimes mentioning the character's goals, but never mentioning the character's feelings. The authors controlled the relevancy of the narratives for the students by enrolling several undergraduate students in the construction of their material. Thus, the narratives were written based on the target emotion by a group of researchers and students. Gernsbacher et al. (1992) chose the target mismatching emotion labels afterwards and included either a mismatching emotion label, differing by its valence but quite similar to the other dimensions defined by Frijda (1986) (Experiments 1 and 3), or a mismatching emotion label of the same valence but differing on one of the other dimensions (Experiment 2).

The choice of Gernsbacher et al.'s (1992) emotion labels was challenged by Gygax et al. (2003). These authors used Gernsbacher et al.'s narratives and asked their participants to complete the target sentence [Main character] felt… without explicitly asking them to generate emotional words. Gygax et al. showed that the responses included a lot of different emotions that were not even synonymous. Gygax et al. then presented eight matching emotion labels for each narrative to their participants and asked them to rate how likely each emotion was to be felt by the protagonist. They found that for each narrative several (at least three) emotion labels were equally rated. These results pointed out that the narratives used in Gernsbacher et al.'s (1992) experiments were compatible with different emotion labels and, if they were relevant to test general emotional knowledge activation, they were not adequate to test the specificity of emotional inference. One possible explanation for this inadequacy may rely on the choice made by Gernsbacher et al. to focus on quite cold descriptions. There was almost no reference made to basic emotion characteristics (e.g., physiological or subjective reaction to the described situation) that are at the very base of emotion. This

may have caused readers to infer a broad emotional feeling, as not enough information was given in order to distinguish between similar specific emotions.

In order to construct experimental emotional narratives leading to a higher agreement concerning the emotion pictured in the text, Gygax and Tapiero (2003) asked students to write descriptions of situations that would cause a given emotion for a hypothetical protagonist. By doing this, they intended to investigate the semantic field related to the different emotion terms used in their narratives. They identified different core categories (e.g., internal or external mental, internal or external physical, punctual or regular time, etc.) and developed their experimental narratives by choosing the most recurrent semantic categories resulting from the students' propositions for Gernsbacher et al.'s (1992) emotion labels. Whereas the resulting narratives may be seen as the most representative for the student population investigated in this kind of research, we again claim that they were not written homogeneously enough. When looking closer at Gygax and Tapiero's (2003) narratives, it appears that they do not contain the same amount of emotional information in terms of emotional features (see the following section for a detail description of what these features are). Whereas several narratives included a lot of physical descriptions (e.g., to walk slowly, to suffer, to retain tears for *sadness*), others were focused on cognitive descriptions (e.g., to blame oneself, to feel remorse in *guilt*) or on situational descriptions (e.g., to go home late, to be in the dark in *fear*). In addition, we consider that Gygax and Tapiero (2003) may have misinterpreted the categories by not relying on more accepted categories (e.g., appraisal, physiological reaction, action tendency) thoroughly described in emotion research as constitutive elements of the emotional experience (e.g., Ekman, 1977; Frijda, 1986; Scherer, 1984). These issues are of great importance in the debate on the specificity of emotional representation during reading since Gygax et al. (2007) argued that rather than including a specific representation of emotion in their mental model, readers infer the behavioural response to a situation as part of the emotion construct. They proposed that readers do not need to infer a specific emotion to comprehend a text and may be more likely to keep an open representation of the protagonist's emotional state, based on stereotypical responses to emotion that can be shared by different emotions. Regarding the content of their experimental narratives, this assumption may have been a premature conclusion as no precise control (i.e., narratives generated by students) was applied to the quantity of emotion-related behavioral information included in the narratives.

A new approach to emotion inferences and the construct of narratives

Theoretical background

In this chapter, we propose a new approach to elaborate emotional narrative by filling the gap between psycholinguistics and emotion research. We argue that the need to control the emotional content of experimental narratives is a crucial issue when focusing on the specificity of emotion inferences. First, researchers need to define exactly which emotional states are under investigation. Then, to ensure the readers' ability to reach a specific emotion representation during reading, an optimal condition should be determined that contains all the necessary emotional information needed to define a given emotion. Finally, less optimal conditions should be constructed by manipulating the information transmitted in the narratives in order to compare the different processes at stake when constructing representations of the protagonist's emotion. This manipulation additionally offers a solution to the match-mismatch issues described above by allowing the construction of narratives differing by their congruency (or typicality) level to the matching emotion. Consequently, the comparison of the processing of the same target sentence in different contexts of congruency, in spite of different target sentences in the same context, would be possible.

Identifying the corresponding emotional information requires the identification of semantic profiles related to the emotion terms used in the readers' language. This line of research was initiated by Scherer (2005) who proposed asking participants to evaluate what would typically elicit a given emotion and what would be the typical responses triggered by this emotion. Before presenting the method used in this semantic approach, it is important to more precisely define what the term emotion encompasses. According to the widely accepted componential theories of emotion (Davidson, 2003; Ellsworth & Scherer, 2003, Ortony, Clore, & Collins, 1988; Scherer, 1984, 2005), an emotion is the resulting episode of a specific evaluation of an event, external or internal, that activates changes in the body. These changes happen in different subsystems of the organism and the activation of each subsystem corresponds to an emotion component. Scherer (2005) identifies the five following emotion components: (1) the Cognitive, (2) the Neurophysiological, (3) the Motivational, (4) the Motor Expression, and (5) the Subjective Feeling components. All components are highly interrelated, where changes

in one subsystem will produce changes in the other subsystems. The synchronized changes of activation in all emotion components lead to an emotional experience. The cognitive component corresponds to the appraisal of the situation and is composed of a hierarchical sequence of stimulus evaluation checks. The emotional responses of the other subsystems are elicited via the appraisal of the situation in a dynamic and cumulative way (Ellsworth & Scherer, 2003; Scherer, 1984). The neurophysiological component refers to bodily symptoms generated in somatic nervous, neuroendocrine and autonomic systems (e.g., heartbeat, breathing or muscle reaction). The motivational component consists of action tendencies produced by the appraisals, like redirecting one's attention or moving towards or away from the stimulus. Changes in facial and vocal expressions compose the Motor Expression component and the Subjective Feeling component regarding the intensity, duration, valence, arousal and tension aspects of the emotional experience.

Various features characterize the five components of emotion and 144 features have been identified and adapted from questionnaires used in previous studies (Scherer & Wallbott, 1994; Scherer, Wallbott, & Summerfield, 1986). Among these features, 31 refer to the Appraisal component, 18 to the Psychophysiological component, 26 to the Motor Expression component, 42 to the Action Tendency component and 22 to the Subjective Feeling component. As a given feature (e.g., to smile) is more or less probable to happen when experiencing different emotions, it is possible to characterize an emotion according to the features it is the most related to. The GRID instrument (Fontaine, Scherer, Roesch, & Ellsworth, 2007; Fontaine, Scherer, & Soriano, in press; Scherer, 2005) was developed to do exactly this. It is a Web-based questionnaire containing 24 emotion terms and all the emotion features. The emotion terms correspond to twelve emotion words often used in emotion research (i.e., anger, contempt, disgust, fear, guilt, interest, joy, pleasure, pride, sadness, shame, surprise) and twelve emotion words frequently reported in free-listing tasks and self-reports of emotional experiences (i.e., anxiety, compassion, contentment, despair, disappointment, happiness, irritation, stress, being hurt, jealousy, hate, love). For a given emotion, participants are asked to evaluate, on a 9-point scale, the probability of each of the 144 emotion features to be inferred when the emotion label is used in their cultural group. In essence, the GRID instrument assesses the semantic field of emotions within more than 20 languages. For psycholinguists, both its semantic input and its cultural specificity are

crucial in enabling them to construct appropriate materials, as outlined in the concrete example presented in the following section.

A practical case: Constructing French narratives

In this section, we present an example of a concrete use of the GRID to construct emotion narratives, in French (based on Fontaine et al., 2007), to investigate the aforementioned issue of specificity within emotion inferences. By using this example, we aim to provide readers with a glimpse at the numerous possibilities that the GRID offers to researchers interested in emotion inferences.

In Fontaine et al. (2007), 145 Swiss French-speaking students were asked to fill in the GRID questionnaire. Centered means for each feature of each emotion were calculated, allowing a classification of the features in terms of the probability of appearance in each emotion. This classification of the feature's scores enabled the authors to identify the most, neutral or least typical features for each component of a given emotion. For example, the most typical Motor Expression feature of *anger* is *to open the eyes widely* whereas the least typical feature is to *not show any change in vocal expression*. More neutral features include expressions such as *showing tears* or *having a trembling voice*.

As stated above, we claim that the specificity of emotion inferences would be best assessed by comparing the same emotion target sentence in different levels of narrative congruency, with a reference level corresponding to the optimal condition in which such inferences are most likely to be generated. Crucially, and according to Scherer's (1984, 2005) definition of emotion, an experimental narrative in the optimal condition should contain all components of the target emotion defined by their most typical feature.

To construct congruency levels of narratives, one can manipulate the quality or the quantity of emotion information transmitted in the narratives. By quality of emotion information, we mean the typicality of the components' features. For example, in a less congruent version of a narrative, in terms of quality, the features defining the different components may be congruent but not typical of the intended emotion. By quantity of emotion information, we mean the total number of components defined by their typical feature. In this case, a less congruent version of a narrative would include only some,

yet not all, components (defined by their typical features) of the particular emotion. In sum, one can quite easily play around with both *quality* and *quantity* dimensions when constructing the narratives, depending on the research question at hand.

Crucially though, when developing the experimental narratives, if it is essential to ensure that they do differ across conditions, it is fundamental to verify that one version of an emotion does not correspond to some version of another emotion. In other words, if it is clear that different narrative versions of a given emotion are more or less congruent regarding the intended emotion, a narrative less congruent to a given emotion may be typical regarding another emotion. In this case, it is possible that encountering the target sentence in the less congruent version of a given emotion narrative may elicit a mismatch effect as the readers may have inferred the emotion word typically defined by the component's features. Still, although some emotions do share *most typical* features for some or most of their components, they usually differ in one or more components. For example, irritation and hate have the same most probable features concerning Appraisal (i.e., *the character is treated unjustly*), Action Tendency (i.e., *to want to damage, hit or say something that hurts*), Motor Expression (i.e., *to move against people or things*) and Psychophysiological Reactions (i.e., *heartbeat getting faster*). However, their Subjective Feeling component is different (i.e., *feeling restless* for irritation and being *in an intense emotional state* for hate). In this case, it is probable that readers confronted with narratives containing all components but the Subjective Feeling component are as likely to infer that the protagonist is feeling *hate* or *irritation*. Note that the scores defining the probability to encounter each of these features may not be the same for the two emotions, giving us some insight into which emotion may or may not be inferred.

There are actually many ways to choose the features to be integrated into the different versions of a narrative, the semantic distance required between the versions being highly influential. In terms of quantity, less congruent versions can contain none to four emotion components, yet in terms of quality, less congruent versions may be more or less close to the optimal version when looking at individual features' scores.

In Gillioz & Gygax (2012, see Chapter 5), we wrote three versions of twenty-four narratives (i.e., twenty-four emotions) using the GRID instrument. Each narrative (whatever version) comprised seven sentences. The first sentence always described a general context and the final sentence, the target sentence, included the intended

emotion. Sentences 2 to 6 were intended for experimental manipulation. Essentially, each sentence could correspond to a component of the intended emotion. Our first manipulation constituted a *quantity* manipulation whereby the quantity of emotion components available to the readers varied in some versions of the narratives. This manipulation concurs with the idea initiated by Gygax et al. (2004) that an emotion inference may reach specificity if sufficient relevant emotional information is provided to the readers. Contrary to Gygax et al. (2004), who focused on the length of the narrative and the number of details to encourage readers to constrain their emotion representation to a specific one, we concentrated on the quantity of emotion components in each narrative. If readers construct their mental representation of an emotion as the emotion itself is constructed when responding to an affective situation (i.e., by cumulating all component responses), readers may require all the components (in the text or inferred) to activate a specific emotion representation. In the *optimal* version of the narratives, we inserted all five relevant components, each described by its most typical feature, hence providing the readers with all the needed information in its most relevant form. In the *moderate* version of the narratives, we only provided readers with three components, also described by their most typical features (the other two component sentences were replaced by neutral filler sentences). Our second manipulation constituted a *quality* manipulation whereby we manipulated the typicality of the features presented for each component. In the *suitable* version of the narratives, we kept the five components as in the *optimal* version but altered the quality of two emotion components (i.e., the Motor Expression and the Psychophysiological components) by including congruent yet less typical features. In sum, each version of the narratives differed only in two sentences. The *optimal* version presented all components with the most typical features, the *suitable* presented all components with two of them including less typical yet congruent features and the *moderate* version presented filler neutral sentences instead of relevant components for the two crucial manipulated sentences.

To ensure that our manipulations were appropriate, we kept the same relative semantic distance between the versions of each narrative by computing a distance ratio as follows: We first identified the one emotion in the GRID that presented the highest score for the most typical feature of the Motor Expression and Psychophysiological components respectively. These were *happiness* and *love*. Basically, we considered

these as our reference emotions. We then selected a congruent yet less typical feature of the Motor Expression component of *happiness* and a congruent yet less typical feature of the Psychophysiological component of *love*. Finally, we computed the ratio between the scores of *typical* and *congruent* features for each component and used it to choose all the features of Motor Expression and Psychophysiological components for the emotions we planned to test.

Importantly for our manipulation check, narratives in the different versions presented statistically different total typicality scores, $F(2, 46) = 616.94$, $p < .001$. The *optimal* versions ($M = 14.00$, $SD = 1.94$) were more typical than the *suitable* versions ($M = 10.77$, $SD = 1.32$), $F(1, 23) = 369.90$, $p < .001$ and, in turn, more typical than the *moderate* version ($M = 8.70$, $SD = 1.29$), $F(1, 23) = 977.92$, $p < .001$. A supplementary offline check was conducted to verify that these new narratives were appropriate to elicit representations of protagonists' emotions, where we asked forty-eight participants to choose among three emotion words the label that best matched the emotional state felt by the protagonist. For each narrative, we presented the participants with the intended emotion word, a similar emotion word and an emotion word of same valence. The agreement concerning the intended emotion label (65%) was constant across all versions of the narratives, showing that they were all congruent to the intended emotion, even more so than those used by Gygax et al. (2004), who found an offline agreement of 49% on the intended emotion when presenting participants with Gernsbacher et al.'s (1992) original narratives. The percentage of choice was very close to the one found by Gygax et al. (2004) when presenting readers with longer narratives (63%), suggesting that if the quality (in terms of components and features) of the emotion information presented in the narratives is sufficient (and this was the case even with only three different components in the *moderate* versions), there is no need to make the narratives longer in order to elicit emotion representations among the readers, at least offline.

In a subsequent reading experiment investigating online processes, sixty-four participants were presented with the emotional narratives constructed with the GRID. In this experiment, special focus was allocated to (self-paced) reading times of target sentences containing intended emotions. Contrary to Gygax et al.'s (2004) findings of no differences in reading times of target sentences containing either an intended, a synonym or a similar emotion, differences in the reading times between the versions (i.e., optimal, suitable and moderate) were apparent. Specifically, readers were slower to

read target sentences in the *optimal* condition than in the *suitable* and *moderate* conditions. If this slowdown effect is somehow contrary to what could be expected in light of the habitual match vs. mismatch effect (i.e., faster reading times in the most typical version of the narrative), the authors suggested that an integration process had taken place in the *optimal* condition, resulting in deeper processes (hence the slower reading times), supporting the idea that under certain ideal conditions (i.e., all relevant components and features are presented), readers can infer specific emotions, contrary to previous claims.

Concluding comments

Emotional narratives based on emotion research (i.e., the GRID instrument), offer new possibilities to investigate emotion inferences and all satellite issues. Most importantly, it provides researchers with a better control over the content of their experimental materials. Consequently, it also broadens paradigm prospects by extending possibilities beyond the usual (and maybe imprecise) *match vs. mismatch* paradigm. Preliminary results using an *optimal congruent vs. moderate congruent* paradigm (as explained above) suggest that, if previously studied, *match vs. mismatch* effects may have highlighted some processes linked to inference processing, but they have not allowed us to pinpoint differences between shallow mapping processes and deeper integration processes. The latter might only become apparent and measurable when comparing same emotion targets in different contexts of typicality/congruency. In fact, results grounded in *typical vs. less typical* effects might question not only previous results on emotion inferences but also more general conclusions on inference processes. For example, Gillioz and Gygax's (2012) reading patterns cast doubts on previous interpretations of reading times.

In conclusion, in this chapter we presented a new way to control the emotion construct (based on emotion research) contained in experimental narratives used to examine emotional inferences. If researchers have so far controlled for basic properties of the text, we argue that this control may not have been sufficient to examine deeper processes involved in emotion inferences.

5. Going Beyond the Simple Match-Mismatch Effect: Emotion Inferences and Their Underlying Construct

Research on emotion inferences has shown that readers include a representation of the character's emotional state in their mental model of the text but the specificity of this representation is still a matter of debate. In this chapter, we show that readers can infer specific emotions but only provided that the text comprises appropriate components of emotions (and their relevant features). We further claim that past psycholinguistic research failed to adequately consider research on emotion construct and that the habitual match-mismatch paradigm may have shadowed the actual processes at stake.

Comprehending a text requires readers to go beyond the words and to form mental representations partly based on the information transmitted by them. These mental representations, called *mental models* (Johnson-Laird, 1983) or *situation models* (Kintsch, 1988) contain not only elements made explicit in the text but also implicit elements. As the text unfolds, readers include these implicit elements in their mental representations by making inferences based on their general knowledge. Inferences enable readers to maintain global or local coherence in the text (Graesser, Singer, & Trabasso, 1994). At a local level, inferences allow readers to connect adjacent components of the text. At a global level, they are necessary to map incoming information to more distant components of the text and to reach comprehension of some general features (Graesser, Millis, & Zwaan, 1997). Very importantly, mental models contain more than the text itself and include perceptual elements associated to symbolic ones (Johnson-Laird, 1983). Their content is perpetually updated according to new information but also according to what was already included in them; in this sense, mental models guide reading and consequently inference processes (Glenberg, Meyer, & Lindem, 1987).

Among all inferences possible, some have received relatively sparse attention, one of which being protagonists' emotional, or affective state(s). Part of the research on this particular inference has tried to focus on the specific nature of emotions in mental models. In other words, some researchers have questioned whether readers infer specific emotions, therefore differentiating between similar emotions such as *sad* and *depressed*, or infer only global emotional states. In these studies, as in other studies on inferences in text comprehension, the *match vs. mismatch* paradigm has been mostly used. In this paradigm, participants are presented with short narratives intended to elicit mental representations of the main protagonist's emotional state. Each narrative usually includes at some point a target sentence either matching or mismatching the intended emotion. The time taken to read this target sentence is typically recorded and the time necessary to process the matching sentence is compared to the time needed to process the mismatching one. Behind this paradigm is the assumption that if readers have previously inferred the intended emotion (i.e., have included it in their mental models), they will be faster to read the matching target sentence. When confronted to the mismatching target sentence, readers should slow their reading pace, as the content of the sentence contradicts their current mental models. In this last case, a relatively

effortful process of adjustment has to be activated, reflected in longer reading times. Essentially, reading times of target sentences mirror how close the information in the sentences are to readers' mental models.

Using this paradigm, Gernsbacher, Goldsmith, and Robertson (1992) showed that readers, when presented with a narrative inducing a representation of the protagonist's emotion, were faster to read a target sentence containing a matching emotion (e.g., guilty) than a target sentence containing either a mismatching converse emotion (e.g., proud) or a mismatching emotion label of the same valence as the intended emotion (e.g., shy). The authors concluded that readers do infer precise (or *specific* in terms of Gygax, Oakhill, and Garham, 2003) emotions when reading, and not only valence. In a later study, Gernsbacher and Robertson (1992) showed that these inferences were rather impermeable to cognitive load, therefore automatic.

Gygax et al. (2003) and Gygax, Garnham, and Oakhill (2004) showed however that even if emotion inferences contain more than just valence, it did not necessarily mean that they were precise or specific. These authors used the same narratives as in Gernsbacher et al. (1992) and also tested target sentences including an emotion *synonym* to the one tested by Gernsbacher et al. (1992) and target sentences including a *similar* emotion, yet not a synonym. If readers always slowed down when encountering the mismatching target sentence, they were equally fast to read the different matching sentences (i.e., initial, synonym and similar emotions). These results remained the same when the narratives were elaborated so as to force a more specific emotion inference by introducing more emotion information in them or by rendering them ambiguous (Gygax et al., 2004).

One possible way to explain the non-specificity of emotion inferences was proposed by Gygax, Tapiero, and Carruzzo (2007), who suggested that emotion inferences may be elaborated in a constructivist manner. According to the authors, emotional inference may be based on a sum of stereotypical components, such as valence or the behavioral responses associated to emotions. They argued that if one were to accurately access emotion inferences, one would need to investigate some of these components as inferences instead of the global resulting emotions. Gygax et al. (2007) presented their participants with similar narratives as used in previous research and also tested target sentences including a matching or a mismatching behavior. They also controlled for what they called the *context integration* issue. Basically, Gygax et al.

argued that the differences between reading times of matching and mismatching target sentences may reflect two different processes: An inferential process (as always assumed) or a context integration process (less likely to give us valuable insight). They argued that researchers rarely differentiated between the two. In the former case, readers are faster to read matching sentences because they include previously inferred information. In the latter case, readers are simply faster to read matching sentences because they do not contradict readers' mental models. Gygax et al. proposed that the difference between reading times of matching and mismatching target sentences related to an inference process should be greater than the difference elicited by a context integration process. They actually showed that differences between matching and mismatching behavior sentences were bigger than differences between matching and mismatching emotion sentences (i.e., including emotion terms), which in turn were similar to those in the context integration control conditions. The authors concluded that these results supported previous claims emotions per se were not adequate to investigate emotion inferences. Gillioz, Gygax, and Tapiero (2012) further showed that if readers infer the behaviors associated to emotions and not the emotions per se, they do it independently of general working memory capacities, empathy level or simulation processes. Still, the authors did find that simulation processes enhanced behavioral preference for readers with high visuo-spatial working memory capacities, giving some support to the idea that mental models may well be perceptual (Glenberg, 1999; Glenberg et al., 1987; Johnson-Laird, 1983).

All these results support the idea that behaviors associated to emotions are more likely to be inferred during reading than emotion per se. Importantly, these behavioral inferences are particular as they are different from inferences of any non-emotional behaviors (Gygax, 2010). The behavioral component of an emotion, as part of the stereotypical information related to this emotion, may well be inferred at an early stage in the elaboration of a specific representation of the main protagonist's emotional state. This early-stage representation might be completed as new information is made available to readers. According to Gygax and colleagues, inferring stereotypical information about an emotion would allow readers to rely on salient characteristics of the emotion yet keeping the representation broad enough to easily adapt it to new information (i.e., a behavior is often shared by more than one emotion). Attributing a very precise or specific label to the emotion felt by the protagonist may force readers

under certain conditions to revise it according to incoming information, which may be cognitively costly. In addition, this representation might well be good enough, or sufficient, to comprehend the text (as in the *good-enough representation* concept of Ferreira, Bailey, and Ferraro, 2002).

One could also argue that the simulation process involved in reading comprehension usually reactivates perceptual symbols acquired during preceding experiences of a situation, which are related to modality specific systems of the organism (Barsalou, 1999b). Even if a full reenactment of the bodily and introspective states is not necessary to access knowledge, some core parts of the previous experience are still reactivated (Barsalou, 1999b). An associated behavior may be a good candidate for such reactivation as emotions can generally be considered as preparation for actions (Frijda, 2005). In addition, all theoretical models of emotion include a behavioral component, either at the center of the emotional process (Frijda, 1986) or as a key component happening at the end of a sequential process of emotion (Davidson, 2003; Ellsworth & Scherer, 2003).

If this idea of *emotion component* has been increasingly linked to emotion inferences in text comprehension (mainly by Gygax & colleagues) we believe that a significant part of its potential contribution to our understanding of emotion inferences has been neglected. Namely, researchers (including Gygax & colleagues) have failed to fully integrate theories on the componential composition of emotions (e.g. Davidson, 2003; Ortony, Clore & Collins, 1988; Scherer, 1984, 2005) into their models of emotion inferences. The present chapter attempts to correct this and to present a more integrative approach of emotion inferences in reading.

Most important to this approach is the fact that if readers construct their mental representation of an emotion as they would construct an emotional response to an emotion-eliciting situation, they will require all relevant components – explicitly in the text or inferred – to activate a *specific* or *complex* emotion. By activating and integrating only one or two components in their mental models, readers will unlikely elaborate a complex emotion representation. The lack of specificity of emotional inferences found in previous studies might therefore simply emanate from the *unspecific* content of the narratives used to test emotion inferences. In other words, the narratives used, whatever the conditions (i.e., high working memory, specific simulation processes, …) could never allow readers to reach more elaborate emotions.

Although Gygax et al. (2004) hinted at the possibility of a failure of the narratives to convey appropriate information, their explanation was based on a *quantitative* argument (i.e., not enough information) and not on a *qualitative* one (i.e., not the appropriate information), which we present here. In previous research, since the most appropriate, or salient information may not have been available to readers, they may have stopped their inference processes at an earlier *component stage*.

Methodologically, we also argue that previous studies may have failed to detect the specificity of emotional inferences due to the use of the match vs. mismatch paradigm. If using this paradigm confirmed that readers were faster to read matching than mismatching emotion target sentences, these results mainly relied on mismatching effects. We claim that it is actually quite difficult to distinguish effects coming from a mismatching sentence (i.e., slower reading times) and those coming from a matching sentence (i.e., faster reading times), although researchers often make claims as if the effect was bound to the matching conditions. Even if implementing Gygax et al.'s (2007) control condition, subtle processes of inference elaboration may be absorbed by relatively huge match vs. mismatch effects.

In the present chapter, we attempted to access more subtle processes (1) by relying on emotion research to better ensure the quality of emotion information in our experimental narratives and (2) by relying on differential levels of congruency only (*moderate*, *suitable* and *optimal*).

For the quality of the information presented to readers (and incidentally for the levels of congruency), we relied on Scherer's (1984, 2005) definition of emotion as a result of synchronized and interrelated changes in five components linked to the different subsystems of the organism. Among the components, the *Appraisal* component corresponds to the evaluation of the situation that triggers the emotion and is composed of a hierarchical sequence of stimulus evaluation checks. The *Motor Expression* component involves the changes in face, voice and gesture. The *Action Tendency* component relates to the motivational aspect of emotion and the *Psychophysiological* component involves the different bodily changes. Finally, the *Subjective Feeling* component is a monitoring component concerning the general feeling associated to the event or situation. All components are highly interrelated, changes in one subsystem producing changes in the other subsystems. Most importantly, the emotional responses of the bodily subsystems are elicited via the

appraisal of the situation in a dynamic and cumulative way (Ellsworth & Scherer, 2003; Scherer, 1984).

Crucially, all the components are present in each emotional episode and different emotions are elicited via different activations of these components (i.e., different component *features*). Scherer (2005) proposed to develop an instrument in order to investigate the semantic field of emotion and determine which features of the components are likely to happen in a given emotional episode. For example, for the emotion *anger*, a psychophysiological feature might be *a red face*. The GRID instrument (Fontaine, Scherer, Roesch, & Ellsworth 2007; Fontaine, Scherer & Soriano, in press; Scherer, 2005), a web-based questionnaire, was built to access this information. It comprises a representative set of 24 emotion terms and 144 emotion features, which reflect activity in the five components of emotion. In Fontaine et al. (2007), 145 French-speaking Swiss students were presented with the emotion terms and the 144 emotion features. They were asked to evaluate on a 9-point scale how each emotion feature is related to the emotion terms in their particular cultural group. This study allowed the authors to identify which feature of each component characterized the most appropriately a given emotion. It also permitted to classify the different features for each component of each emotion, from the most typical to the least typical. For example, the most typical motor expression feature for *happiness* is *to smile* whereas the least typical feature is *to frown*. In between, features such as *increase the volume of voice* or *having a trembling voice* are quite neutral, because they are neither judged as likely to happen nor as unlikely to happen.

The GRID scores allowed us to identify typical features as well a less typical ones for a given emotion, with which we created better controlled emotional narratives by manipulating the number of emotional components present in the narratives and the typicality of their features. The reading experiments presented in this chapter were consequently based on an *optimal congruent vs. moderate congruent* paradigm instead of a *matching vs. mismatching* paradigm. This manipulation gives the possibility to compare specific emotional inference as well as emotion components inference in different conditions of typicality. In short, a congruent target sentence following a narrative with most typical features (i.e., the *optimal* condition) should be read faster than the same congruent target sentence following less typical, yet still plausible features (i.e., the *moderate* condition). In addition, internally to the narratives, if readers

elaborate their mental representation of emotion based on emotion components, these components described by typical features should be read faster than those described by less typical features.

Inherent to these issues is the difficulty of constructing appropriate narratives. We next present a Pilot study intended to provide us with adequate materials for our purposes.

Constructing narratives: Pilot study

The goal of the pilot study was to construct emotional narratives based on the features identified in the GRID instrument and to control that these narratives did elicit the intended emotions. In essence, we made sure that the GRID provided us with valuable information as to investigate emotion inferences.

Method

Participants

Forty-eight students of a psychology introductory course from the University of Lausanne took part in this experiment. All participants spoke French as their first language. There were 38 women and the participants were aged from 19 to 33 (M = 22.14, SD = 3.58).

Materials

Emotional narratives

For each of the 24 emotional labels contained in the GRID instrument, we constructed a corresponding narrative (see Table 5 for a full list of the emotions tested in our study). Each narrative started with a sentence introducing the protagonist and describing the context of the narrative. This sentence was followed by five sentences, each related to one of the five emotion components (i.e., Motor Expression, Appraisal, Psychophysiology, Action Tendency and Subjective Feeling). We wrote each narrative in three versions in order to manipulate the specificity of the narrative, as discussed

earlier. We varied the degree of typicality of the components present in the narratives and the number of components across the narratives to get three levels of typicality (i.e., *moderate*, *suitable* & *optimal*). In the *optimal* version of each narrative, the most typical feature of each component was included in its corresponding sentence. For example, in the narrative about *Happiness*, the most typical Motor Expression component corresponded to *smile,* the most typical Psychophysiology component to *the heartbeat getting faster* and the most typical Appraisal component corresponded to *a situation in itself pleasant for the person*. In other words, the *optimal* version of each narrative contained all the necessary information needed to define a specific emotion.

TABLE 5. *Emotions investigated by the GRID instrument and used in Experiments 3, 4, 5 and 6.*

Happiness, Joy, Contentment, Pleasure, Pride, Anger, Love, Fear, Sadness, Despair, Shame, Interest, Irritation, Jealousy, Guilt, Anxiety, Surprise, Hate, Disappointment, Being hurt, Disgust, Contempt, Stress, Compassion.

In the *suitable* version of each narrative, we replaced the most typical features of the Motor Expression and the Psychophysiology components with congruent but less typical features whereas the Appraisal, Action Tendency and Subjective Feeling components remained unchanged. In the narrative about *Happiness*, for example, the Motor Expression component *to smile* was replaced by *to speak faster*, whereas the Psychophysiology component *the heartbeat getting faster* was replaced by *the breathing getting faster*. All other components were unchanged. The *suitable* version hence contained as many component sentences as the typical version but two of these component sentences were less typical as to the intended emotion.

In the *moderate* version of each narrative, the Motor Expression and the Psychophysiology components sentences were replaced by neutral filler sentences that did not convey any emotional information. In a pre-test, eight students were asked to evaluate the extent to which 78 sentences intended to be neutral conveyed an emotional information on a 6-point scale (0 = *does not convey any emotional information* to 5 = *conveys a lot of emotional information*).

TABLE 6. *Example of an emotional narrative used in the pilot study and Experiments 3, 4, 5 and 6 in the three typicality versions. In the Pilot study, the final target sentence was not presented. Instead, participants had to rank three possible emotions in terms of salience to the narrative.*

Optimal version
Context sentence: *As she was arguing with her best friend, Emily did not agree with her and could not help shouting at her.*
Motor expression component: *As soon as she heard what she said, Emily fell silent.*
Psychophysiology component: *At the same time, she felt a knot in her stomach.*
Appraisal component: *Emily knew she could have avoided this situation.*
Action Tendency component: *She really wanted to disappear.*
Subjective Feeling component: *At that moment, Emily felt bad.*
Target sentence: *Emily felt guilty.*
Suitable version
Context sentence: *As she was arguing with her best friend, Emily did not agree with her and could not help shouting at her.*
Motor expression component: *As soon as she heard what she said, Emily changed the melody of her voice.*
Psychophysiology component: *At the same time, she felt her muscles tensing.*
Appraisal component: *Emily knew she could have avoided this situation.*
Action Tendency component: *She really wanted to disappear.*
Subjective Feeling component: *At that moment, Emily felt bad.*
Target sentence: *Emily felt guilty.*
Moderate version
Context sentence: *As she was arguing with her best friend, Emily did not agree with her and could not help shouting at her.*
Filler neutral sentence: *The two friends were at Emily's place.*
Filler neutral sentence: *They were talking about what had happened that day.*
Appraisal component: *Emily knew she could have avoided this situation.*
Action Tendency component: *She really wanted to disappear.*
Subjective Feeling component: *At that moment, Emily felt bad.*
Target sentence: *Emily felt guilty.*

We retained the 48 filler sentences having the lowest scores (M = 0.26, SD = 0.44) and added them in the *moderate* versions of the narratives, ensuring that their meaning would not impinge upon the narratives' general meaning. Compared to the *optimal* and *suitable* versions, the *moderate* version of each narrative contained only three components of emotional experiences.

In all versions of the narratives and for each component sentence, we included the exact words used in the GRID. Table 6 shows an example of a narrative in each version of typicality.

Questionnaire about the emotional narratives

Three booklets containing eight narratives in the *optimal* version, eight narratives in the *suitable* version and eight narratives in the *moderate* version were constructed. In each booklet, a narrative appeared in one version and the order of presentation of the narratives was random. For each narrative, three emotion labels were proposed. The first emotion label corresponded to the emotion intended by the authors and to the features combination present in the narrative. The second emotion label corresponded to a synonym emotion term when possible or to an emotion term matching the described situation (e.g., *pleasure* in the *happiness* narrative, or *hate* in the *anger* narrative). The third emotion term corresponded to an emotion of same valence as the intended emotion but not synonym of it (e.g., *interest* in the *happiness* narrative or *anxiety* in the *anger* narrative). The emotion labels were presented in a semi-random order.

Procedure

Each participant received one of the three booklets. The participants were asked to read each narrative of the booklet carefully and to order the three emotions from the most relevant to the narrative to the least relevant.

Results and discussion

In this pilot study, we wanted to ensure that our narratives would lead to a high agreement among participants about which emotion is ranked first, especially for the *optimal* versions. Still, as these narratives were elaborated on the emotion features

identified by the GRID instrument and contained at least three typical features of the emotion, we expected the participants to generally rank the intended emotions as first and those of same valence as last.

In Table 7, we present the percentages of choice of each emotion type across the different versions. The choice of the intended emotion label as the best label for the narrative was constant among the different versions of the narratives, $F(2,46) = 1.00$, $MSE = 1.68$, $p = .38$, and was clearly above chance (33%), $t(23) = 7.68$, $p < .001$.

TABLE 7. *Percentages of choice of the different emotions in the three versions of the emotional narratives in the Pilot study*

Versions	Intended label	Similar label	Same valence label
Optimal	64.39	28.54	7.07
Suitable	64.05	27.34	8.61
Moderate	66.96	25.99	7.07

As expected, the narratives constructed based on typical features of emotion components identified by the GRID instrument elicited a high choice rate of the intended emotions compared to synonym emotions or emotions of same valence, and this in all three versions. These results confirm that all versions of the narratives are congruent to the intended emotions (i.e., which become the target emotion in Experiments 3, 4, 5 and 6) and that the GRID provided us with the appropriate materials on which to base our materials.

Note that, as this Pilot study was offline by nature, these results could be taken as support to the idea raised by Gygax et al.'s (2004) that, if readers are provided with the appropriate information, they may build a more specific emotion representation, at least offline. However, nothing can yet be said about the online status of these inferences, which is central to Experiment 3. If investigated offline there did not seem to be much difference between the different versions of the narratives, we actually expect this to be different when tested online.

Experiment 3:
Emotion components and the specificity of emotion inferences

The Pilot study mainly showed that the GRID instrument provided us with the appropriate materials on which to base our narratives to test our hypotheses on the influence of typicality on the mental representations of emotions. In the present experiment, we went a step further and investigated the online construction of the protagonist's emotional status using narratives based on the GRID. The aim of this experiment was twofold.

First, we wanted to see if the lack of specificity of emotion inference argued by Gygax and colleagues was a consequence of the underspecified emotion information in terms of emotion components in the experimental narratives used in previous research. Embodied views of cognition suggest that previous experiences of emotion may be central to the understanding of any emotional situation, hinting that this may also be the case when understanding emotion from text. Consequently, readers may construct their mental representations of a protagonist's emotional state on the basis of different stereotypical emotional features. We therefore hypothesized that readers are more likely to specifically infer an intended emotion when presented with all the emotion features highly consistent with and typical to this emotion (i.e., in the *optimal* condition). A decrease in typicality (i.e., in the *suitable* or *moderate* conditions), although all features may be present, may result in a less specific representation.

Second, we wanted to look at the sequential process of inferences as a narrative unfolds its emotion components. As proposed by Gygax and colleagues, readers may rely on these components to infer specific emotions, but some of them may well be inferred well before readers reach their explicit mention. To investigate this issue, we measured reading times of all sentences (i.e., not only the final target sentence).

Method

Participants

Sixty-four participants (fifty women) of a psychology introductory course from the University of Fribourg took part in this experiment. All participants spoke French as their first language. The participants were aged from 18 to 44 (M = 22.87, SD = 4.59).

Material

Emotional narratives

The same emotional narratives as in the Pilot study were used in this experiment. We added a target sentence containing the intended emotion (i.e., the one from the GRID instrument) at the end of each narrative, structured as this: [Main character] felt [target emotion].

Each participant saw eight narratives in the *optimal* version, eight narratives in the *suitable* version and eight narratives in the *moderate* version. In each version set, half of the narratives were presented with the Appraisal and Motor Expression components appearing at the beginning of the narrative and the other half of the narratives with the Action Tendency and Psychophysiology components appearing first. To ensure that all narratives would be seen across the experiment in all versions and that participants would be confronted to all experimental condition versions, we constructed six lists.

Filler narratives

Twenty-four filler narratives were added to the experimental narratives. These narratives were written in the same style as the experimental narratives but were not intended to transmit any emotional information. They were mainly intended to ensure that the participants did not uncover the aim of the experiment.

The narratives were randomly presented using Psyscope Software (Cohen, MacWhinney, Flatt, & Provost, 1993). Reading times of each sentence were collected using a response button box attached to the computer, which permits millisecond accuracy.

Additional post-experimental questionnaire

To investigate individual differences, at the end of the experiment, we repeated the same procedure as in the Pilot study in order to ensure that each participant agreed with the emotion labels we included in the narratives. Each participant saw the narratives in the same version in the questionnaire as in the experiment. For each narrative, we also added two questions to assess (1) the extent to which the participants identified themselves with the protagonist (*0 = not at all*, *4 = completely*) and (2) if the

participants had already experienced a similar situation (*yes* or *no*) than the one depicted in the narrative.

We also assessed each participant's level of empathy with a French version of the Interpersonal Reactivity Index (Davis, 1980, 1983). This questionnaire differentiates between two facets of empathy, each characterized by two scales. The *cognitive facet* of empathy is measured through the Perspective Taking (i.e., to what extent is it easy to adopt the point of view of others) and the Fantasy (to what extent is it possible to imagine itself in other people's shoes) scales. The *emotional facet* of empathy is evaluated through the Empathic Concern and the Personal Distress scales that measure other-oriented and self-oriented feelings.

Procedure

Each narrative was presented one sentence at a time. Participants were asked to read the sentences at their normal pace, as if they were at home reading a magazine. At the beginning of each narrative, the message Are you ready? appeared on the screen. Participants pressed the Yes button in order to make the first sentence appear and to move forward in the narrative after each sentence. Some narratives (n = 14) were followed by a question related to the text that required a Yes or No answer in order to ensure that all participants paid adequate attention to the narratives. Before the beginning of the experiment participants were presented with three practice narratives.

After the completion of the self-pace reading task, participants filled in the Interpersonal Reactivity Index and the questionnaire about the emotional narratives. The whole testing session lasted approximately 45 minutes.

Results

Data transformation

Reading times were transformed in order to take into account the characteristics of the sentences (i.e., length and position in the narrative as well as position in the in the experiment) and those of the participants (i.e., individual natural reading speed). Following the method introduced by Trueswell, Tanenhaus, and Garnsey (1994) and used in Gygax et al. (2007), we calculated, for each participant and separately for each sentence, a regression equation of time (i.e., reading time) against position of the

sentence in the experiment (i.e., trial number) and length (i.e., number of syllables in the sentence). We subtracted the actual reading time from the time predicted by the regression to obtain residual reading times. A positive residual reading time therefore means that the time to process the sentence was longer than expected. Residual reading times falling more than 2.5 SD above or under each participant's mean of each sentence were replaced by their cutoff value (2.4% of the data). The analyses were done on the residual reading times. All analyses were conducted both by-participants (F1) and by-items (F2) (Clark, 1973).

Sentences composing the narratives (not the target sentences)

In this experiment, we manipulated the very content of emotional narratives by varying the number and the typicality of emotion components formulated in the narratives. We hypothesized that if readers base their mental representations of the main protagonist's emotional status on stereotypical information, some presented emotion components might well have already been inferred during reading of the preceding context. Consequently, we expected the components described by typical features to be more easily included in the readers' mental model compared to the components described by less typical ones. At least, we expected to find differences in residual times between the more typical and the less typical Motor Expression component (and maybe the Psychophysiological component) when presented the second part of the narratives (i.e., when readers have had enough information available to infer the particular component). Such an effect would support Gygax et al.'s (2007)' results showing that readers may spontaneously infer behavioral components associated to the emotion.

We compared the residual reading times of the two experimental component sentences (i.e., Motor Expression and Psychophysiology) presented in the second part of the text in the *optimal* and *suitable* versions. We did not consider the *moderate* version, as the experimental component sentences were replaced by neutral sentences in this condition. As expected, when analyzing the Motor Expression component, participants were faster to read the typical Motor Expression component sentences (-86 ms) than the less typical ones (15 ms), marginally significant in the by-item analysis, $t_1(63) = 1.84$, $p = .04$ (one-tailed), $t_2(23) = 1.47$, $p = .08$ (one-tailed). This result signaled the importance of the Motor Expression component in readers' mental representations of emotion to the extent of possibly inferring the information before encountering it

explicitly if the context is strong enough. Although the data showed the same tendency for the Psychophysiology component, typical sentences (-28 ms) being read faster than the less typical ones (8 ms), it was not significant, $t_1(63) = .55$, $p = .30$ (one-tailed), $t_2(23) = .44$, $p = .30$ (one-tailed).

Target sentences including the emotion term

As for the emotion inference per se, we hypothesized that the more typical the emotion information is, the more specific an emotion inference would be. As the *optimal* version of each narrative contained all the necessary information needed to define a specific emotion, we expected that readers in this condition should be most likely to infer the intended emotion than in the two other conditions. If faster reading times mirror a better adequacy of the content of the target sentence to the content of the readers' mental representations, as argued in previous studies based on the match vs. mismatch paradigm, we should expect faster reading times of the target emotion sentence in the *optimal* than in the *suitable* condition, in turn faster than in the *moderate* condition.

Unexpectedly, our results (see Figure 5) showed the opposite pattern: there was a significant linear trend indicating that residual reading times were higher with increased typicality, $F_1(1, 63) = 5.33$, $MSE = 12092.87$, $p = .02$, $F_2(1, 23) = 4.71$, $MSE = 6252.78$, $p = .04$. Readers were slower to read the target sentences in the *optimal* version than in the *suitable* version, in turn slower than in the *moderate* version.

A careful scrutiny at the results of each narrative suggested that only two narratives elicited a reverse typicality effect (i.e., the one expected). For the narratives about *Love* and *Interest,* readers were slower to read the target sentence in the *moderate* condition and *optimal* condition. Since Scherer (2005) himself raised the issue that both *Love* and *Interest* should not be truly considered as real emotions, but more as attitudes or preferences, we considered our analyses without them. Of course, when conducting the analyses again, without the two narratives the preceding trend was enhanced, $F_1(1, 63) = 9.59$, $MSE = 14055.41$, $p = .003$, $F_2(1, 21) = 13.33$, $MSE = 8183.36$, $p = .001$.

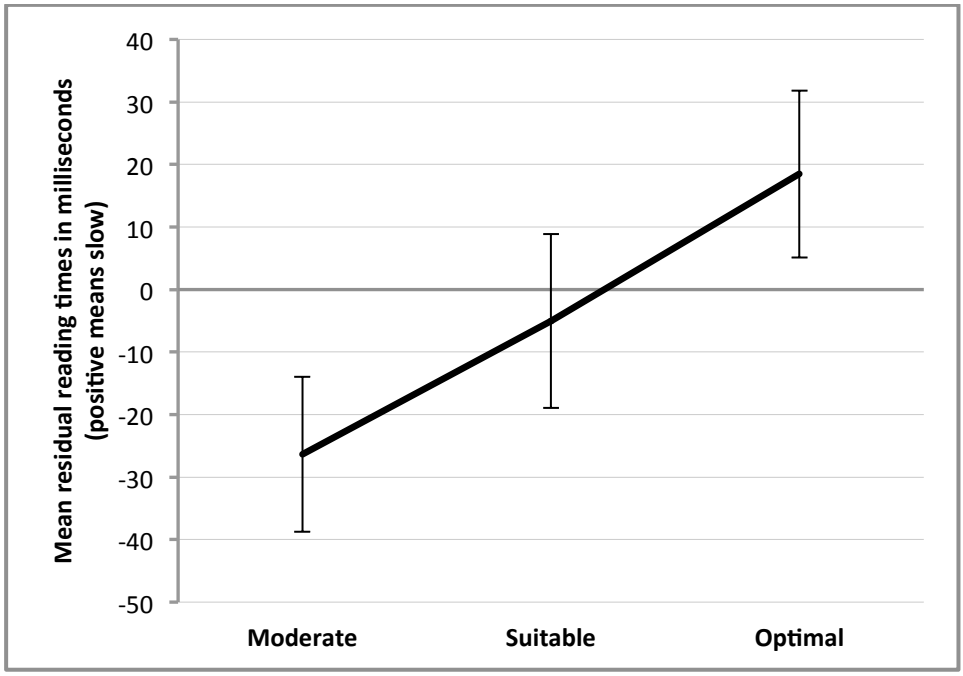

FIGURE 5. *Mean differences in residual reading times of the emotional target sentence across the three versions of the narratives in Experiment 3. The same target sentences are in different typicality contexts.*

In order to be certain that the slowdown associated to the typicality of the narrative could not be attributed to a mismatch effect associated to the fact that some participants may have considered the emotion terms in the final sentences as not appropriate (despite the results in the Pilot study), we eliminated for each reader the narratives for which they did not choose the intended emotional label in the additional post-experimental questionnaire about the emotional narratives they had just seen in the experimental task. The analyses still showed the exact same pattern, the linear trend being still present in the same direction both by-participants $F_1(1, 63) = 6.49$, $MSE = 19163.30$, $p = .013$, and by-items $F_2(1, 21) = 5.06$, $MSE = 7955.41$ $p = .035$.

One might argue that readers were slower to read the target sentence in the *optimal* version of the narrative because, as this version offers the most highly salient information to infer a specific emotion, the target sentence might be too obvious and cause a pragmatic reaction of surprise (i.e., why do they tell me, it's so obvious) leading to longer reading times. If this was the case, we should get similar effects in the Subjective Feeling component (i.e., the sentence before the target sentence), which defines a broader feeling relevant to the narrative (e.g., *felt good*, *was in an intense emotional state*) and can be consequently considered as even more obvious than the

target sentence. However, contrary to the target sentence, no influence of the version of the narrative was found on the reading times of the Subjective Feeling sentence, $F_1(2, 126) = .36$, $MSE = 25584.16$, $p = .70$, $F_2(2, 42) = .54$, $MSE = 9981.84$, $p = .59$, indicating that readers inferred the general feeling associated to the narrative as easily in the different versions of the narrative. The slowdown associated to the target sentences seems to be associated to the target sentence containing the emotion.

Before we discuss this effect in more detail and propose an explanation of the possible processes in place, it is important to note that we found no signal of any effect of our individual difference measures. The results hold across Empathy groups (low- and high-empathic participants), as well as across participants with different emotion experiences in terms of the experiences described in the narratives.

Discussion

Our results seem to challenge our initial idea that enhancing the emotional typicality in narratives contributes to more specific representations of the main protagonist's emotional status. Readers seemed indeed slower to map the intended emotions onto readers' ongoing mental representations in the *optimal*, highly typical versions of the narratives, However, sentences composed of highly typical components (and preceding the target sentences) were read faster than less typical ones, suggesting us to be somehow cautious when interpreting slower reading times.

We suggest that when confronted to congruent, yet not typical components of an emotion construct, readers keep an open representation of emotion, allowing any target (congruent) emotion to fit, or be easily map onto, the elaborated situation model (as suggested Gygax et al., 2003, 2004). When confronted to typical components and as the text itself provides sufficient information to justify a more constraining and restrictive choice, readers may engage in a process of integrating specific emotions (as specific as *sad*, or *happy*).

Different explanations may then be drawn concerning the slowdown in reading times when encountering an explicit emotion embedded in a target sentence. First, it might be the case that as readers process narrative information prior to the target sentence, they may integrate a specific emotion term that corresponds to their individual lexicon of emotion. The term integrated might not be the one presented in the target

sentence, therefore slowing down any mapping process. If this is plausible, it might be unlikely, as the emotion chosen in this experiment to be presented in the target sentences were confirmed in the Pilot study, as well as the GRID instrument created from a similar population.

A second explanation, more plausible to us, regards the Structure Building Framework (Gernsbacher, 1997), stipulating that readers habitually build mental representations based on memory nodes of previously stored memory traces, which are reactivated as the text is being processed. When pertinent memory nodes are first activated, readers build a text foundation based on them. Incoming information that activates similar memory nodes is simply mapped on to the current foundation. According to Gernsbacher (1997), building a foundation takes time whereas simply mapping new information does not, given that the new information is coherent with the foundation.

When reading narratives containing congruent yet not highly constraining information, readers keep a relatively open representation of the main protagonist's emotional state. In other words, they built a foundation composed on several components and on which different emotions can easily be mapped onto. Consequently, when encountering the target emotion in the *suitable* or the *moderate* conditions, it is very likely to be easily mapped on a relatively underspecified foundation.

When presented with narratives congruent and composed of highly constraining information, readers may activate two different yet related mechanisms. First, they may activate a suppression mechanism (Gernsbacher, 1997) and diminish the activation of memory nodes that do not fully correspond to the emotion description. Second and in parallel, they may enhance the activation of memory nodes (Gernsbacher, 1997) that are highly relevant to the emotion described in the text. In this case, fewer emotions might be easily mapped onto readers' representations. When encountering an appropriate emotion, readers may have to engage in suppression and activation processes that will result in a more specific foundation, yet taking more time to finalize it. Note that any following information, congruent but not necessarily salient, may then be more difficult to map onto readers' representations, especially if it does not completely match the information in the foundation. We put this idea to test in the following experiment.

Experiment 4:
Testing the *mapping vs. integration hypothesis*

In Experiment 3, we found slower reading times of target sentences in the condition when the narratives are composed with all salient and typical emotion features than when they were composed or several yet not all typical features. We argue that this slowdown mirrors an integration process, different from a mapping one, at the base of habitual reading times interpretations.

If readers perform a simple mapping process of a target sentence when it follows a narrative that is composed of some but not all the information needed to infer a specific emotion (i.e., the moderate version of the narrative), they should be able to easily map other following congruent yet not salient emotions onto their mental model. In other words, it should be easy to map any more congruent yet different emotions onto an underspecified mental model. In contrast, if the same congruent yet not salient emotion follows a specific representation resulting from an integration process (where a specific emotion has been integrated), this emotion will not be easily mapped onto readers' mental model. In Experiment 4, we tested this hypothesis by including a plausible yet unlikely additional emotion after the target sentence, which comprised our target emotion (as in Experiment 3)

Method

Participants

Fourty-four participants (thirty-five women) of a psychology introductory course from the University of Lausanne took part in this experiment. All participants spoke French as their maternal language. The participants were aged from 18 to 34 (M = 20.44, SD = 3.17).

Material

Emotional narratives

Considering the rather linear trend across the three conditions in Experiment 3, we decided to only use the *optimal* and *moderate* narratives in Experiment 4. By doing

this, we also increased power, as each list comprised more narratives per condition. To each initial narrative, we added a second target sentence containing a congruent emotion yet of low relevancy (i.e., unlikely to be inferred). The two emotional target sentences were structured as follows:

(1) [Main character] felt [intended emotion]. (as in Experiment 3)

(2) At the same time, [he/she] felt [congruent emotion].

The *congruent* emotion, chosen again on the basis of the features contained in the GRID instrument, was of the same valence as the *intended* emotion and shared no more than one typical feature with it. Table 8 shows all *intended-congruent emotion* pairs.

TABLE 8. *Pairs of emotions used in Experiment 4. The first emotion is the intended emotion and the second is the congruent emotion. The same emotion term never happened as an intended and a congruent emotion in the same part (except for the pairs Love-Pleasure and Pleasure-Joy. The pair Pleasure-Joy was discarded from the analyses).*

Part I		**Part II**	
Happiness	Pride	Pride	Happiness
Surprise	Contentment	Contentment	Surprise
Anger	Being hurt	Being hurt	Anger
Despair	Shame	Shame	Despair
Guilt	Disappointment	Disappointment	Guilt
Love	Pleasure	Compassion	Love
Interest	Joy	Joy	Interest
Fear	Hate	Hate	Fear
Sadness	Anxiety	Anxiety	Sadness
Stress	Jealousy	Disgust	Stress
Pleasure	Joy	Irritation	Contempt
Contempt	Disgust	Jealousy	Guilt

Importantly, congruent emotions had to be unlikely to be inferred from the narratives yet had to be coherent with the corresponding narrative to avoid incongruity effects. When creating the *intended-congruent emotion* pairs of emotions, we attempted to match them so as to maximize the possibility that each of 24 intended emotions would appear once in the *intended emotion* sentence and once in the *congruent emotion* sentence. Two intended emotions could not be used as *congruent* ones (i.e., *compassion* and *irritation*) and were replaced by two other emotions (*joy* and *guilt*). In order to ensure that the congruent emotions met the congruency requirements, six judges were asked to read the narratives and detect possible incongruences imputed to the *congruent* emotions.

Each participant saw twelve narratives in the *optimal* version and twelve narratives in the *moderate* version. Since each emotion could appear as *intended* or as *congruent*, we divided the experiment in two parts, separated by an interference task, so that each emotion could appear once in each part (once as *intended* and once as *congruent*) for the same participant. We constructed four lists to ensure that each participant would see all conditions and that each narrative would be present in each condition. Each list contained six *optimal* narratives, six *moderate* narratives and twelve filler narratives. Each participant hence saw 48 narratives, with a break (i.e., interference task) in the middle.

We also controlled for several methodological issues that may have some of the results of Experiment 3. First, we controlled for spill-over effects from a narrative onto the next one. As readers can keep an emotion representation for longer than just one or two sentences (deVega, Leon, & Diaz, 1996), an emotion inference may well interfere with the processing of a subsequent narrative, especially if the latter is also relevant to emotion representations. Readers may have to engage in simultaneous activation (of the new components) and inhibitory (of the previous components) processes. To control this issue, we used the same filler narratives as in Experiment 3, but, although chosen randomly, always inserted them between the experimental narratives.

Interference task

The Eriksen flanker task (Eriksen & Schultz, 1979) was used as an interference task to separate the two parts of the experiment. In this task, participants see an arrow pointing to the left or the right in the middle of the screen. This arrow is surrounded by

other arrows pointing either in the same (congruent condition) or in a different direction (incongruent condition), or by straight lines (neutral condition). The participants have to indicate as fast as possible the direction to which the middle arrow is pointing. As participants quite automatically process the surrounding arrows, response times are higher in the incongruent condition (when surrounding arrows point to the opposite direction as to the target arrow) than in the neutral and the congruent conditions. Although one could argue that inhibitory processes may be central in reading comprehension, we considered this task only as an interference task, therefore do not present any analyses pertaining to this measure.

Questionnaire on emotions proximity

As their contribution was rather small, we replaced the *Identification* and *Relevancy* questionnaires used in Experiment 3 (but kept the Interpersonal Reactivity Index) with a questionnaire on emotion proximity in order to control that the emotions chosen for the *congruent* sentences were considered as mismatching. The questionnaire comprised the experimental pairs (e.g., happiness-pride, despair-shame) and 18 filler pairs that were either highly similar (e.g., joy-happiness) or highly dissimilar (e.g., shame-pride). The participants were asked to evaluate on a 8-point scale (*0 = not at all*, *7 = completely*) the extent to which the emotions presented in each pair were similar.

Procedure

The same procedure as in Experiment 3 was used. Each narrative was presented one sentence at a time. Participants were asked to read the sentences at their normal pace, as if they were at home reading a magazine. At the beginning of each narrative, the message Are you ready? appeared on the screen. Participants pressed the Yes button in order to make the first sentence appear and to move forward in the narrative after each sentence. Some narratives (n = 14) were followed by a question related to the text that required a Yes or No answer in order to ensure that all participants paid adequate attention to the narratives. Before the beginning of the experiment participants were presented with three practice narratives.

After completion of the first part of the self-paced reading experiment (i.e., half of the narratives were presented), participants were asked to do the flanker task before

seeing the second part of the experiment. At the end of the experiment, the participants filled in the IRI and the questionnaire on emotion proximity.

Results

The same data transformation as in Experiment 3 was applied in Experiment 4 and all analyses were performed on the residual reading times. 4.7 % of the data were replaced by their cutoff values.

Relevancy of the emotional pairs

The choice of the emotion pairs was confirmed by the questionnaire on emotion proximity. The participants estimated that the emotions in each pairs were similar but not synonym (M = 4.36, SD = 1.07). This ensured that any expected differences between target sentences were not due to mismatch effects. Note that this proximity was not appropriate for two pairs (*pleasure-joy* and *irritation-contempt*), hence we discarded them for further analyses.

Sentences composing the narratives (not the target sentences)

As opposed to Experiment 3, in this experiment we did not manipulate the typicality of the emotion components presented in the narratives per se (i.e., the difference between the *optimal* and *suitable* versions) but mainly manipulated the number of these components (i.e., five vs. three). If this manipulation did not allow us to compare Experiment 3 to this one in terms of the Motor Expression component, we were nonetheless interested in the results linked to the Subjective Feeling component (similar in both conditions). In Experiment 3, this component inference did not seem to be influenced by the version of the narrative in which it appeared. However, we still expected the Subjective Feeling component to be read faster in the *optimal* than in the *moderate* version of the narratives. This would reflect that readers easily map this broad emotional information onto their mental representation of emotions. Supporting this idea, results showed that readers were faster to read the Subjective Feeling sentence in the *optimal* (-159 ms) *than* in the *moderate* condition (-31 ms), $t_1(42) = 4.78$, $p < .001$, $t_2(23) = 3.47$, $p < .01$.

Target sentences including an emotion term

We first expected to replicate the results of Experiment 3 as to the *intended* emotion target sentence (i.e., slower reading times in the *optimal* than in the *moderate* version). Second, we expected that, in both conditions, readers would slowdown when encountering the second target sentence, as this sentence contained an emotional word unlikely to have been inferred during reading, yet still plausible (i.e., test of the ease to map the information onto readers' mental models). Third and finally, we expected slower reading times for the *congruent* emotion in the *optimal* than in the *moderate* version of the narratives. In the former version, readers may have more difficulty to map the *congruent* emotion onto a specific mental representation of emotion (i.e., highly constraining foundation), whereas in the latter version, the rather unspecific nature of the emotion representation might ease the mapping process.

A first glance at the data signaled that, as in Experiment 3, the narratives on *Love* and *Interest* had to be discarded from the analyses. As discussed earlier, it could be argued that they may actually not be considered as emotions. Figure 6 shows the residual reading times of the intended target sentences and the congruent target sentences in Experiment 4.

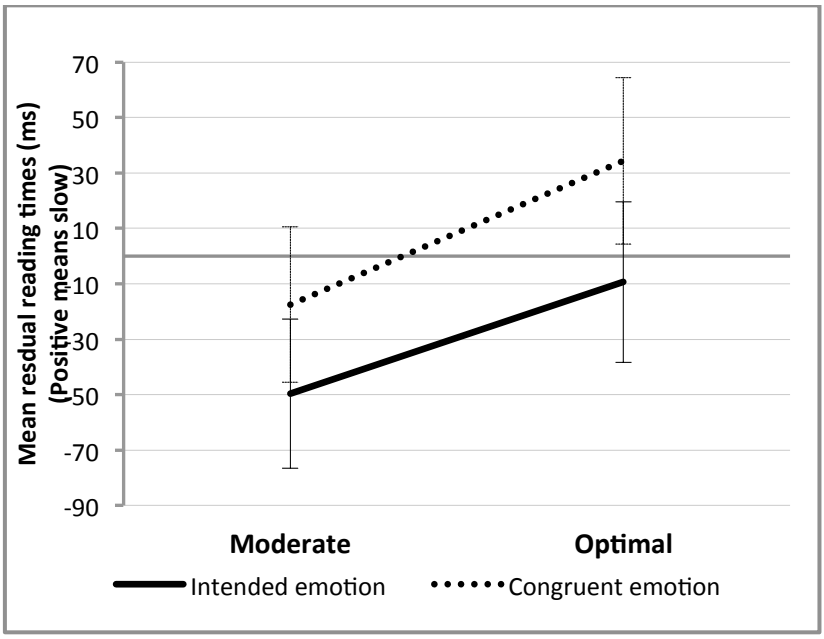

FIGURE 6. *Residual reading times of the emotion target sentences in the different versions of the narratives in Experiment 4.*

One-tailed paired comparisons (i.e., planned comparisons) conducted on the residual reading times showed that, as expected, readers were faster by 40 milliseconds to read the *intended* emotion target sentence in the *moderate* version than in the *optimal* version, $t_1(42) = 2.66$, $p = .01$, $t_2(19) = 1.67$, $p = .06$. Interestingly, and as expected, this was also the case for the *congruent* target sentence, but to a greater extent, as readers were faster by 52 milliseconds to read the *congruent* emotion target sentence in the *moderate* version than in the *optimal* version, $t_1(42) = 1.87$, $p = .035$, $t_2(19) = 1.82$, $p = .04$. This numerical difference between the slopes of the two target sentences is most interesting. Again, note that in the *congruent* target sentence, the information presented was an *easy-to-map* one, yet in the *optimal* version, it seemed difficult to map, at least compared to the *moderate* version.

This latter point was also apparent when considering the target sentences within the typicality conditions. The *congruent* emotion target sentence in the *optimal* version was read slower than the *intended* emotion, significantly by-participant $t_1(42) = -2.65$, $p = .006$, marginally significantly by-item, $t_2(19) = -1.40$, $p = .09$, whereas the difference in the *moderate* version was only significant by participant, $t_1(42) = -4.74$, $p < .001$, $t_2(19) < 1$ (See Figure 6).

If an interaction effect (Target by Version) would have been ideal to illustrate our point, our data still support two ideas: (a) readers most likely integrate the emotion included in the *intended* emotion target sentence (hence slower times) in their mental representation of emotion, (b) the latter being highly specific (contrary to what was claimed in past research) to the extent of making it difficult for readers to map any congruent information onto it.

Discussion

In Experiment 4, we replicated the results of Experiment 3 regarding the *intended* emotion target sentence: readers were slower to read the target sentence containing the *intended* emotion when the narratives conveyed all the relevant information compared to when they conveyed only some components of the emotion. Although we have to consider reading times of both sentences as reflecting different processes, mainly due to the very different nature of the information presented (i.e., highest congruency vs. lowest congruency), readers were also slower to read the

following *congruent* target sentence containing a plausible yet unlikely emotion in the *optimal* version than in the *moderate* version. Most importantly, the difference between two versions was, at least numerically, highest in the *congruent emotion* condition.

These results support our integration hypothesis: readers seem to build a specific foundation based on the *intended* emotion when the information available is highly salient and typical, and that further processing of congruent yet not salient emotion information is rendered more difficult.

Experiment 5:

Less obvious target sentences

In Experiments 3 and 4, we relied on an *optimal* vs. *moderate* congruent paradigm to investigate the specificity of emotion inferences. We found that the more the narrative contained congruent information, the more the readers needed time to process the target sentence containing the emotional state of the protagonist. We interpreted these findings as mirroring an integration process triggered by the constraining nature of the narratives in the optimal condition.

An alternative explanation for this increase in reading times associated to the increase in emotion information contained in the narrative may be a pragmatic reaction of surprise (as already introduced in Experiment 3). When encountering the target sentence, which explicitly states that the protagonist is experiencing a specific emotion, readers may be disturbed in their normal reading process as they may find this information so obvious that they wonder why the narrator would bother to give it. If this surprise effect may exist in the moderate version of the narratives, it would be more likely to happen in the optimal version of the narrative (where the emotion word in the target sentence may be most redundant), hence possibly leading to the linear trend shown in the previous experiments.

In the present experiment, we investigated this issue by modifying the target sentences presented at the end of the narratives in order to make them less obvious. Instead of stating that the protagonist is experiencing an emotion, the new target sentences stated that *because* of the experienced emotion, the protagonist reacted in some particular way. These new target sentences should be less obvious, as they do not only explain what emotion the protagonist is feeling but also end the narrative in a more natural way (i.e., *that's what he/she did*).

If the surprise hypothesis were true, the slowdown associated to more relevant emotion information should not be present with the less obvious target sentences and the usual pattern of reading times should appear. That is, the reading times of the target sentences should be faster in the optimal than in the moderate version of the narrative.

Method

Participants

Sixty participants (13 men and 47 women) from the University of Fribourg participated in this experiment. The participants were aged from 18 to 41 (M = 21.72, SD = 4.55). All participants were native French speakers. Due to unusually long reading times, two participants were discarded from the analyses.

Material

The same emotional and filler narratives as in Experiment 3 were used in this experiment. The target sentences were modified so as to transmit less obvious information than in previous experiments and were structured as such:

(Part I of the sentence): As [he/she] felt [target emotion],

(Part II of the sentence): [main character did something].

The second part of the sentence was elaborated so as to convey only already known information (i.e., related to the Action Tendency or to the Appraisal component described in the narrative). For example, in the Happiness narrative, the Action Tendency component (i.e., wanting to sing and dance), already made explicit in the narrative, was included in the target sentence: *As she felt happy, Sarah danced until the end of the night*.

This choice was made in order to ensure that the time needed to process the second part of the target sentence was very unlikely to reflect an inference process related to this part of the sentence, as readers had already been presented with the information put in it. It also gave the possibility to analyze the processing time of the second part of the sentence in order to investigate possible spill-over effects coming from the processing of the emotion word present in the first part of the sentence.

In order to get the participants used to seeing some of the sentences appear one part after the other, we also separated other sentences of the narratives. This was always the first sentence (i.e., the context sentence) of the experimental narratives in the optimal and suitable versions. Half of the narratives in the moderate version also presented the first sentence in two parts and the other half presented either the second

sentence or the third sentence (i.e., a filler sentence replacing the Motor Expression or the Psychophysiological component) in two parts.

Procedure

The same procedure as in Experiments 3 and 4 was followed in this experiment. Participants had to read the narratives at their own pace. Each narrative was presented one sentence at a time. At the beginning of each narrative, the message Are you ready? appeared on the screen. Participants pressed the Yes button in order to make the first sentence appear and to move forward in the narrative after each sentence. Some narratives (n = 14) were followed by a question related to the text that required a Yes or No answer in order to ensure that all participants paid adequate attention to the narratives. Before the beginning of the experiment participants were presented with three practice narratives.

After the completion of the self-pace reading task, participants filled in the Interpersonal Reactivity Index and the questionnaire about the emotional narratives. The whole testing session lasted approximately 45 minutes.

Results

Data transformation

Before conducting the analyses, reading times were transformed to residual reading times as in Experiments 3 and 4. Residual reading times were calculated based on a regression of time (i.e., reading time) against position of the sentence in the experiment (i.e., trial number) and length (i.e., number of syllables in the sentence) for each participant and separately for each sentence. Residual reading times that were more than 2.5 *SD* above or below each participant's overall mean were replaced in the analyses by the cut-off values (2.5% of the data). Positive residual reading times mean slower time to process the sentence.

Sentences composing the narratives (not the target sentences)

As in Experiment 3, the number and typicality of the features describing the emotional components present in the narratives was manipulated. We therefore present here the same analyses as those performed in Experiment 3 regarding the different

emotion components. As in the aforementioned experiment, we expected readers to base their emotion inferences on the different emotion components and consequently to infer these components whilst reading the emotional narratives. According to this hypothesis, we expected faster reading times for the component sentences described by typical features than for those described by less typical features. When comparing the reading times of the experimental component sentences (i.e., Motor Expression and Psychophysiology), participants showed the same tendency as those found in Experiments 3 and 4, yet the differences were not always significant. The typical Motor Expression component sentences were read faster (-13 ms) than the less typical ones (65 ms), yet not significantly faster, $t_1(57) = 1.09$, $p = .14$ (one-tailed), $t_2(23) = .88$, $p = .19$ (one-tailed). The same result came out for the Psychophysiology component sentences, the typical sentences being read on average only 35 ms faster than the less typical ones, $t_1(57) = .88$, $p = .19$ (one-tailed), $t_2(23) = .37$, $p = .36$ (one-tailed).

As in previous experiments, we expected the Subjective Feeling sentences to be read faster in the optimal than in the suitable condition, in turn faster than in the moderate condition. If the residual reading times showed this tendency to decrease with more congruent information in the narrative, the linear trend did not reach significance, $F_1(1, 57) = 2.39$, $p = .13$, $F_2(1, 23) = 1.26$, $p = .27$.

Target sentences including the emotion term

This experiment aimed at ruling out the possibility that the linear trend found in Experiments 3 and 4 was due to a surprise effect when encountering the target sentence. If the surprise hypothesis were true, the reading times associated to the new target sentences should decrease with more information transmitted in the narrative, so as to mirror previous results found using the match vs. mismatch paradigm (i.e., faster reading times in the congruent condition). Table 9 presents the mean residual reading times for the different parts of the target sentences in the three versions of the narrative.

A repeated measures ANOVA on the residual reading times of the first part of the target sentence (containing the emotion word) revealed no differences between the three contexts of congruency either when all narratives were taken into account, when the same two narratives as in the previous chapter (i.e., Love and Interest) were discarded from the analyses or when we considered only the narratives for which the participants totally agreed with the intended emotion term (all $F_s < 1$).

TABLE 9. *Mean residual reading times in milliseconds (and standard errors) of the target sentences in the different versions of the narratives in Experiment 5 (Positive residual time means slower reading time).*

Versions	First part of the target sentence	Second part of the target sentence	Whole target sentence
Optimal	4 (11)	26 (18)	5 (13)
Suitable	6 (16)	1 (21)	-10 (16)
Moderate	20 (11)	-3 (16)	-8 (14)

As the first part of the sentence was relatively short (i.e., between five and eleven syllables) and consequently easily kept in memory, it may be possible that readers did not thoroughly process its content before pressing the button to move on in the narrative, hence continuing its processing when reading the second part of the sentence. In order to verify these potential spillover effects, a repeated measure ANOVA was done on the residual reading times of the second part of the target sentence. Again, no differences appeared between the three versions of the narratives (all $F_s < 1$). We completed the analyses by calculating residual reading times of the whole target sentences (both parts together) and ran a repeated measures ANOVA on these new residual times that again did not show any significant differences between the different versions of the narratives (all $F_s < 1$).

Discussion

In this experiment, we expected to replicate the results found in Experiments 3 and 4 when using less obvious target sentences. When looking at the results, it first appeared that readers did not show the preference for emotion components described by typical features compared to that described by less typical features found in Experiment 3. Secondly, we did not replicate the pattern of reading times associated to the Subjective Feeling component sentences.

In addition, no differences in reading times of the target sentences between the versions of the narratives were found in this experiment. In order to rule out the surprise hypothesis that this experiment aimed at testing, we expected the same pattern of

reading times regarding the target sentences than that we found in Experiments 3 and 4. This pattern was however not demonstrated here. Nevertheless, the pattern of reading times of the target sentences found in this experiment does not permit us to conclude that a surprise effect was the basis of the previous experiments' results. Still, it is possible to hypothesize that rendering the target sentences less obvious may have attenuated a potential surprise effect without allowing readers to completely suppress it. Reading times of the target sentences indeed showed a change of pattern that might lead to the expected reverse pattern if the sentences were made even less obvious.

If this last hypothesis may be plausible, we favor an alternative explanation directly linked to the manipulation intending to make the target emotion sentences less obvious. By integrating the emotion term in the first part of target sentences describing the protagonist's action, we may have changed the nature of the processes applied to this emotional information. Specifically, providing readers with the statement As [he/she] felt [target emotion] may have made the emotion information less central than when providing them with a sentence describing the emotion component. In this experiment, the emotion felt by the protagonist may have been considered as a cause for their behavior. In this sense, the focus of the target sentences may have been on its second part, not on the part containing the emotion term. The reading times of the first part of the target sentences somehow support this assumption (i.e., readers were faster in the moderate than in the optimal condition).

Finally, we could also hypothesize that as the first part of the target sentences were relatively short (as said earlier), the processing of the emotion term may have overlapped with the processing of the second part of the sentence. In our analyses, we took this into account by looking at the reading times of the second part of the target sentences. However, spill-over effects are generally occurring on the word following to word of interest (Rayner, 1998). Consequently, by looking at the reading times of the whole second part of the narratives, potential spill-over effects may not have been detected (i.e., confounded in the whole sentence part reading time).

Chapter discussion

In the experiments presented in this chapter, we assessed the specificity of emotional inferences using a *congruency levels* paradigm. Contrary to the usual *match vs. mismatch* paradigm, this paradigm allowed us to investigate fine-grained processes involved when different typicality contexts constrain readers' mental models. The rather small yet highly informative reading time differences found in our experiments suggest deeper elaborating processes than the ones investigated so far with the habitual *match vs. mismatch* paradigm.

Our results also generally suggest that past research on emotion inferences may have failed to address these processes simply because their narratives were unfortunately not constructed with rigorous attention to the emotion construct literature. Here, we propose that the GRID instrument (Fontaine et al., 2007; Fontaine et al., in press; Scherer, 2005) is a good base on which to create the materials necessary to investigate emotion inferences.

Still, we propose that generally, when reading narratives about emotions, readers elaborate mental representations of the protagonist's emotional state based on the available features of the components of this emotion. These representations may remain quite open (i.e., any congruent emotion can be mapped onto them) as long as the narratives do not constrain them by conveying necessary components and their associated typical and salient emotion features. When these are conveyed, readers may gradually build a strong and specific foundation based on the relevant emotion. Other incoming information, even if congruent, may be much more difficult to map onto the resulting representation than if mapped onto an underspecified representation.

In terms of past research, Gernsbacher and colleagues were right to assume that specific representations of emotions were possible, yet they failed to clarify the necessary conditions for them to happen. Gygax and colleagues were right to assume that under normal conditions, readers build rather broad representations of emotion, onto which a large number of emotions can be mapped onto, yet they failed to acknowledge the possibility of specific emotion representations. Still, Gillioz et al. (2012), did try to investigate individual differences that might have resulted in more specific representations of emotions, and to a certain extent, they managed to do so. Both teams however reached their conclusions without carefully and appropriately

considering the emotion construct conveyed by their narratives. Note that Gygax et al. (2004), when questioning the content of their narratives, were in the right direction – without truly targeting the exact problem though –, and their results, if one considers only their matching conditions, were very similar to the ones found in this chapter (i.e., the more congruent the slower the reading times). However, since they concentrated on the *match vs. mismatch paradigm*, any signals of congruency level differences were absorbed by the (mighty) incongruence effects.

As a final note, if our data constitute an initial step towards conciliating psycholinguistic research on emotion inferences and emotion construct research, one could also explain our results, especially the unexpected ones, in other ways. For example, we interpreted longer reading times as reflecting integration processes, but actually, we may have looked at attention processes. As the narratives were highly relevant in the *optimal* condition in terms of the protagonist's emotional status, participants may have allocated more attention to the target sentences, without really having to integrate the information included in them into their mental models. Also, it could be that participants may have included specific emotions, justified by the constraining context, and that the level of individual specificity might mean that they included something different then what we suggested in our target sentences (hence longer reading times).

Anyways, these explanations lead to the same conclusion, which we would like to stress as a take-home message and settle the specificity issue: given the appropriate emotion context, readers can infer specific emotions when reading.

6. Going Beyond the Match vs. Mismatch Effect: Back to Empathy Issues

Experiment 6 : Priming empathy

In previous experiments (i.e., Experiments 1 and 2), we showed no influence of the participants' empathy level on the emotion inferences made during reading. We interpreted this fact by assuming that generating emotion inferences is quite automatic and independent of some individual factors. However, an alternative explanation may come from the relative homogeneity regarding some individual factors in the student samples having taken part in our experiments. If it is common in psychology to recruit psychology students as participants, this may be a problem when it comes to investigating a potential effect of the empathy level on the dependent variables.

Additionally, it may be argued that the empathy level considered in previous experiments and measured via the Interpersonal Reactivity Index (Davis, 1980, 1983) relates more to a stable trait than to empathic reactions that someone may have in response to the protagonist's situation in a narrative. We actually took this fact into account by looking at the Fantasy scores (i.e., the tendency to transpose themselves into a fictional character's shoes) in addition to the general empathy score in Experiments 1 and 2, but we nevertheless think that directly manipulating the empathic state of the participants may further shed light onto the link between empathy and emotion inferences. In the present experiment, we tried to stimulate the participants' empathic level by manipulating the social context in which the experiment took part.

The social sharing of emotion is a process in which people communicate with target persons about some emotions they experience in their life (Rimé, 1989). When listening to a shared emotional episode, people activate mental images of the described situation that reactivate bodily reactions associated to similar situations they have already encountered (Rimé, 2005), a process similar to the simulation process described earlier (e.g., Barsalou, 1999b; Glenberg, 1999).

The impact of the social sharing of emotion on the persons implicated in the communication event was investigated by Christophe and Rimé (1997). These authors

used a retrospective method (e.g., Scherer & Wallbott, 1994) in which the participants have to recall an emotional event and answer questions about specific aspects of this event. In Christophe and Rimé's (1997) study, the participants had to recall an event in which someone shared an emotion with them. They were then asked to rate the emotion they felt during the social sharing of the emotion episode. In this study, Christophe and Rimé (1997) showed that the social sharing of emotion has an emotional impact on the target persons involved in it, notably by inducing them to feel some emotions and triggering them to share these emotions with other persons. This study further showed that the more intense the shared episode is, the more the listener is aroused and experiences emotion in response to the episode. Rimé (2005) adds that when listening to the shared experience, the listener shows support and physical contact towards the person sharing their emotion in order to create connections with them. Additionally, Collins and Miller (1994), in a meta-analysis on the link between self-disclosure (i.e., the act of revealing information about oneself to another) and liking, reported that generally the listener develop positive beliefs about the persons disclosing personal information about themselves. On this basis, Rimé (2005) further argued that the social sharing of emotion promotes empathic processes.

In this experiment, the activation of empathic processes was manipulated via the context in which the experiment took place. We asked participants to go through the reading task (as in Experiments 3, 4 and 5) in pairs. Some of these pairs had to complete a *social sharing of emotion* task before actually reading the narratives. We expected these participants to be more empathic during the reading task, hence more focused on the protagonist's emotional state. Consequently, if the readers' empathic state had an impact on the specificity of emotion inferences, the patterns of reading times of the target sentences should vary between the different groups of participants.

Method

Participants

Thirty-six participants (6 men and 30 women) from the University of Fribourg participated in this experiment. The participants were aged from 18 to 38 (M = 21.53, SD = 3.36). All participants were native French speakers.

Materials

Experimental and filler narratives

The same emotional and filler narratives as in Experiment 3 were used in this experiment. As we were principally interested in the influence of empathy on readers' emotion representations and not on the construction of these representations, the order of the components in the narratives was not fully randomized. Hence, contrary to Experiments 3, 4 and 5, only three lists of narratives were used in this experiment (i.e., half of the narratives were presented with the experimental components in the beginning and half with these components in the end).

Empathy manipulation

In order to manipulate the participants' empathy, we tested randomly assigned pairs of participants who did the reading task simultaneously. We tried to recreate a situation mirroring an episode of social sharing of emotion, hence promoting empathic processes in the listener (Rimé, 2005). In order to do so, one participant in the pair was asked to recall an emotional episode that happened recently and explain it to the other participant who was asked to carefully listen. This corresponded to the social sharing of emotion condition.

We created a second condition in which empathic processes were not promoted by the social sharing of emotion. This condition also allowed controlling for the activation of empathic processes potentially resulting from the fact that the participants did the experiment together. One participant in this condition was given a task that had no relation with emotion or empathy processes (i.e., they were asked to solve simple mathematic equations). A second control regarding a potential activation of empathy in response to the act of simply expressing one's emotion was done by asking the second participant to write down a recalled emotional event. Crucially, in both conditions, complete confidentiality was assured to the participants who were asked to recall their personal event.

In sum, the participants were assigned to one out of four conditions regarding two factors: interaction and narration. The first factor, Interaction, was manipulated between groups of participants. That is, in the Interaction condition, both participants were asked to interact with each other whereas in the No Interaction condition, they had to

accomplish a task independent to each other. The second factor, Recall, was manipulated within groups of participants.

The participants' level of empathy was assessed with two items. They were asked to evaluate on a 5-point scale (*0 = not at all, 4 = totally*) the extent to which (1) they felt close to the other participant and (2) they had put themselves in the other participant's shoes.

Procedure

After the empathy manipulation, the participants were asked to evaluate their empathy level. This was followed by the reading experiment. Each narrative was presented one sentence at a time. Participants were asked to read the sentences at their normal pace, as if they were at home reading a magazine. At the beginning of each narrative, the message Are you ready? appeared on the screen. Participants pressed the Yes button in order to make the first sentence appear and to move forward in the narrative after each sentence. Some narratives (n = 14) were followed by a question related to the text that required a Yes or No answer in order to ensure that all participants paid adequate attention to the narratives. Before the beginning of the experiment participants were presented with three practice narratives.

After the completion of the self-pace reading task, participants filled in the Interpersonal Reactivity Index, the questionnaire about the emotional narratives and were asked to re-evaluate their empathy level. The whole testing session lasted approximately 45 minutes.

Results

Data transformation

Reading times were transformed in order to take into account the characteristics of the sentences (i.e., length and position in the narrative as well as position in the in the experiment) and those of the participants (i.e., individual natural reading speed). Following the method introduced by Trueswell, Tanenhaus, and Garnsey (1994) and used in Gygax et al. (2007), we calculated, for each participant and separately for each sentence, a regression equation of time (i.e., reading time) against position of the

sentence in the experiment (i.e., trial number) and length (i.e., number of syllables in the sentence). We subtracted the actual reading time from the time predicted by the regression to obtain residual reading times. A positive residual reading time therefore means that the time to process the sentence was longer than expected. Residual reading times falling more than 2.5 SD above or under each participant's mean of each sentence were replaced by their cutoff value (3.5% of the data).

Empathy manipulation

Following Rimé's (2005) findings that empathic processes are promoted by the social sharing of emotion, we expected the participants' level of empathic feelings to be higher in the Interaction condition compared to the No Interaction condition. We also expected Recall to interact with Interaction: Whereas empathy may be more promoted in participants in the No Recall condition when confronted with the Interaction situation, it may be more promoted in participants in the Recall condition when in the No Interaction condition.

A 2 (Time: Before Reading vs. After Reading) X 2 (Interaction: Interaction vs. No Interaction) X 2 (Recall: Recall vs. No Recall) mixed ANOVA on the mean empathy scores considering Time as an intra-participant measure and Interaction and Recall as inter-participants measures revealed a main effect of Time $F(1, 32) = 12.87$, $p = .001$ showing that the participants reported more empathic feelings after ($M = 1.68$, $SE = .15$) than before the reading task ($M = 1.35$, $SD = .11$). This suggested that being in the same room as another person and performing the task simultaneously may suffice to trigger empathic feelings. The analysis also showed a main effect of Interaction, $F(1, 32) = 21.25$, $p < .001$, and a main effect of Recall, $F(1, 32) = 5.18$, $p = .03$. Generally and as expected, the participants in the Interaction condition reported higher empathic feelings ($M = 2.1$, $SE = .17$) than the participants in the No Interaction condition ($M = .93$, $SE = .19$). Surprisingly, the participants in the No Recall condition also reported higher empathic feelings ($M = 1.80$, $SE = .19$) than that in the Recall condition ($M = 1.23$, $SE = .17$). These main effects were qualified by a Time by Interaction, $F(1, 32) = 12.87$, $p = .001$, and a Time by Recall, $F(1, 32) = 10.71$, $p < .01$, interaction effects but no Interaction by Recall interaction effect, $F(1, 32) = .76$, $p = .39$.

As shown in Figure 7, in the Interaction condition, the participants' reports were stable before and after the reading task whereas they increased in the No Interaction

condition. In a similar fashion, the participants in the No Recall condition were stable across the experiment, although the participants in the Recall condition reported higher empathic feelings at the end of the reading experiment compared to the beginning of the experiment.

The participants showing the highest empathic feelings were, as expected, persons who were asked to listen to the other participant's emotional experience (Interaction-No Recall). They were followed by participants asked to share a personal emotional experience (Interaction-Recall).

However and contrary to what was hypothesized, the participants in the No Interaction-No Recall condition (i.e., that solved arithmetic simple operations) reported more empathic feelings than the participants in the No Interaction-Recall condition. This may follow from the fact that recalling a personal emotional experience and putting it on paper instead of sharing it may only activate self-directed feelings but not other-directed feelings present in empathy.

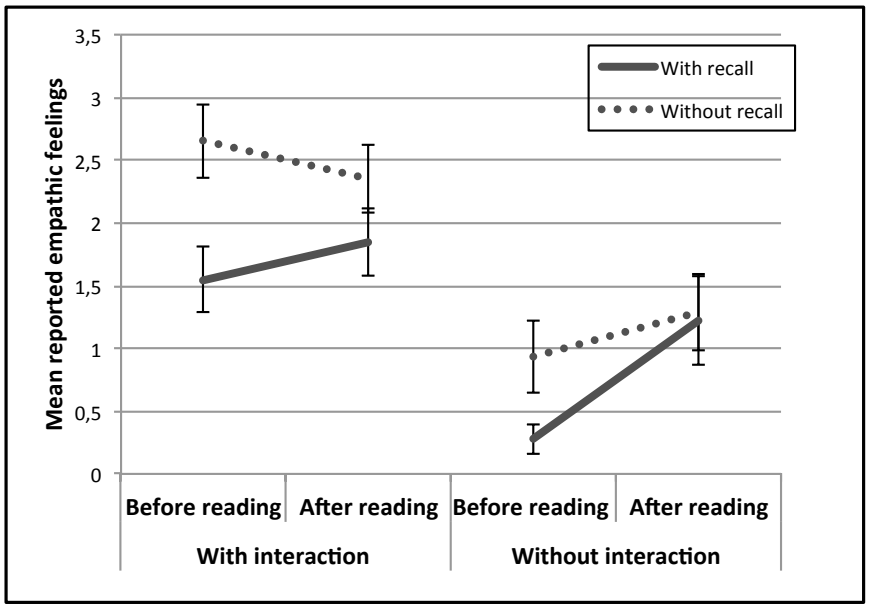

FIGURE 7. *Mean reported empathic feelings in the different empathy conditions in Experiment 6. Participants had to rate the extent to which they felt close to the other participant and put themselves in the other participant's shoes on a scale from 0 (not at all) to 4 (totally).*

Sentences composing the narratives (not the target sentences)

Given that the narratives were presented in only one component order, it was not possible to compare the reading times of the experimental component sentences between the suitable and optimal versions. However, we still expected the Subjective Feeling component to be read faster in the optimal than in the suitable, in turn in the moderate version of the narratives. Contrary to our expectations, no difference was revealed between the three versions, $F_1(2, 70) = .65$, $p = .52$, $F_2(2, 46) = .57$, $p = .57$ (see Table 10).

Target sentences including the emotion term

In this experiment, we first expected to replicate the linear trend found in Experiments 3 and 4. Contrary to our expectations, there was no difference in the reading times of the target sentences between the different versions of the narrative when all narratives were taken into account (see Table 10), nor when the same two narratives as in the previous chapter were discarded from the analyses (i.e., Love and Interest) nor when we considered only the narratives for which the participants totally agreed with the intended emotion term (all $F_s < 1$).

When including the Interaction and Recall variables in the analysis, no interaction effect with the Version of the narrative was found. We then separated the participants into a higher empathy group ($n = 17$, $M = .76$, $SD = .51$) and a lower empathy group ($n = 19$, $M = 2.47$, $SD = .48$) regarding their mean score of reported empathic feeling. When running the analysis with this new factor, no additional interaction effect was revealed.

TABLE 10. *Mean residual reading times (and standard errors) of the experimental sentences in the different versions of the narratives in Experiment 3 and in this experiment (Positive residual time means slower reading time).*

	Target emotion sentences		**Subjective Feeling sentences**	
Version	Experiment 3	This experiment	Experiment 3	This experiment
Optimal	18 (13)	12 (14)	-126 (19)	-33 (24)
Suitable	-5 (14)	17 (18)	-102 (18)	-56 (20)
Moderate	-26 (12)	25 (15)	-111 (19)	-16 (24)

Discussion

In this experiment, we tried to directly manipulate the readers' empathy with the context in which the reading experiment took part. We expected that empathy processes would be promoted in the group of participants exposed to the social sharing of emotion compared to the group of participants asked to perform the reading task together without communicating about emotions prior to the task. The measures of reported empathy showed that the participants in the interaction condition felt more empathic with their paired participants. In this sense, our manipulation seemed to have promoted empathic processes among the targeted participants. However, the reported empathy in the interaction group, if it was higher than in the no interaction group, was still not maximal (i.e., 2.1 on a scale with a maximum of 4). This can be explained by the differences between our experimental condition and the natural situations in which people usually decide to share some of their feelings. In natural situations, the addressee is generally an intimate person with which the communicator decides to share a personal experience (Christophe & Rimé, 1997). This was not the case in our experiment: The participants were not intimate even if they knew each other given that they followed the same cursus of studies. This last fact may also have affected the social sharing of emotion as the participants may not have wanted to share an important emotional episode with their paired participants. Since the intensity of shared emotional episodes has a direct relation with the emotions felt by the listeners (i.e., the more intense they are, the more the listeners are likely to be aroused) (Christophe & Rimé, 1997), sharing episodes of low intensity may not conduct the promotion of empathic processes. In addition, Collins and Miller (1994) reported that the content, either positive or negative of the shared episode has an impact on the feelings activated in the listener. When negative events are shared, less positive beliefs about the person are activated than when positive events are exchanged. In this experiment, given confidentiality issues, no data were collected regarding the content of the events described by the participants, hence not allowing us to examine more deeply this issue.

It might be argued that this relative failure to promote empathic processes among participants could be an explanation for the lack of differences in emotion processing between the groups of participants. An alternative explanation lies in the fact that no control was done on the content of the emotional episodes shared between participants in

the *Interaction* condition and transcribed by the participants in the *No Interaction* condition. It seems plausible that some participants shared positive emotional events whereas some other participants shared negative emotional events. (Re)activating the representations linked to these events may have promoted better comprehension of positive or negative emotions presented in the narratives. On a similar note, if emotion comprehension via simulation is favored when the readers' body and subjective states are congruent with the emotion in the narratives, then these processes might have been impaired for some narratives in this study. In further research, it would be relevant to manipulate and control the valence of shared episodes as well as their intensity by presenting the participants to a pretend participant (i.e., an accomplice).

Nevertheless, when relying only on the reported empathy scores without taking into account the empathy condition, no additional effect of empathy on reading times of emotion sentences was found. These last results suggest that emotion inferences are driven quite automatically and that their specificity may not depend on general empathic capacities and support previous findings reported in Chapter 3.

Concerning the specificity of emotion inferences, this experiment failed to replicate previous results regarding the pattern of reading times of the target emotion sentences. Again, the changes in the experimental conditions may have conducted the participants not to process the narratives in the same manner than in Experiments 3 and 4. For example, hearing the paired participants going through the narratives (i.e., by hearing the button being pressed) may have brought distraction in the experiment. Finally, the fact that the null effects reported here result from a lack of statistical power cannot be excluded.

7. Summary and General Discussion

The aim of this thesis was to investigate the specificity of emotion inferences and the different factors that may allow readers to integrate specific emotion labels in their representations of the text. The different factors under investigation were related either to top-down (i.e., linked to the readers' characteristics and strategies used during reading) or bottom-up processes (i.e., linked to the content of the narratives). In the experimental part of this thesis, it was suggested that individual differences play only little role in the specificity of emotion inferences. This can be explained by the fact that readers do not need to integrate specific emotion representations during reading. However, we strongly argue that when the text constrains, or encourages (in term of emotion content), specific emotion representations, readers are likely to include specific emotion label in their mental models of the text. These results are discussed after the presentation of a summary of this thesis' results.

Summary of findings

In Chapter 3 it was first hypothesized that individual differences such as empathy level and working memory capacities may explain the complexity of emotion inferences. In addition, it was hypothesized that emotion inferences may be influenced by the readers' involvement in the narratives through *simulation* and *elaboration time* constraints during reading. To investigate these issues, two experiments were conducted, based on the same narratives as in Gygax et al. (2007). In Experiment 1, the participants were asked to read emotional narratives ending with a target sentence containing either a matching emotion, a mismatching emotion, a matching behavioral information or a mismatching behavioral information. In the first half of the experiment, the participants read the narratives in order to comprehend them, without further instruction. In the second half of the experiment, the participants were explicitly instructed to simulate the narratives, i.e., to imagine themselves in the protagonist's shoes. The readers' reading span, visuo-spatial span and empathy level were assessed. The results of Experiment 1 supported Gygax et al.'s (2007) findings regarding the under-specificity of emotion inferences. That is, readers were generally more sensible to the mismatch effect linked to behavioral information than that linked to emotion per se.

Moreover, little influence of the factors under investigation was found. Namely, only visuo-spatial working memory was shown to play a role in emotion inferences when the participants were asked to simulate the narratives, by reinforcing the readers' preference for behavioral information compared to emotion per se. In Experiment 2, the same materials and measures as in Experiment 1 were used, but the time between the sentences was extended in order to allocate more time to process the content of the sentences to the participants. With extended time to elaborate, the results did not demonstrate any differences in the mismatch effect between behavioral and emotion inferences, nor did the readers' individual characteristics play a role in generating inferences. Importantly, if the preference for behavioral information did not occur with extended time to elaborate, it was not replaced by the preference for inferences of emotion per se, as it was hypothesized.

Though Experiment 6 was based on different materials (hence its later position in the thesis), we further examined the notion of empathy. In Experiment 6, it was hypothesized that the empathy trait measured in Experiments 1 and 2 in terms of IRI score may not mirror the actual empathy that someone may feel when reading a narrative (i.e., it may mirror just a trait). Therefore, Experiment 6 aimed at manipulating the participants' empathy level prior to the reading task, by relying on the concept of the social sharing of emotion. Whereas our empathy manipulation seemed to work, at least to an extent, its influence during the experiment on the reading times of the emotion target sentences was moderate, if not unclear.

The results of Experiments 1, 2 and 6 therefore suggested that individual differences play only little role in inferring emotions and that, when they do, they principally reinforce the behavioral representations of emotion inferences. In these experiments, it was also suggested that readers quite automatically enter simulation when reading and that simulation (or lack of simulation) may not explain the (lack of) specificity of emotion inferences (see section *Future directions* for a possible way to further explore simulation processes and their influence on emotion inferences).

Bottom-up processes were addressed in the second experimental part of this thesis (Experiments 3, 4 & 5), which focused on the text characteristics that may encourage more elaborate or more specific emotion inferences. The second experimental part of the thesis relied on the simulation account of reading comprehension and tested the idea that emotional inferences are based on the same

components than those at stake during the actual experience of an emotion. In line with this idea, it was suggested in Chapter 4 that in order to fully comprehend an emotion described in the text (i.e., to include a specific representation of an emotion), readers need access to all the components of a given emotion, as defined by Scherer (e.g., 2005).

In order to investigate this issue, new experimental narratives were constructed based on the semantic field of emotion identified by the GRID (Fontaine et al., 2007, Fontaine et al., in press; Scherer, 2005). The emotion information transmitted through experimental narratives was manipulated in terms of *quantity* (i.e., the number of emotion components present in the narratives) and *quality* (i.e., the relevancy of the features characterizing these components), resulting in three versions of the narratives (i.e., *optimal*, *suitable* and *moderate*). A pilot study in Chapter 5 showed that the new narratives actually elicited a high agreement among the readers regarding the intended emotion. Very importantly, the agreement (offline task) was constant across the different versions of the narratives. In other words, no difference between the different versions of the narratives were showed in an offline task, when the participants were asked to choose the best matching emotion term corresponding to the narratives. Therefore, it was suggested that any differences occurring in a reading task based on the new emotional narratives should principally result from online processes. Experiment 3 showed that when reading the narratives, the participants differed in their reading times of the target sentences between the different versions. More specifically, the more the narratives contained constraining emotion information (i.e., more emotion components defined by typical features constraining to one central emotion), the more readers needed time to process the target sentence containing the emotion word, though the increase was extremely fine-grained, unlike that found in the habitual *match vs. mismatch* paradigm. According to these results, it was suggested that the difference in the reading times of the target sentences between the versions of the narratives mirrored different processes at stake when encountering the target sentence. It was proposed that when narratives only correspond to an emotion, without truly constraining the representation of the protagonist's emotion, readers *map* the emotion information contained in the target sentence onto their current representations. When narratives convey more typical information (hence more salient) as to activate a specific emotion representation, readers not only map the incoming information onto their current

representations but also integrate the incoming information into their mental representations of the text and make a foundation based on it. This integration process is reflected in higher reading times.

This hypothesis was tested in Experiment 4, in which the participants were confronted to the same narratives as in Experiment 3, with an added target sentence. This additional sentence contained a congruent, possible yet not intended emotion term. It was expected that mapping this second target sentence onto the readers' mental representation would be more difficult (i.e., need more time) if readers had elaborated a foundation based on a specific emotion word contained in the first target sentence than if they had only *mapped* the first emotion onto their representations. Supporting this *mapping vs. integration* hypothesis, the congruent target sentences were read slower in the optimal version compared to the moderate version of the narratives.

In Experiment 5, the original emotion target sentences (e.g., *At the moment, Sarah was happy*) were replaced by less obvious target sentences (e.g., *As she was happy, Sarah danced until the end of the night*) that were presented in two parts. This manipulation aimed at ruling out the possibility that the increase in reading times of the target sentences associated to the increase of emotion information in the narratives may result from a surprise effect when encountering the target sentences resulting from those being too obvious (i.e., Why do they put this target sentence, it is so obvious). Experiment 5's results did not demonstrate any differences between the different versions of the narratives in the reading times of the first part of the sentences, those of the second part of the sentences, or those of the whole sentences. These null results were interpreted as a consequence of the change in the content of the target sentences (i.e., the task activating a deductive process focused on the second part of the target sentence) that may have conducted the readers to map the incoming information rather than integrate it into their representations when reading the optimal version of the narratives.

Theoretical implications and related issues

Individual differences and the specificity of emotion inferences

The first aim of this study was to shed light on the influence of individual characteristics on the specificity of emotion inferences. According to the results found in Experiments 1 and 2, it is unlikely that the individual factors investigated in this thesis explain the under-specificity of emotion inferences found in previous studies (e.g., Gygax and colleagues, 2003, 2004, 2007). In spite of this, some satellite explanations might be difficult to rule out. For example, it might be the case that in these experiments, the way that the individual factors were assessed did not reveal their influence on emotion inferences. Regarding empathy, and as previously explained in Chapter 3, if the high- and low- empathy groups were different, their scores still corresponded to average or above average scores in the population. This may have lead to slight differences in their emotion inferences that did not conduct to visible differences in their reading times. In addition, the theoretical overlap between empathy and simulation may have altered the influence of empathy per se. Following evidence for the tight relation between empathy and simulation (Decety & Grèzes, 2006; Goldman, 2005; Preston & de Waal, 2002) and the assumptions that simulation processes are automatically involved in reading comprehension, disentangle empathic and simulation processes might not be possible in a reading task such as the one used in this thesis. In other words, empathy per se, as long as the participants belong to a normal population, may not explain the specificity of emotion inferences during reading. Consequently, the readers' identification and sympathy to the protagonist might be more relevant factors implied in the complexity of emotion representations during reading. Indeed, the readers' sympathy for the protagonist has been showed to play an important role on their representations of a situation. For example, Rapp and Gerrig (2002, 2006) showed that when readers experienced sympathy for the protagonist they were inclined to adapt their mental representations of the text in order to accept a preferred but impossible outcome. General empathy as well as contextual empathy may not directly impact on the readers' identification or sympathy for the protagonist, thus not directly influence their mental representations. In essence, the

readers' empathy level might be a too wide concept to directly influence emotion representations.

In a similar fashion, working memory implications in inferring emotions might not have been revealed, as we exclusively relied on participants' reading span (i.e., our sample was relatively good). Still, without relying on the reading span, Gernsbacher et al. (1998) did not show any disruption in the representations of the protagonist's emotion when the readers were subject to concurrent memory loads. Therefore, as emotion inferences seem to be drawn in an *automatic* manner (to use Gernsbacher et al.'s terms), it could be argued that it is not surprising that readers' memory span did not show any influence on the specificity of emotion inferences in Experiments 1 and 2.

Another explanation for the lack of influence of working memory and empathy, already introduced in Chapter 3, may relate to the fact that readers do not actually need to integrate a specific emotion word in their mental representations of the text. Experiments 1 and 2 confirmed a predominant role of behavioral component inference in readers' mental representation of emotional short narratives. Most interestingly, when readers' mental representations of emotion were influenced by simulation, it was not in the way that was expected (i.e., in triggering complex emotion inference), but in further favoring the behavioral component of emotion. These results strongly confirmed the idea first introduced by Gygax et al. (2007) that emotion inferences are best thought of in terms of the behavioral components of emotion, which the authors argued to be more easily *integratable* components of emotion inferences.

Such a principle is grounded in two different yet related concepts. First, readers may only construct *good enough* representations (Sanford & Graesser, 2006), those being sufficient for readers to maintain a coherent understanding of the text (locally and globally). In essence, readers may not need to elaborate a complex representation of emotions. It would probably even be counterproductive to automatically integrate an elaborate representation of the main protagonist's emotion, as any change of emotional status (signaled by very simple changes in the protagonists' behaviors) may involve a large amount of cognitive processing. Second, according to the embodied accounts of cognition (Barsalou, 1999b), perceptual symbols manipulated during comprehension are multimodal and distributed throughout modality-specific systems (i.e., the different sensory modalities, proprioception and introspection). Behavioral information may be

easily mapped onto different modes of a distributed network of representations (i.e., as it is easily shared by *verbal* as well as *perceptual* representations).

In addition to the aforementioned explanation, we also argued that the role of individual differences in inferring emotions may not have been revealed in Experiments 1 and 2 because of the very content of the experimental narratives that did not allow readers to reach specific emotion representations. This issue is directly related to the way that emotion representations are constructed during reading.

The construction of emotion inferences

In this thesis, it was hypothesized that simulation processes play a central role in inferring emotion and that readers base their emotion representations on emotion components. According to simulation accounts of reading comprehension, mental models (in terms of Phil Johnson-Laird's account, e.g., 1983) are not only propositional but represent rich, lifelike situations: 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, 1999a; Zwaan, 2004; Zwaan & Rapp, 2006). This process of simulation has been well documented in the field of emotion comprehension and embodiment of language (for a review, see Winkielman, Niedenthal, & Oberman, 2008). Evidence was found at the lexical level (i.e., word level) by Niedenthal et al. (2009) who showed that embodied responses (i.e., activation of facial muscles characteristics of a given emotion) are elicited when encountering emotion words (either concrete or abstract), yet only when the task required simulation in a particular modality-specific system (i.e., the somatic system in their experiment). In addition to the fact that comprehending emotion words requires simulation, they also showed that blocking the activation of the relevant muscles impair the comprehension of an emotion word.

At the sentence level (yet still not at the discourse level), Havas et al. (2007) demonstrated similar interference effects when blocking the activation of the relevant muscles and the comprehension of emotion sentences as described earlier in this thesis. Further demonstration for the language embodiment of emotion was provided by a study from Havas, Glenberg, Gutowski, Lucarelli, and Davidson (2010) in which they showed that patients treated with botulinum toxin-A (i.e., a substance that paralyzes

muscles) were slower to comprehend anger sentences (which content would require the paralyzed muscles for fully comprehension) but were equally fast to comprehend happy or sad sentences than non-patients (which content would not require the paralyzed muscles).

In this thesis, indirect evidence for the importance of simulation processes was demonstrated at the discourse level. Experiments 3 and 5 provided evidence that when reading emotional narratives, readers activate representations of the different *real-life* emotion components in order to construct their emotion representations. This was mirrored by faster reading times for the components described by highly typical features compared to components described by congruent but not typical features. In this thesis, we assumed that readers need the different emotion components (as they would when *experiencing* emotions) to infer a specific emotion and that emotion representations are based on those components. Therefore, it is assumed that readers, as long as they do not have included all relevant components in their mental representations of the text (either based on the text or on inference processes), do not constrain their emotion representations to specific ones. Note that if we based our assumptions on constructive processes, at the discourse level, one may argue that the components activate specific emotions in a more simple lexical-based, resonance mechanism.

In this case, rather than reflecting a constructionist process in which readers actively integrate information related to the incoming salient components, our results may only mirror passive memory activation. Specifically, the resonance process corresponds to the passive activation of information stored in long-term memory in response to information present in working memory (Gerrig & McKoon, 1998). Myers and O'Brien (1998) argue that information entering working memory is not only dependent on low-level priming (i.e., related lexical items) but also on the activation of text elements, information present in the readers' mental models and general knowledge of the world. When the text offers sufficient supporting context for an inference to be drawn, this latter is activated through a passive resonance mechanism.

Since it was not the purpose of this thesis to disentangle between resonance (i.e., passive) and constructionist (i.e., active) processes during reading, no definitive conclusion regarding the processes at work when mapping emotion components onto the current readers' representations can be drawn based on this thesis' results. Nevertheless, note that as readers encounter emotion features within different emotion

components, a passive activation of all potential related features (within or across components) would lead to an enormous cognitive load for readers. This is especially true, as most features are also part of many emotions (of course with different typicality levels), resulting in additional activations (taken passive activations). In all this seems rather unlikely. Empirically, our results, especially those signaling slower reading times for *more salient* target sentences seem to contradict a simple intra-lexical (or intra-feature) passive activation, which would logically lead to a reverse pattern. We believe that although they might be resonance processes, they cannot fully account for our results.

In all, the hypothesis that readers elaborate their emotion representations based on emotion components seems to be supported by the results found in this thesis. It was further argued that when all these components are accessed, readers reach specific emotion representations.

The specificity of emotion inferences

This claim regarding the specificity of emotion inferences follows from Experiments 3 and 4 results. In these experiments, readers, when provided with all relevant information regarding the protagonist's emotion were slower to read the target sentences containing the emotion label than when they had access to incomplete emotion information. The slowdown in reading times of the target sentences when the narratives were highly constraining regarding the intended emotion (i.e., optimal condition) was interpreted as mirroring an integration process as opposed to the faster mapping process that may happen when the narratives were matching the intended emotion but not constraining its representation (i.e., moderate condition). This hypothesis was further supported by the fact that mapping another matching emotion onto the readers' representations was more difficult in the optimal condition (i.e., highly salient) than in the moderate condition. This suggested that a new foundation based on the first emotion term had been built when encountering the first emotion term in the optimal version of the narratives (by integrating the specific emotion label in readers' representations). In this sense, by integrating the intended emotion into their mental representations of the protagonist's emotion, readers reach specific emotion representations.

It could be argued however (as in Chapter 5) that this slowdown in the reading times of the target emotion sentences related to more relevant information in the narratives may mirror a mismatch effect (yet of approximately 20 milliseconds). It is possible that readers have a quite large amount of activated emotion terms at the beginning of the narratives. When encountering the different emotion components throughout the text, readers may diminish the amount of relevant emotion labels and keep only emotion terms relevant to these components. When reaching the end of the narratives, readers may have restrained the amount of possible emotion alternatives. As more emotion information was given to them in the optimal version than in the moderate version of the narratives, the resulting amount of relevant emotions may be relatively small in the optimal version and larger in the moderate version. When encountering the emotion term in the target sentences in the optimal version, the pre-activated relevant emotion terms may be different from the emotion term contained in the sentence, leading to a mismatch effect reflected in slower reading times. In the moderate version of the narratives, such a mismatch effect is unlikely given that more emotion terms are activated. If this last explanation offers another way to consider this thesis's results, it nonetheless also supports the assumption that readers are able to reach specific emotion representations by restraining the amount of emotion terms relevant to a given narrative.

In summary, the findings presented in this thesis support the fact that when readers have access to the different components of emotion, they may elaborate a representations of the protagonist's emotion based on these components and draw specific emotion inferences.

Future directions

Appraisal of emotion

In this thesis, it was proposed that readers construct their mental representations of the protagonist's emotion by simulating this emotion. It was also suggested that, via this simulation process, readers infer the different emotion components in order to reach a complex emotion representation. If this thesis focused on the quantity and quality of information linked to the different emotion components included in the narratives, no

specific attention was dedicated to the appraisal process of emotion. Indeed, componential theories of emotion not only define the different components to be activated during the experience of a given emotion but also state that emotions are elicited and differentiated by the subjective interpretation of the personal significance of events (Scherer & Ellsworth, 2003, p.45). In this view, the *appraisal* of the event triggering an emotion is central not only to the activation of different components, but also of the temporal sequence of the activation of these components. Researchers on emotion have proposed different assumptions regarding this temporal sequence, being seen either as *partially* (Ellsworth, 1991) or *completely* fixed (Scherer, 1984). Scherer's model (1984, 1999) actually postulates that appraisal is composed of different stimulus evaluation checks according to the following sequence: Novelty, Object Pleasantness, Goal Conduciveness, Coping Potential and Compatibility with Standards.

Scherer (1999) showed indirect evidence for a fixed sequential appraisal process. He presented participants with emotional episodes described either according to his predicted temporal sequence or to a random sequence and asked them to recognize as fast and as accurately as possible the emotion pictured in the description. The results showed that, when the sequence of events was in the predicted order, participants were faster and more accurate in their decisions. This supports the fact that not only the different components of emotion but also the way (i.e., the order) these components are related to the different appraisal checks are of prime importance in the construction of emotion representations. In order to complement this thesis' results regarding the importance of emotion components in the process of emotion inferences when reading narratives, it is relevant to adapt Scherer's (1999) study into a reading paradigm and investigate the influence of appraisal sequence on the *online* construction of the representation of emotions.

Depending on the appraisal sequence described in the emotional narratives, readers may have more or less facility to infer a specific emotion. In order to investigate this issue, the sequence of components, as defined by Scherer's evaluation checks, could be manipulated in addition to manipulating the emotion components as done in this thesis. Sentences composing the narratives could be presented either according to Scherer's predicted sequence or in a random order, prior to the congruent target sentence containing the intended emotion. As in this thesis, the congruency of the target sentence (i.e., highly vs. moderately congruent) would be defined according to the

preceding context. Essentially, and according to Scherer's (1999) suggestion, the predicted sequence should constitute the highly congruent condition whereas the random order sequence the moderate condition. Based on this thesis' results showing a slowdown in reading times of the target emotion sentence following a highly relevant context, and based on Scherer's (1999) suggestion, it may be expected that target sentences following a narrative containing the predicted appraisal sequence would be read slower that target sentences following a narrative containing a random appraisal sequence, implying an integrative process onto readers' mental models.

If, as expected, controlling for the appraisal order enhances the emotion relevancy of the narratives, the specificity of emotion representations inferred based on these narratives should be maximal. Simulation processes implied in text comprehension may therefore be highly favored by the relevancy of the emotional narratives, leading to potentially more vivid reactivations of the perceptual symbols linked to the emotion concepts conveyed in the narratives. In this case, the link between feeling emotions and representing them may be further investigated.

Internalization of the protagonist's emotion

Comprehending an emotion or accessing knowledge about an emotion requires at least a partial simulation of sensory, motor and introspective states associated to this emotion (Barsalou, 1999a; Niedenthal et al., 2009). There is evidence for the fact that people experience congruent emotional states in response to other's emotions (for a review, see Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). However, very little is known about the extent to which readers actually *feel* the protagonist's emotion when reading (although the question is raised in most papers on emotion inferences). Still, there are studies on this issue, yet no consensus has been reached. For example, Komeda et al. (2008) showed that readers do not evaluate the main protagonist's emotional status in terms of their own emotions during reading. However, Brunyé, Ditman, Mahoney, and Taylor (2011), demonstrated that readers, when directly addressed as the subject of a sentence (*You*) developed congruent emotion states to those of the protagonist, reflected in changes in their evaluation of affective valence and arousal.

Unfortunately, these experiments assessed readers' emotions only via offline introspective measures (i.e., questionnaires and self-reports), preventing any solid conclusions as to the actual processes at stake. Only direct and non-introspective measures, such as psychophysiological affective reactions, may provide us with adequate data on the actual simulation processes at work when building a representation of emotions when reading narratives. These data could finally address appropriately the simulation issue raised by many in the text comprehension literature.

This issue can be explored using physiological measures such as facial electromyography (EMG) to access potential simulation processes. Facial EMG is widely used in measuring emotion response through the activation of facial muscles, which are markers of changing emotional state, as they allow us to access covert muscular activation (i.e., not reflected into visible changes on the face). The facial EMG responses mostly distinguish the valence and the intensity of emotional reactions (Cacioppo & Petty, 1981). In addition, specific patterns of activation can differentiate between some emotions: activity over the corrugator supercilii is typical of anger-related stimuli and activity over the zygomatic major and orbicularis oculi is associated to joy-related stimuli (Dimberg & Karlsson, 1997). Disgust, in addition to the same pattern of activation than anger-related emotions, provokes a reaction in levator labii superioris (Vrana, 1993). For this reason, assessing the internalization of the protagonist's emotion should focus on narratives about the subset of emotions that have the clearest patterns (as regard to the literature) in terms of facial muscles (i.e., joy-related, anger-related and disgust).

In a study on the internalization of the protagonist's emotion, the link between the protagonist's emotional status and possible emotional experiences felt by readers would be investigated. If readers internalize main protagonists' emotions during reading, greater specific activation of the muscles related to the described emotional term when reading the target sentence in the complete version of the narratives than in the incomplete version could be expected. More specifically, the corrugator region should show greater activity when the participants are confronted to anger and disgust compared to happiness or neutral narratives. The zygomaticus and orbicularis regions should reveal a greater activity during the reading of happiness narratives whereas the levator muscle should be more activated during the reading of disgust narratives compared to anger, happiness or neutral narratives (Niedenthal et al., 2009). All these

activations should be enhanced in the complete version of the narratives compared to the incomplete version.

In addition, the simulation process should increase during the reading of the narratives as additional components are made accessible to the readers and allow them to elaborate a rich emotion representation. Following this hypothesis, the muscle activity mirroring the simulation process should get enhanced throughout each narrative, in a greater way for the complete than the incomplete narratives.

As demonstrated by Brunyé et al. (2011), deeper simulation processes happen when reading second-person narratives. This issue could be addressed by using narratives written with a second-person pronoun (*You*) in order to directly address the reader and lead to more vivid reading experience and deeper simulation. Direct comparison with narratives written with a third-person pronoun (*He*/*She*) would allow determining which conditions are necessary for extensive (or optimal) simulation.

Conclusion

In the present thesis, we investigated the influence of top-down (i.e., individual differences and reading strategies) as well as bottom-up processes (i.e., the content of the text in terms of emotion components) on the specificity of emotion inferences. We strongly argue that readers construct emotion inferences during reading by relying on core components of emotion (conveyed by the text or inferred during reading) in order to elaborate a foundation on which specific emotion representations can be built. The experiments presented in this thesis supported this argument and demonstrated that elaborating emotion inferences in a constructive manner does not necessarily depend on readers' characteristics yet reflect simulation processes related to emotion comprehension. Importantly, this thesis claims that the core components implied in emotion inferences correspond to the emotion components described in the componential theory of emotion (e.g., Scherer, 1984) and that when these components are made available to readers, complex emotion representations can be reached.

Finally, the results presented in this thesis suggest that previous studies using the match vs. mismatch paradigm might have failed to assess the specific emotion integration process during reading and that combining emotion and text comprehension research offers new insights on the elaboration and specificity of emotion inferences.

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