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**ABSTRACT**

This study examined to what extent children and adults differ in how they process negative emotions during reading, and how they rate their own and protagonists' emotional states. Results show that both children's and adults' processing of target sentences was facilitated when they described negative emotions. Processing of spill-over sentences was facilitated for adults but inhibited for children, suggesting children needed additional time to process protagonists' emotional states and integrate them into coherent mental representations. Children and adults were similar in their valence and arousal ratings as they rated protagonists' emotional states as more negative and more intense than their own emotional states. However, they differed in that children rated their own emotional states as relatively neutral, whereas adults' ratings of their own emotional states more closely matched the negative emotional states of the protagonists. This suggests a possible difference between children and adults in the mechanism underlying emotional inferencing.

In narrative texts emotions play a crucial role in capturing readers' attention and interest. Learning to read is one of the key achievements that children

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have to attain, and usually their first introduction to reading is through narratives. Understanding emotions in narratives requires the development of sufficient social-cognitive abilities such as perspective taking and Theory of Mind (Diergarten & Nieding, 2015). People seem innately motivated to understand the mental worlds of others, and many studies have examined the development of the ability to do so. However, the majority of studies has focused on early childhood (Davidson, Vanegas, & Hilvert, 2015) and usually do not involve reading. Social-cognitive abilities continue to mature throughout childhood and into adolescence (e.g., Burnett, Sebastian, Cohen Kadosh, & Blakemore, 2011), but relatively little is known about the role of social-cognitive abilities in the context of narrative comprehension in childhood. Whereas recent studies have suggested that reading of narratives may contribute to the development of social-cognitive abilities (Kidd & Castano, 2013), the process underlying the relation between emotion understanding and narrative comprehension in late childhood is not well understood. The present study examined the role of emotions in narrative understanding by combining measures of cognitive processes during reading of narratives with measures of emotion understanding.

## Emotion and cognitive models of reading comprehension

Cognitive models of text comprehension focus on readers' need to construct a coherent mental representation or situation model of the state of affairs described in a text during reading by combining information from the text with relevant background knowledge (Kintsch & van Dijk, 1978). Such situation models are multidimensional and involve several story aspects, such as story setting, events, actions, and protagonist's goals, motives, and emotions (Stein & Glenn, 1979; Zwaan & Radvansky, 1998). Readers develop richer situation models if they comprehend emotions of story characters because these emotions often are related to character goals and drive actions in the narrative, thus contributing to the causal structure of the text (e.g., De Vega, Léon, & Díaz, 1996). Adults usually infer the emotional state of the protagonist and engage emotionally with the narrative (e.g., Gernsbacher, Goldsmith, & Robertson, 1992). A possible mechanism through which readers understand the protagonist's emotions is proposed in theories of embodied cognition (e.g., Zwaan & Radvansky, 1998): Readers may create situation models during reading in ways that are grounded in how they create situation models of real-life experiences. Regarding emotions, this suggests that readers use their knowledge about their own mental world and the mental world of others to comprehend, simulate, and/or infer the emotions experienced by a protagonist. One potential role of emotions that readers experience, for example by sympathizing with a protagonist's emotions, is that they help distinguish important from less important information (Dyer, 1983), which aids in determining what information should be included in a reader's situation model of the text. This way emotional information in

narratives facilitates comprehension as reflected in faster reading times for sentences describing emotional states (e.g., De Vega et al., 1996).

Several lines of research suggest that negative emotions are of particular interest. First, in the (neuro)cognitive literature on performance monitoring and cognitive control most studies focus on negative events, such as errors and conflicts and their consequences, because unfavourable outcomes are typically more consequential for regulation of behaviour than favourable outcomes (e.g., Ridderinkhof, Ullsperger, Crone, & Nieuwenhuis, 2004). Second, narratives usually revolve around a problem that has to be resolved. Stories may serve as opportunities for our mind to simulate ways to resolve problems we might encounter without having to experience actual negative consequences.

## Valence and arousal

Prior research has predominantly focused on how adult readers infer certain aspects of emotional states of a protagonist during reading. For example, Gernsbacher et al. (1992) found that readers are sensitive to the valence dimension of emotional states, which refers to the direction of an emotion and ranges from positive to negative, as readers distinguish between happy and sad emotions. However, capturing the specificity of emotional states is less straightforward (Gernsbacher et al., 1992; Gygax, Garnham, & Oakhill, 2004). The degree to which readers are able to infer the specificity of an emotion is determined by the experienced intensity of an emotion. For example, readers have more difficulty differentiating between emotional states that are broadly similar such as anger and fury than between emotional states that differ in the intensity of the experience they elicit in readers such as fury and irritation (Gillioz, Gygax, & Tapiero, 2012). Participants in the Gygax et al. (2004) study either read sentences containing a specific emotion, a synonym of this emotion, or emotions that were broadly similar. Gygax and colleagues (2004) found that reading times for these sentences did not differ and concluded that readers only infer general emotional information during reading but not the specificity of an emotion.

To capture the specificity of an emotion, readers may need to infer more than merely the valence dimension of an emotion. Emotional states can, for instance, be defined in terms of both a valence and an arousal dimension (Russell, 1980). The arousal dimension refers to the experienced intensity of an emotion and ranges from calm to aroused. However, it is unclear if readers do or do not infer the arousal dimension of protagonists' emotional states and include this information in their mental representation, and whether this contributes to an accurate capturing of an emotion's specificity.

Another possible explanation for adults' difficulties in inferring emotional states is that reader's own emotions may be either similar to or different from those of the protagonist, both in valence and in arousal. Adult readers can experience emotions separately from a protagonist's emotions. The experienced emotions

and those of the protagonist are sometimes even opposite in valence, especially when a reader and protagonist do not share the same situational knowledge (Blanc, 2007; De Vega, Díaz, & León, 1997). However, other studies suggest that readers' emotions are strongly related to those of the protagonists (Gygax & Gillioz, 2015). Also, research on theories on transportation suggests that the alignment of reader's own emotional states with those of the protagonist is essential for story comprehension (Gerrig & Foy, 2013). These findings pertain to valence, not arousal.

## Development of emotion understanding

Research generally examining how young children (6-and 7-year-olds) monitor different situational dimensions of a narrative, including the emotion dimension, has already been performed (e.g., Blanc, 2009), and primary-school children's (fourth and sixth grade) ability to monitor the emotional, causal, spatial, or temporal coherence of narratives appears best in narratives containing emotional information (Wassenburg, Beker, van den Broek, & van der Schoot, 2015). However, research into children's emotion understanding is in flux and it seems that emotion understanding also contributes to narrative comprehension.

The ability to understand emotions slowly develops (Pons, Harris, & de Rosnay, 2004) and, as children mature, they are able to categorize emotions more precisely (Herba, Landau, Russell, Ecker, & Phillips, 2006; Widen & Russell, 2010). In the context of theories of embodied cognition, it is reasonable to assume that the ability to infer emotional states in narratives follows similar age-related improvements. Children as young as 4 years already make inferences regarding protagonists' mental states, particularly about protagonists' goals (Lynch & van den Broek, 2007). However, the accuracy of emotional inferences continues to develop as children mature (e.g., Vendeville, Brechet, & Blanc, 2015). For example, Diergarten and Nieding (2015) examined the ability of both children (aged 5, 8, and 10) and adults to infer protagonists' emotional states using movie clips and audiobooks. They found that irrespective of modality, 5-year-old children were already able to infer the valence dimension of protagonists' emotional states. However, the precision of children's emotional inferences increased with age, and the ability to infer exact emotional states emerged by the age of 10 but did not yet reach adult levels. Creissen and Blanc (2015) confirm that children's ability to infer the protagonist's emotion in both auditory and audio-visual situations improves over age. Neither study measured comprehension of emotional states during reading. Reading is likely to place an even greater burden on children's cognitive resources and, as a result, inferring the emotional states of protagonists while reading could be even more challenging.

## The present study

To our knowledge, investigation of reader's abilities to infer both valance and arousal using off- and online measures of emotional inferencing has not yet

been extended to children. Given the importance of understanding emotional states for narrative comprehension, this study examines to what extent children and adults differ in their processing of negative emotions during reading, and in their ratings of their own and protagonists' emotional states. We hypothesize that readers' own emotional states facilitate comprehension of protagonists' emotional states and, thus, reading, and that children may be at a disadvantage because of their immature social-cognitive abilities. As discussed previously, most studies examined inferencing processes using online measures, even though Gygax and colleagues (2004) showed that the specificity of emotions may not only be inferred during reading but also after having had time to reflect on protagonists' emotional states and responses. Therefore, we used an offline measure to assess participants' ratings of the valence and arousal dimensions of emotional states in addition to sentence reading times.

## Method

### Participants

Participants were 98 fifth-grade children (55 girls, $M_{age}=10.99$ years, SD = 4.32 months) recruited from six primary schools in the Netherlands, and 84 young adults (67 females, $M_{age}=19.96$ years, SD = 21.99 months) recruited through the research participation system at a major university in the Netherlands. No participants reported any learning disorders, and all read Dutch fluently. For all children, written parental informed consent was obtained; all young adults provided written informed consent.

### Materials

#### Narratives
We designed a reading task around ten emotional states (sadness, jealously, anger, anxiety, embarrassment, disgust, guilt, despair, pride, and happiness) that were selected from the narratives designed by Gernsbacher and colleagues (1992). We focused on eight negative emotions because negative affect can influence the quality of recall positively (Spachtholz, Kuhbandner, & Pekrun, 2014), and added two positive emotions (pride and happiness) to check if participants in both age groups were able to accurately distinguish between positive and negative emotion valence. For each emotional state, two six-sentence narratives were written; an experimental (emotional) and a control (neutral) version.

The first four sentences of each narrative introduce the protagonist and the setting. In the experimental versions, the fifth sentence primes an emotional state (Sentence 5$_{experimental}$ in Tables 1 and 2). Neutral narratives were similar to the experimental narratives but contained a neutral fifth sentence (Sentence 5$_{neutral}$, highlighted in grey in Tables 1 and 2). A sixth, spill-over sentence was

**Table 1.** Example of children's narrative priming anger.

| Sentence number | Sentence |
| --- | --- |
| 1 | Eve often plays with her older sister Lynn in the playroom |
| 2 | They have to clean the playroom because dad does not like it when it's messy |
| 3 | Eve cleans the room all by herself because Lynn refuses to help her |
| 4 | Dad comes home and walks in the playroom |
| 5$_{experimental}$ | Lynn immediately tells dad that she cleaned the room all by herself |
| 5$_{neutral}$ | Lynn immediately tells dad that Eve cleaned the room all by herself |
| 6 | Dad slowly takes his jacket off |

**Table 2.** Example of adults' narrative priming anger.

| Sentence number | Sentence |
| --- | --- |
| 1 | Jill is a hardworking student who collaborates with Evan in the Educational Psychology course |
| 2 | Every time they schedule to work on a paper, Evan does not show up |
| 3 | In the end, Jill decides to write the paper all by herself |
| 4 | During class the teacher walks up to Jill and Evan and says they have written an excellent paper together |
| 5$_{experimental}$ | Evan nods and says they have worked really hard together* |
| 5$_{neutral}$ | Evan shakes his head and says Jill has worked really hard* |
| 6 | The teacher continued class |

*The length of the experimental and neutral target sentences is similar when translated to Dutch.

added to allow measurement of possible spill-over processing as a result of differences in the target sentence. The structure of the narrative and the length of the target sentences were identical in the experimental and neutral conditions. Length of target sentences varied between emotions because the narratives had to be as natural as possible. Several factors such as story content, grammar complexity, and story structure could influence reading processes, and could give rise to differences in reading times between narratives. To allow comparison of processing times across texts and between conditions reading times in milliseconds per syllable were used in the analyses.

Separate age-appropriate narratives were written for the fifth-grade children and adults. To ensure that the two sets of narratives were similar and valid, they were evaluated by an expert group of reading researchers ($N = 7$). The expert group unanimously concluded that each emotional state was described in structurally similar narratives in the two sets and that settings and plots were comparable. The suitability and readability of the child versions were evaluated in a small pilot study ($N = 12$; 7 girls, $M_{age} = 11.85$ years, SD = 3.97 months). The children were asked how difficult each story was, which emotion the protagonist may have felt, and if they encountered unfamiliar words. Based on their responses minor adjustments were made, mostly regarding vocabulary.

Narratives were presented sentence by sentence on a computer screen using E-prime software version 2.0.8. Presentation rates were self-paced: Participants progressed to the next sentence with a space-bar press. To preclude participants from advancing too fast, they were unable to use the space-bar for 500 ms.

Reading times (in ms) were recorded for each sentence. Experimental and control versions of the narratives were counterbalanced between participants. Participants were instructed to carefully read each narrative and to take the perspective of the protagonist by imagining themselves in the same situation as the protagonist (Gillioz et al., 2012). To facilitate perspective taking, the protagonist's gender was matched to that of the reader. To this end, two versions of each narrative were created, one with a female main character and the other with a male character. Following Bourg, Risden, Thompson, and Davis (1993), participants were instructed to read silently but with expression (i.e., as if reading aloud with expressive intonation). Prior research has shown that 6-to 9-year-old children without decoding problems are able to read with expression without a problem (Schwanenflugel, Hamilton, Wisenbaker, Kuhn, & Stahl, 2004). Given that the children in the current study are older and have no decoding problems it is unlikely that the prosodic reading procedure placed a significant burden on children's cognitive resources.
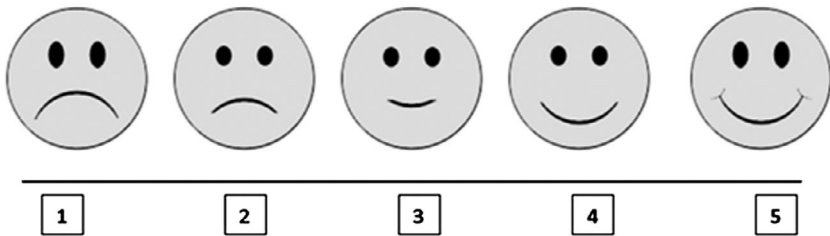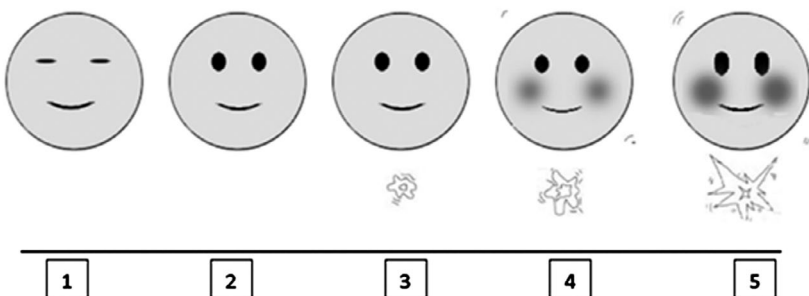


Figure 1. Five-point Likert scales used to rate the valence and arousal dimensions of readers' own emotional states and that of the protagonist.

### *Valence and arousal ratings*

Following each narrative, participants rated the valence and arousal of their own emotional state (*How did you feel while you read this story?*) and those of the protagonist (*How do you think the protagonist felt in this story?*) on two five-point Likert scales (1 = *negative valence* or *low arousal* and 5 = *positive valence* or *high arousal*; see Figure 1) in E-prime by typing in the number corresponding to the emoticons presented in Figure 1. This type of Likert scale representing unlabelled emotional dimensions has been reliably used with children (e.g., McManis, Bradley, Berg, Cuthbert, & Lang, 2001), and, therefore, is suitable for our age groups. Participants first rated the direction of their own emotional state, then the intensity of their own emotional state, and finally the direction and intensity of the protagonist's emotional state. This order of first rating one's own and then the protagonist's emotional state was chosen because the reverse order might have influenced readers' ratings of their own emotional state, due to the empathic tendency towards susceptibility to others' emotions (i.e., that of the protagonist) similar to processes of emotional contagion (Schoenewolf, 1990).

### *Procedure*

The study was conducted in a quiet room (at the children's school) or lab (at the university) where the tasks were administered to participants individually using a laptop. The experimenter provided standardized written and verbal instructions about the procedures and was present at all times to provide help. In addition, participants practiced expressive reading and perspective taking using an example narrative. Both children and adults completed the reading task and rated the emotional states of the 20 narratives in approximately 30 min. Participants received a token of appreciation upon completion of the experiment (i.e., a small gift for the children, and course credits or a small gift for the young adults).

## Results

### *Manipulation check*

Our main interest concerned the data from the negative emotion narratives. However, we first compared participants' valence ratings for positive and negative narratives in a 2 (Perspective: reader, protagonist) $\times$ 2 (Valence: positive, negative) repeated measures ANOVA for each age group. There were significant main effects of valence in both age groups. Children, $F(1, 97) = 761.66, p < .001$, $\eta^2 = .89$, as well as young adults, $F(1, 83) = 1258.64, p < .001, \eta^2 = .94$, rated the positive narratives as significantly more positive ($M = 4.20$, SD = .49, and $M = 4.26$, SD = .53, for children and adults respectively) than negative narratives

(*M* = 2.14, SD = .43, and *M* = 1.75, SD = .30, for children and adults respectively), confirming that the valence manipulation worked. In all subsequent analyses, we only report reading times and ratings of negative emotions.

### Sentence reading times

We examined if children's and adults' reading times (RTs) were shorter for the negative emotion target and spill-over sentences than for the neutral sentences. If emotions facilitate processing, then RTs would be shorter. To correct for sentence length, reading times for target and spill-over sentences were divided by the number of syllables. Next, an average RT over all eight target sentences was calculated for each condition. The same was done for the spill-over sentences. We submitted these averaged RTs to a 2 (Emotion: negative, neutral) × 2 (Sentence: target, spill-over) repeated measures ANOVA.

#### Children's sentence reading times

For children's RTs, a significant main effect of sentence was found, $F(1, 97) = 300.80$, $p < .001$, $\eta^2 = .76$, indicating that children read target sentences faster than spill-over sentences (see Figure 2(a)). This main effect was qualified by a significant Emotion × Sentence interaction, $F(1, 97) = 9.70$, $p < .005$, $\eta^2 = .09$. Post-hoc comparisons revealed that RTs for target sentences were shorter for negative (*M* = 215.75, SD = 48.87) than for neutral (*M* = 229.85, SD = 61.64) narratives, $F(1, 97) = 12.56$, $p = .001$, whereas there was no significant difference in RTs between neutral and negative narratives on spill-over sentences. Furthermore, they revealed that spill-over sentences were read more slowly than target sentences in both negative, $F(1, 97) = 228.95$, $p < .001$, $\eta^2 = .70$, and
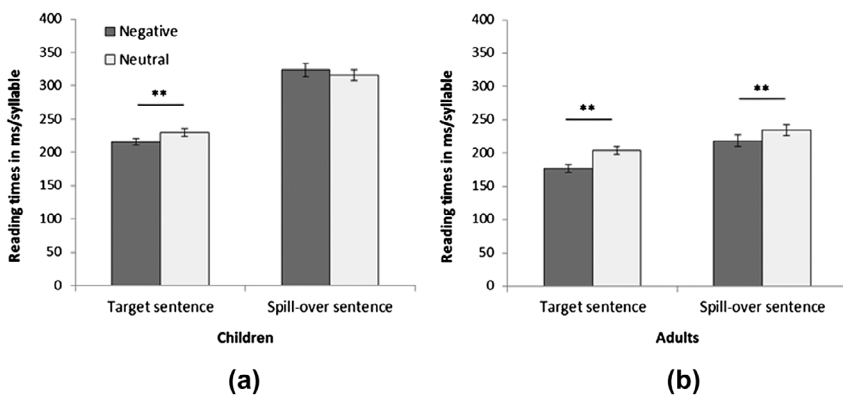


**Figure 2.** Mean sentence reading times in milliseconds/syllable for target sentences and spill-over sentences in the negative and neutral emotion conditions for children (a) and adults (b).

Notes: Error bars depict the standard error of the mean, **indicates significant effect at $p \leq .001$.

neutral conditions, $F(1, 97) = 201.19$, $p < .001$, $\eta^2 = .68$, but that this effect was stronger in the negative condition, $F(1, 97) = 9.70$, $p < .005$, $\eta^2 = .09$. There was no significant main effect of emotion on children's RTs.

### Adults' sentence reading times

Analysis of adults' RTs resulted in significant main effects of sentence, $F(1, 83) = 63.63$, $p < .001$, $\eta^2 = .43$, and emotion, $F(1, 83) = 26.11$, $p < .001$, $\eta^2 = .24$ (see Figure 2(b)). Follow-up ANOVAs revealed that adults on average read target sentences ($M = 190.50$, SD $= 50.45$) faster than spill-over sentences ($M = 226.36$, SD $= 68.24$), and both sentence types faster for negative ($M = 197.87$, SD $= 60.83$) than for neutral narratives ($M = 218.99$, SD $= 58.06$). There was no significant Sentence × Emotion interaction.

### Valence and arousal ratings

On each trial participants rated the valence and arousal dimensions of their own emotional states and those of the protagonists. In the following analyses, the orthogonal emotional dimensions valence and arousal are examined separately (Russell, 1980). For an overview of the pattern of valence and arousal ratings for each age group, see Supplemental Figure A.

    We examined if children and young adults distinguished between their own emotional states and those of protagonists for both the valence and arousal dimensions of emotion. If emotions facilitate reading comprehension and readers use their knowledge about their own and others' mental world to comprehend emotions experienced by a protagonist, then similar ratings for the reader and the protagonist should be reported.
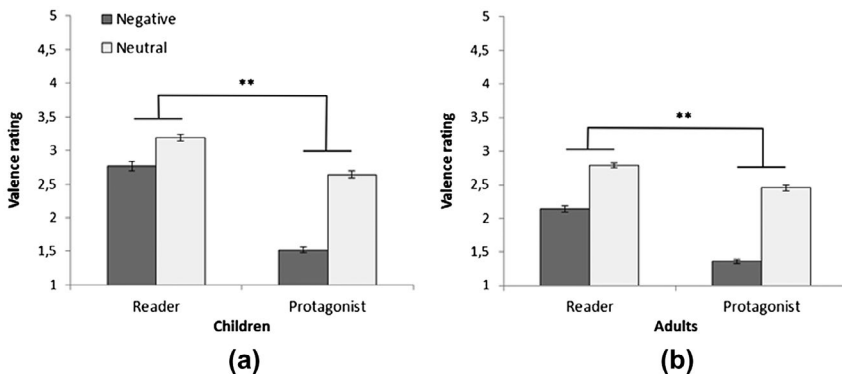


**Figure 3.** Mean valence ratings (1 = *negative valence*, 5 = *positive valence*) of readers' and protagonists' emotional states in the negative and neutral emotion conditions for children (a) and adults (b).

Notes: Error bars depict the standard error of the mean, **indicates significant effect at $p \leq .001$.
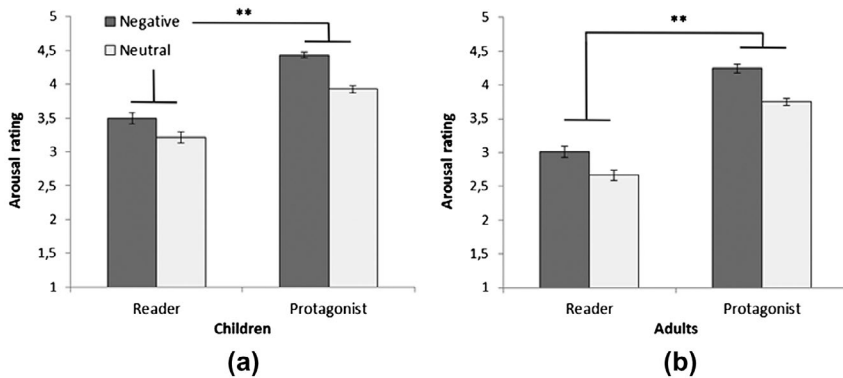
### Children's valence ratings

We submitted valence ratings from children's data to a 2 (Emotion: negative, neutral) × 2 (Perspective: reader's own emotion, protagonist's emotion) repeated measures ANOVA. This analysis resulted in significant main effects of emotion, $F(1, 97) = 260.81$, $p < .001$, $\eta^2 = .73$, and perspective, $F(1, 97) = 313.36$, $p < .001$, $\eta^2 = .76$, and a significant Emotion × Perspective interaction, $F(1, 97) = 127.12$, $p < .001$, $\eta^2 = .57$ (see Figure 3(a)). Children rated emotional states of protagonists as more negative in negative narratives than in neutral narratives, $F(1, 97) = 384.90$, $p < .001$, $\eta^2 = .78$. Similarly, they judged their own emotional states as more negative in negative narratives than in neutral narratives, $F(1, 97) = 56.62$, $p < .001$, $\eta^2 = .37$. Children rated emotional states of protagonists as stronger than their own emotional states in both negative, $F(1, 97) = 372.39$, $p < .001$, $\eta^2 = .79$, and neutral narratives, $F(1, 97) = 105.22$, $p < .001$, $\eta^2 = .52$.

### Adults' valence ratings

We submitted valence ratings from young adults' data to a 2 (Emotion: negative, neutral) × 2 (Perspective: reader's own emotion, protagonist's emotion) repeated measures ANOVA. This analysis resulted in main effects of emotion, $F(1, 83) = 518.99$, $p < .001$, $\eta^2 = .86$, perspective, $F(1, 83) = 265.43$, $p < .001$, $\eta^2 = .76$, and a significant Emotion × Perspective interaction, $F(1, 83) = 60.24$, $p < .001$, $\eta^2 = .42$ (see Figure 3(b)). Follow-up ANOVAs revealed that adults rated emotional states of protagonists as more negative in negative narratives than in neutral narratives, $F(1, 83) = 533.13$, $p < .001$, $\eta^2 = .87$. Similarly, they judged their own emotional states as more negative in negative narratives than in neutral narratives, $F(1, 83) = 176.97$, $p < .001$, $\eta^2 = .68$. Adults rated emotional states of protagonists as more negative than their own emotional states in both negative, $F(1, 83) = 294.52$, $p < .001$, $\eta^2 = .78$, and neutral narratives, $F(1, 83) = 56.55$, $p < .001$, $\eta^2 = .41$.

### Children's arousal ratings

We submitted arousal ratings from children's data to a 2 (Emotion: negative, neutral) × 2 (Perspective: reader's own emotion, protagonist's emotion) repeated measures ANOVA. This analysis showed significant main effects of emotion, $F(1, 97) = 95.31$, $p < .001$, $\eta^2 = .50$, and perspective, $F(1, 97) = 174.28$, $p < .001$, $\eta^2 = .64$, and a significant Emotion × Perspective interaction, $F(1, 97) = 18.10$, $p < .001$, $\eta^2 = .16$ (see Figure 4(a)). Follow-up ANOVAs revealed that children gave higher arousal ratings for protagonists in negative narratives than in neutral narratives, $F(1, 97) = 128.17$, $p < .001$, $\eta^2 = .57$. Similarly, children rated their own arousal levels as higher in negative narratives than in neutral narratives, $F(1, 97) = 29.68$, $p < .001$, $\eta^2 = .23$. Children rated emotional states of protagonists as more aroused than their own emotional states in both negative, $F(1, 97) = 175.88$, $p < .001$, $\eta^2 = .65$, and neutral narratives, $F(1, 97) = 120.87$, $p < .001$, $\eta^2 = .55$.

Figure 4. Mean arousal ratings (1 = *low arousal*; 5 = *high arousal*) of readers' and protagonists' emotional states in the negative and neutral emotion conditions for children (a) and adults (b).

Notes: Error bars depict the standard error of the mean, **indicates significant effect at $p \leq .001$.

### Adults' arousal ratings

We submitted arousal ratings from young adults' data to a 2 (Emotion: negative, neutral) × 2 (Perspective: reader's own emotion, protagonist's emotion) repeated measures ANOVA. This analysis resulted in main effects of emotion, $F(1, 83) = 61.32$, $p < .001$, $\eta^2 = .43$, and perspective, $F(1, 83) = 312.62$, $p < .001$, $\eta^2 = .79$, and a significant Emotion × Perspective interaction, $F(1, 83) = 5.80$, $p < .05$, $\eta^2 = .07$ (see Figure 4(b)). Follow-up ANOVAs revealed that adults gave higher arousal ratings for protagonists in negative narratives than in neutral narratives, $F(1, 83) = 69.42$, $p < .001$, $\eta^2 = .46$. Similarly, adults rated their own arousal level as higher in negative narratives than in neutral narratives, $F(1, 83) = 29.41$, $p < .001$, $\eta^2 = .26$. Adults rated emotional states of protagonists as more aroused than their own emotional states in both negative $F(1, 83) = 290.63$, $p < .001$, $\eta^2 = .78$, and neutral narratives, $F(1, 83) = 224.43$, $p < .001$, $\eta^2 = .73$.

## Discussion

The aim of this study was to examine whether children and adults differ in their processing of negative emotions during reading, and in their ratings of their own and protagonist's emotional states after reading. If emotions facilitate processing, one would expect shorter reading times (RTs) for target sentences. In addition, if emotions facilitate reading comprehension and readers use their knowledge about their own and others' mental world to comprehend emotions experienced by a protagonist, valence and arousal ratings would be similar for the reader and the protagonist.

The reading-time results show that negative emotional states facilitate both children's and adults' reading processes. Readers in both age groups read target

sentences that contain a negative emotional state faster than emotionally neutral target sentences. Interestingly, the same pattern is observed for adults' reading times on the spill-over sentences, suggesting that adults' inferences about protagonists' emotional states benefits their construction of situation models of the narratives in subsequent sentences. Children showed the opposite pattern: Reading about negative emotions resulted in a greater slowdown on the spill-over sentences than reading of the neutral spill-over sentences. This suggests that children needed additional time to process the protagonist's emotional state and construct coherent mental representations of the narratives during subsequent reading. The potential facilitative or inhibiting effects of emotional statements on processing of subsequent text, by children and adults, would be a fruitful topic for future research. For example, think-aloud methods could be used to identify the circumstances for such facilitative or inhibitory effects to occur.

The valence and arousal ratings were similar for children and adults. Children and adults rated the protagonists' emotional states as more negative and more aroused than their own emotional states. These findings extend those of Diergarten and Nieding (2015) and suggest that, like adults, 11-year-old children are able to infer emotional states during reading. Although a direct comparison of age groups is not possible because children and adults read different narratives, the patterns suggest that especially on the valence dimension children's ratings of their own emotional states and those of the protagonists differ more than those for adults. Thus, when reading about negative emotions, children rate their own emotional states as relatively neutral compared to those of the protagonists, whereas adults' ratings of their own emotional states more closely match those of the protagonists. This could point to a developmental difference in the mechanism underlying emotional inferencing: Adults possibly simulate the most likely emotional state of a protagonist spontaneously and use this to make emotional inferences, whereas children infer the emotional states of the protagonists without strongly experiencing the emotion themselves. One explanation is suggested by findings on children's and adults' cognitive perspective taking abilities. For example, children often reason from their own egocentric point of view and are less able to take a protagonist's perspective, whereas adults are better able to ignore their own perspective when processing another's thoughts and (visual) viewpoints (Epley, Morewedge, & Keysar, 2004). Furthermore, adults have constructed scripts about how the minds of other people work and how views of others may differ from their own, and take these differences into account when evaluating another's thoughts and feelings (Elkind, 1967; Epley et al., 2004). These findings pertain to cognitive accounts of social cognition, but it is interesting to speculate whether the development of emotional inferencing follows a similar trajectory.

The present study corroborates previous research suggesting that it is possible to induce emotions through the reading of short texts (e.g., Westermann,

Spies, Stahl, & Hesse, 1996) as children and adults were able to *infer* the emotional state of the protagonist. Such narratives therefore are a fruitful way of studying children's emotional understanding (e.g., Blanc, 2007). Specifically, our findings show that children evaluated their own emotional states as relatively more neutral than those of the protagonists about whose negative emotional states they read. This was somewhat unexpected and may imply that the children were less able to *identify* with the protagonist after reading emotion-inducing narratives. It may also be that short narratives are limited in priming emotional states in children (and adults) because they may not provide enough contextual information for children to identify with the protagonist (e.g., Gygax et al., 2004). In the latter case, longer narratives with more links between emotional states and protagonists' behaviours may enable young readers to more readily identify with the protagonists.

To conclude, this study's findings provide valuable theoretical insight into possible mechanisms underlying the development of the ability to infer emotional states during reading and suggest directions for future research on the developmental trajectory of emotion inferences and its relation with narrative comprehension. Although both children and are able to rate the emotional states experienced by the protagonists along the valence as well as arousal dimensions, their ratings of their own emotional states and the patterns of reading times suggest that the underlying processes differ.

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