When story characters communicate: readers' representations of characters' linguistic exchanges

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Abstract Klin, Ralano, and Weingartner (2007) found transfer effects when a phrase, described as part of a note one character had left for another, was repeated across two passages. However, when the phrase was part of a note in story A and part of a conversation in story B, transfer effects were eliminated (Klin & Drumm, 2010). Klin and Drumm concluded that readers encoded the perceptual features of story characters' linguistic exchanges and that the mismatch (visual vs. auditory) eliminated transfer effects. The present experiments support this conclusion and also demonstrate that readers encode details of the social interaction that surrounds the characters' linguistic exchanges: Effects were reduced when the phrase in story A was part of a direct social interaction between the characters (e.g., phone conversation), whereas in story B, the interaction was indirect (e.g., voicemail). More generally, readers are exquisitely tuned to subtle aspects of characters' linguistic exchanges.

Keywords Reading · Repetition priming · Discourse processing

A central issue in the study of text comprehension is determining what aspects of the narrative world readers include in their mental representations. Most generally, we know that readers develop a representation that is rich and multidimensional. A reader's representation has been described as a combination of contextual, semantic, and lexical information, all of which contribute to the formula-

tion of a situation model (e.g., Raney, Thierrault, & Minkoff, 2000; van Dijk & Kintsch, 1983). The situation model includes many aspects of the story world, such as narrative time and space and the protagonist's goals (e.g., Anderson, Garrod, & Sanford, 1983; Bower & Morrow, 1990; Johnson-Laird, 1983; Zwaan, Langston, & Graesser, 1995). Furthermore, many of the details in readers' representations are consistent with the story character's perspective (e.g., Black, Turner, & Bower, 1979; O'Brien & Albrecht, 1992). For example, Levine and Klin (2001) found that readers responded more quickly to a probe word representing an entity in a character's current location (e.g., the trees) than in the character's former location, even if the current location had not been mentioned recently. Readers appear to take the character's perspective and keep active in memory aspects of the situation that are salient to them.

Recent findings in embodied, or grounded, cognition (e.g., Barsalou, 1999, 2008; Fischer & Zwaan, 2008; Gibbs, 2006) have extended the idea that the story characters' perspective influences the situation model. According to this framework, a critical element in understanding the behavior of others is the ability to form a mental simulation of their behavior. In keeping with this, a critical element in understanding a story character's behavior may involve simulating it as well. Just as we simulate other people's behavior in order to comprehend it, readers may mentally simulate the experience and behavior of story characters.

Support for this idea is extensive, indicating that readers simulate multiple aspects of the characters' experience, such as their visual perspective, including the shape, orientation, and color of objects (Connell, 2007; Stanfield & Zwaan, 2001; Yaxley & Zwaan, 2007), as well as their motor movements (Speer, Reynolds, Swallow, & Zachs, 2009; Taylor, Lev-Ari, & Zwaan, 2008; Taylor & Zwaan, 2008). For example, Glenberg and Kaschak (2002) found

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that after reading a sentence describing a character making a movement in a particular direction (e.g., “He closed the drawer”), readers were faster to press a key on a response box that involved making a movement in the same direction as the character (e.g., moving their hand away from their body) than making a movement in the opposite direction. This demonstrates that readers inferred the relevant perceptual information and formed a simulation of the character’s action.

But what about a reader’s experience of a story character’s linguistic experience? At least in adult fiction, the linguistic exchanges between characters often contain the most salient and central aspects of a story. However, in contrast to the attention paid to understanding how readers represent descriptions of a character’s motor movements, location, or goals, little is known about how readers represent characters’ linguistic exchanges.

Klin and Drumm (2010) hypothesized that readers mentally simulate a character’s linguistic experiences much as they mentally simulate a character’s motor actions. This hypothesis is consistent with evidence from brain-imaging studies in which the processing of phrases describing visual, tactile, auditory, gustatory, olfactory, kinesthetic, and somatic perception (e.g., “to hear a shot,” “to see a candle”; Belardinelli et al., 2009; Palmiero et al., 2009) led to significant activation of brain regions that are generally associated with the use of those senses. If processing phrases describing visual and auditory images involves the same brain areas that are involved in seeing and listening, it seems plausible that reading descriptions of characters processing written and spoken language causes readers to mentally simulate those visual and auditory experiences as well. More specifically, Klin and Drumm hypothesized that just as people encode some of the perceptual details of the words they read and hear—leading, for example, to reduced cross- vs. within-modality priming effects (e.g., Rajaram & Roediger, 1993)—readers encode some of the perceptual details of the words that story characters read and hear.

To examine this hypothesis, Klin and Drumm (2010) used a research design employed by Klin et al. (2007; Klin, Drumm, & Ralano, 2009) that examined text repetition effects across two unrelated passages, story A and story B (see Table 1 for a sample passage). There were two versions of story A: a *repeated* version that contained the repetition line and a *not repeated* version that did not. Story B contained the repetition line and was the same for the two conditions. The question pertains to the processing of the repetition line in story B: Will readers in the repeated condition experience the phrase as familiar, on the basis of having reactivated it from memory?

To answer this question, Klin et al. (2007) examined readers’ understanding of the story B repetition line. Note that this line is ambiguous; in the sample passage, it is unclear whether Justin is being sincere or sarcastic.

Table 1 Experiment 1: Voicemail/note

Story A

Introduction

Alex wanted to make some money to buy a new CD player. So she agreed to babysit her neighbor Kurt’s dog for the long weekend. After Kurt went over the instructions with Alex he said, “Damian is a wonderful dog. He’ll be great company for you.”

Critical Information

Repeated condition (*repetition line*) Alex exhausted herself all weekend cleaning up after Damian. She tried to play with him, but he growled at her whenever she got too close. Alex had an early-morning class on Monday. Knowing that she would be gone when Kurt returned home, she left a voicemail on his cell phone. She mentioned that Damian was difficult to get along with and added: “Damian *sure is great company*. Nothing like being growled at for 48 hours.”

Not repeated condition Alex enjoyed spending time with Damian over the weekend. They went for several peaceful walks in the park up the street. Alex had an early-morning class on Monday.

Knowing that she would be gone when Kurt returned home, she left voicemail on his cell phone. She mentioned that Damian is easy to get along with and added: “I really enjoyed babysitting Damian. I especially enjoyed taking him to the park.”

Conclusion

Then Alex headed off to her class. On the way there she stopped at the mini mart to get some coffee. She hoped today’s class would be interesting.

Story B

Introduction

Justin had just moved to Baltimore to attend school at Johns Hopkins University. He hadn’t been able to afford living alone, so he’d found a roommate. Today Justin spent most of the morning getting settled into his apartment, and then he went to buy the books he needed for his classes. Later that evening, Justin emailed his girlfriend, Kate, to fill her in on his day. He also told her all about his new roommate:

Repetition line

“Wonderful guy, and he *sure is great company*.”

Disambiguation line

Justin found his roommate very annoying.

Conclusion

He knew that it could be very difficult to live with someone else, but his new roommate was the absolute worst.

However, in the repeated version of story A, the context clearly promotes a bias for a sarcastic interpretation of this phrase. When participants were asked to explicitly judge whether the repeated sentence in story B was sarcastic or sincere, they responded that it was meant sarcastically significantly more often in the repeated condition than in the not repeated condition. This suggests that without prior knowledge of the sarcastic interpretation of the repetition line, a sincere interpretation is more likely.

In a similar experiment, Klin et al. (2007; Klin et al., 2009) investigated the transfer of a sarcastic, subordinate meaning between story A and story B by using an online task. The logic was as follows. Assuming that there is a

transfer effect, when participants read the repetition line in story B, they will reactivate from memory the repetition line from story A, as well as their interpretation of it. Thus, participants should be more likely to interpret the repetition line in story B as sarcastic in the repeated version than in the not repeated version. Consequently, reading times should be shorter on the disambiguation line that follows the repetition line in story B and is consistent with a sarcastic interpretation.

This is exactly what Klin et al. (2007; Klin et al., 2009) found, despite findings from a large number of studies that suggested that repetition effects are often limited to conditions in which the context remains consistent across the two processing episodes (e.g., Levy et al., 1995). Furthermore, Klin et al.'s findings are inconsistent with episodic, or context-dependent, accounts of repetition priming (e.g., Tenpenny, 1995). These accounts claim that repetition priming is the result of the reactivation of the initial processing episode and, thus, the memory representation of words is contextually bound (e.g., Levy & Kirsner, 1989). In addition to demonstrating that text repetition effects can be found across thematically and semantically unrelated narratives and are, therefore, context independent, Klin et al. (2007) demonstrated that this effect is robust and can be found in a variety of conditions. Impressively, inserting an unrelated filler passage between story A and story B (Klin et al., 2009) did not diminish the effect. Even in this condition, when readers processed an ambiguous phrase that had previously been encountered two passages earlier, not only did they retrieve the phrase from memory, but also they retrieved their sarcastic interpretation of it.

Klin and Drumm (2010) went beyond a demonstration of context-independent repetition effects and used this paradigm to investigate the nature of the readers' representation of the repeated phrase. More specifically, they asked whether the readers would encode the perceptual details of the story characters' linguistic exchanges. To do so, they asked whether transfer effects would still be found if, in one of the two passages, the repeated phrase was described as having been spoken by the communicator to the addressee. This is in contrast to Klin et al. (2007; Klin et al., 2009), where the repeated phrase was described as part of a written note in both stories A and B. Although it seemed likely that readers would infer that the addressee had processed the phonological details of the words in the phrase in one case and the orthographic details in the other, the question was whether the reader's memory representation of the phrases would include those perceptual details as well.

The manipulation was quite subtle, involving a change in only a couple of words in rather lengthy passages. For example, the phrase, "Justin emailed his girlfriend," was changed to "Justin called his girlfriend." Although the change was minor, the effects were powerful. When

participants read the repeated phrase in story B, the meaning of the phrase (sarcastic in story A) was no longer retrieved from memory. That is, by describing the repetition line as having been written in story A and spoken in story B, a transfer effect that was large and had been replicated numerous times (Klin et al., 2009; Klin et al., 2007) was entirely eliminated. Even though having an unrelated filler passage between story A and story B (Klin et al., 2009) did not diminish transfer effects, simply changing the word "emailed" to "called" entirely eliminated them. Critically, the elimination of the transfer effect occurred even though the repetition was within a modality for the readers. The participants in the experiments simply read; nothing was ever said or heard. Despite this, there was a strong influence of the modality of the phrase from the point of view of the story characters.

Because the findings of Klin and Drumm (2010) were surprising, and because they have potentially important implications for our understanding of the way in which readers understand linguistic exchanges, in the present article, we explore these findings further. More specifically, we ask what aspects of the mismatch in the phrases were responsible for the elimination of the transfer effects. The simplest possibility is that readers encoded either the phonological or the visual details of the words in the repeated phrase, depending on whether the phrase was described as spoken or written, and this mismatch interfered with memory retrieval. However, another possibility is that the written and spoken phrases differed in ways unrelated to their perceptual modality. The specific possibility that we explore in the present article is the nature of the social interaction between the communicator and the addressee. When one character leaves a note for the other, this involves no direct social interaction between the two characters; in contrast, a spoken conversation involves direct social interaction. Although these details were simply implied in the passages, rather than explicitly stated, we ask whether readers inferred these details and whether it was the mismatch between story A and story B in this dimension that led to, or contributed to, the elimination of the transfer effects.

Why might the nature of the two characters' social interaction play such a salient role in the formation of a situation model and in retrieval? As Van Berkum, van den Brink, Tesnik, Kos, and Hagoort (2008) argued,

[L]anguage comprehension takes very rapid account of the social context, and the construction of meaning based on language alone cannot be separated from the social aspects of language use. . . . Also, recent linguistic research suggests that the computation of a context-free sentence meaning is, in fact, highly problematic, and that linguistic meaning is always

colored by the pragmatics of the communicative exchange. (pp. 580–581)

In the present set of experiments, we asked whether social context influences comprehension of only our own linguistic exchanges, or whether it also influences our comprehension of story characters' linguistic exchanges. If the latter is true, then our previous work served to explore only two of the four relevant conditions, confounding perceptual match with a match in social interaction (see Fig. 1). In the present set of experiments, we examined the two remaining cells of the table—the cells representing a match in one dimension (perceptual or social) and a mismatch in the other. If the social context of the characters' linguistic exchange plays no role in retrieval, we should find transfer effects in both cells of the perceptual match column and no transfer effects in either cell of the perceptual mismatch column. In contrast, if social context contributed to the different findings in the perceptual-match/social-match and perceptual-mismatch/social-mismatch conditions, transfer effects should be eliminated, or reduced, in Experiments 1 and 2.

Experiment 1

In Experiment 1, the materials were very similar to those used by Klin and Drumm (2010). In story A, the message in the repetition line was described as having been spoken, and in story B, it was described as being part of a note. In this condition, Klin and Drumm found null results, with no transfer effects. In the present experiment, we ask whether the null finding was influenced in part by the fact that the materials used by Klin and Drumm contrasted a face-to-face (or telephone) conversation with a note, two forms of communication that differ with regard to the nature of the social interaction. To examine this, in the present experiment we contrast a voicemail message and a note. Although

one message was spoken and one was written, in neither case did the linguistic exchange imply a direct social interaction between the two characters.

The question was whether the pattern of findings from Klin and Drumm (2010)—the lack of a transfer effect—would again be found. If so, this would indicate that the mismatch in social interaction in the materials used by Klin and Drumm was not responsible for the lack of transfer effects. Instead, it would indicate that it was the mismatch in the perceptual modality of the two phrases, from the point of view of the story characters, that influenced retrieval. Conversely, if transfer effects are found despite the mismatch in the perceptual features of the repeated phrase, this would indicate that the match in the social context facilitates retrieval and that social context plays an important role in the comprehension of characters' linguistic exchanges.

Method

Participants One hundred twenty-eight undergraduates at the State University of New York at Binghamton participated as part of a requirement for an introductory psychology course. The data were eliminated for 11 participants who did not follow instructions. Therefore, the data analyses were based on 117 participants.

Materials The experimental items used by Klin and Drumm (2010) were modified for the present study. Participants read 14 experimental items, with each item consisting of a pair of unrelated stories, story A and story B. There were two versions of story A: repeated and not repeated. Both versions of story A began with an Introduction that described an interaction between two characters. This was followed by a Critical Information section. In the repeated version of this section, one character had a negative reaction to the other. The first character—the communicator—said something sarcastic to the second character—the addressee—in a voicemail. This dialogue included the use of a sarcastic repetition line (e.g., “Damian sure is great company.”). The repetition line was written so that if it appeared in isolation, without context, it would be ambiguous and could be interpreted as either sarcastic or sincere. However, the sentence that preceded the repetition line explicitly stated that the communicator was angry or unhappy, and the sentence following the repetition line was clearly sarcastic. In the not repeated version of story A, the repetition line was not included in the Critical Information section. In its place, the communicator left a voicemail that was unambiguous and sincere. The Critical Information sections in the two versions of story A were matched for length.

		Perceptual Modality	
		Match	Mismatch
Social Interaction	Match	Note/Note [†] Conv./Conv [‡]	Experiment 1 (Voicemail/Note)
	Mismatch	Experiment 2 (Voicemail/Conv. Conv./Voicemail)	Note/Conv. [†] Conv./Note [‡]

Fig. 1 Full research design investigating the influence of social-interaction and perceptual modality on repetition effects, including the present Experiments 1 and 2.[†]Klin, Ralano, and Weingartner (2007).[‡]Klin and Drumm (2010)

Story B was identical in the repeated and not repeated conditions. Story B contained the repetition line, which had the same phrase (e.g., “he sure is great company”) as the repeated version of story A. However, in contrast with story A, the repetition line was presented in a neutral context, and it was, therefore, unclear whether it was intended to be sarcastic or sincere. Furthermore, instead of the communicator’s leaving a spoken message, as in story A, the communicator left a written note or e-mail (e.g., “that evening, Justin emailed his girlfriend”). Thus, there was no direct social interaction between the characters. The repetition line was followed by the disambiguation line, which made it clear that the communicator intended the repetition line to be sarcastic.

Twenty-six filler items were also presented. Immediately after the last line of story B and at the end of 19 of the 26 filler items, a comprehension question was presented to ensure that participants were reading carefully. For half of the comprehension questions, the correct answer was yes.

Design For each participant, experimental items were randomly assigned to the repeated and not repeated versions with two constraints: (1) Each participant read half of the experimental items in each version, and (2) each version was presented to half of the participants. Filler items were interspersed among the experimental items, and the order of presentation was the same for all participants.

Note that although studies examining the repetition of individual words often use reading time during the second reading as the dependent measure (e.g., Raney & Rayner, 1995), the primary dependent measure in this experiment was reading time on the story B disambiguation line, rather than the repetition line itself. In contrast with encountering a repeated word, which tends to lead to faster reading, encountering a repeated phrase in an unrelated passage might be surprising or confusing to readers, causing reading times to increase. Consistent with this, Klin et al. (2007; Klin et al., 2009) found variable effects on the repetition line itself but consistently found shorter reading times on the disambiguation line in the repeated condition. Furthermore, whereas facilitation on the repetition line appears to be primarily the result of faster processing of the lexical items making up the phrase, effects on the disambiguation line in story B (referred to as meaning-selection effects by Klin et al., 2009) appear to be based on the retrieval of the sarcastic meaning of the ambiguous phrase as it was used in story A. Klin and Drumm (2010) found that a mismatch in the perceptual modality of the repeated phrase from story A to story B did not prevent reactivation of the lexical items of the phrase but did eliminate meaning selection effects. Similarly, Klin et al. (2009) found that repetition effects for the lexical items were long lasting and relatively immune to manipulations at the text level. In the present set of

experiments, we asked which features of characters’ linguistic exchanges (i.e., perceptual, social) were encoded in readers’ situation models. Thus, we were again interested in reading times on the disambiguation line, rather than the repetition line itself.

Procedure Participants were tested individually in sessions that lasted approximately 45 min. The passages were presented on a computer monitor. Participants controlled the presentation of the text with a line advance key on a response box. Each key press caused the current line of text to be erased and the next line to be presented. Between stories, the phrase “Press Advance For the Next Story” appeared at the center of the monitor. Importantly, this phrase appeared between story A and story B to ensure that readers did not treat story A and story B as part of the same experimental trial.

Immediately after the last line of story B and after the last line of 19 of the 26 filler items, a yes/no comprehension question was presented. To familiarize participants with the procedure, they were given three practice items before beginning the experiment.

Results and discussion

The mean reading times for the repetition and disambiguation lines are presented in Table 2. Statistical analyses were performed both with participants as a random effect variable (t_1) and with items as a random effect variable (t_2). An alpha level of .05 was used for all analyses. Any outliers, as defined by Tukey’s (1977) criterion, were discarded and not replaced; this eliminated 4.8% of the data.

Reading times on the repetition line were faster in the repeated condition than in the not repeated condition.

Table 2 Experiments 1 and 2: Reading times (in milliseconds) for repetition and disambiguation lines

Experiment 1 – VoiceMail/Note		
Condition	Repetition	Disambiguation
Not repeated	1,751	2,397
Repeated	1,656	2,314
Difference	95*	83**
Experiment 2 – Conversation/VoiceMail; VoiceMail/Conversation		
Condition	Repetition	Disambiguation
Not repeated	1,857	2,446
Repeated	1,735	2,379
Difference	122*	67**

* $p < .05$ by participants and by items

** $p < .05$ by participants only

Although the effect on the repetition line has been somewhat variable across experiments (Klin et al., 2007; Klin et al., 2009), it is not surprising that reading times were shorter when the words of the phrase were repeated. This 94-ms difference (95% confidence interval; 29.7–159.6 ms) was significant by participants, $t_1(96) = 2.88$, $SEM = 32.78$, and by items, $t_2(13) = 2.96$, $SEM = 34.8$.

More important, reading times on the disambiguation line in story B were shorter in the repeated condition than in the not repeated condition. This mean difference of 83 ms (95% confidence interval; 22.1–144.2 ms) was significant by participants, $t_1(116) = 2.69$, $SEM = 30.81$, but not by items, $t_2(13) = 1.43$, $SEM = 54.15$, $p = .26$. (The lack of significance in the items analysis was likely due to a lack of power. We will return to a discussion of this issue.)

Although the effect size was smaller than that found in the fully-matched conditions (note/note or conversation/conversation), it was much larger than the null effect (averaging 15 ms) found when there was a mismatch in both perceptual modality and social interaction (conversation/note). In the present experiment, although there was also a mismatch in the perceptual modality of the phrase, there was a match in the nature of the social interaction (voicemail/note). Thus, the reliable effect on the disambiguation line (at least in the participants analysis) indicates that the match in the social interaction led readers to reactivate from memory the repetition line and its sarcastic meaning from story A, despite the mismatch in the perceptual modality. Importantly, this suggests that the match in social interaction facilitated retrieval.

Although there was a reliable difference in reading times between the repeated and not repeated conditions in the participants analysis, the effect was not reliable in the items analysis. Clearly, this was due to the fact that the effect was smaller than in the original findings (Klin & Drumm, 2010; Klin et al., 2009, 2007), where there was a match in both perceptual modality and social interaction (note/note or conversation/conversation). In these studies, reading times were consistently shorter on the disambiguation line in the repeated than in the not repeated condition, with differences averaging approximately 160 ms, even when a filler passage intervened between story A and story B.

What does the smaller effect size tell us? The most interesting possibility is that both a match in social interaction and a match in perceptual modality facilitate retrieval. If this is the case, we would expect exactly this result: In the matched/mismatched condition of the present experiment, the effect size was approximately half of what it was in the matched/matched condition in Klin et al. (2007, 2009) and was larger than the null effects in the mismatch/mismatch condition in Klin and Drumm (2010). However, the nonsignificant items analysis makes it difficult to rule out the less interesting possibility that the

result from the participants analysis was simply a Type 1 error. Unfortunately, a reduced effect—83 ms in this experiment—was virtually impossible to detect in the items analysis with only 14 experimental items. Thus, instead of increasing the number of items, which was impractical, we provided a conceptual replication of the finding in Experiment 2. Finding a similar-sized effect in a second, independent experiment would help to address concerns about a Type 1 error.

Experiment 2

The goal of Experiment 2 was to further explore the influence of characters' social interaction on the situation model. To do so, we examined the final cell of the 2×2 table (see Fig. 1). As in Experiment 1, the critical phrase matched on one of the two dimensions and mismatched on the other. More specifically, the critical phrase was described as being part of a conversation in one story, either in person or on the telephone, and part of a voicemail in the other. As in Klin and Drumm (2010), the perceptual modality of the two messages matched; both were spoken. However, the social interaction between the two characters did not match; whereas a conversation involves direct interaction, leaving a voicemail does not. If the mismatch in the type of social interaction was encoded and interfered with retrieval, transfer effects should again be reduced from the 160-ms effects found in the match/match conditions of the previous experiments (Klin & Drumm, 2010; Klin et al., 2009, 2007).

In Experiment 2, we also examined order effects. We presented passages in one of two orders: For half of the participants, story A described the critical phrase as being part of a conversation, and story B described the critical phrase as part of a voicemail; for the other half of the participants, the order was reversed. In addition to potentially increasing power in the items analysis by increasing the number of items, this allowed us to determine whether order influences the effect. One might imagine, for example, that readers find a conversation between two characters to be more salient than the leaving of a voicemail. If this were the case, the mismatch in the social interaction might be more apparent when the conversation was described first.

Method

Participants Two hundred eighteen undergraduates at the State University of New York at Binghamton participated as part of the requirement for an introductory psychology course. The data were eliminated for 14 participants who

did not follow instructions. Therefore, the data analyses were based on 204 participants.

Materials and design The experimental items were similar to those in [Experiment 1](#), except that, for half the participants, the repetition line in the repeated version of story A was described as being part of a spoken conversation and in story B it was described as being part of a voicemail. For the other half of the participants, the repetition line in story A was described as being part of a voicemail, and in story B as part of a conversation. All other aspects of the design and procedure were identical to those in [Experiment 1](#).

Results and discussion

The mean reading times for the repetition and disambiguation lines are presented in [Table 2](#) (7.4% of the data were eliminated as outliers). First, there was no effect of order, $F < 1$. Because of this, order was not used for the remainder of the analyses. As in [Experiment 1](#), reading times on the story B repetition line were shorter in the repeated condition than in the not repeated condition. The 122-ms difference (95% confidence interval; 68.4–176 ms) was significant, $t_1(203) = 4.48$, $SEM = 27.2$; $t_2(27) = 3.32$, $SEM = 35.4$.

More important, reading times on the disambiguation line were shorter in the repeated condition than in the not repeated condition, just as was found in [Experiment 1](#). The 67-ms difference (95% confidence interval; 18.5–116 ms) was significant by participants, $t_1(199) = 2.72$, $SEM = 27.74$, and marginally so by items, $t_2(27) = 1.87$, $SEM = 34.06$, $p = .07$. It appears that participants were able to retrieve the meaning of the repetition line from memory during the reading of story B, despite the mismatch in the type of social interaction between the characters.

The transfer effects found in this experiment are in contrast with the null effects found by Klin and Drumm (2010), where the passages also included a mismatch in the description of the social interaction (conversation/note). The difference is that in the present experiment, the description of the perceptual modality of the critical phrase matched across story A and story B. Both were spoken. Because of this, when participants read the critical phrase in story B, they were able to retrieve the sarcastic meaning of the line from memory. Importantly, this provides support for the conclusions of Klin and Drumm: The perceptual features of the characters' linguistic exchange are encoded by readers. When these features match, the critical phrase in story B is a more effective retrieval cue to memory.

The results can also be contrasted with the large effects found by Klin and Drumm (2010) and Klin et al. (2007, 2009) when the repeated phrase matched on both dimen-

sions of interest.¹ Although reliable, in the present experiment, the facilitation in the repeated condition was clearly reduced: 67 ms, as compared with the 160-ms effects found in the fully matched conditions. We have limited statistical power to compare a medium effect size (160 ms, $d = .32$) from the fully-matched conditions (note/note and conversation/conversation) in the previous studies with a small effect size (67 ms, $d = .13$) from the partially-matched condition in the present experiment. However, if we compare these two results, the difference is reliable in a one-tailed test: $t_1(263) = 1.68$, $SEM = 52.38$, $p = .045$; $t_2(27) = 1.7$, $SEM = 59.36$, $p = .048$. This provides additional support for the conclusions from [Experiment 1](#): The nature of the social interaction between the two characters is encoded by readers, and when these features mismatch, the critical phrase in story B is a less effective retrieval cue to memory.

General discussion

In the present experiments, we continued to explore the question of what aspects of the narrative world readers include in their mental representations. More specifically, we asked whether readers encoded features of the written and spoken phrases used by Klin and Drumm (2010) that were unrelated to their perceptual modality. Given the argument that linguistic meaning is always influenced by the pragmatics of the communicative exchange (Van Berkum et al., 2008), we asked whether readers' representations' linguistic exchanges are influenced by the social conditions in which they are described. Since language is essentially a tool for social interaction, we hypothesized that information about the nature of the social interaction between characters would influence readers' representations of the linguistic exchange.

To investigate this hypothesis, we examined the two missing cells of the 2×2 table (see [Fig. 1](#)). To eliminate the confound between perceptual match and match in social interaction, in [Experiment 1](#), we constructed passages in which the critical phrase matched in social interaction but mismatched in the perceptual details of the message (voicemail/note). In [Experiment 2](#), the phrase mismatched in the nature of the social interaction but matched in the perceptual details (voicemail/conversation). In both [Experiments 1](#) and [2](#), we found that the effects were reliably different from 0, but approximately half the size that they

¹ Several post hoc analyses were carried out to ensure that we were drawing from the same population in each experiment. No differences were found in accuracy on comprehension questions ($p > .4$), reading times for an early line in story A ($p > .5$), or number of passages that yielded a repetition effect ($p > .9$).

were in the fully-matched conditions (Klin & Drumm, 2010; Klin et al., 2009, 2007). This is precisely the pattern of effects that would be expected if both of the factors we examined—the perceptual features of the critical phrase and the nature of the social interaction between the communicator and the addressee—influenced retrieval.

Despite some nonsignificant or marginally significant results, particularly in the items analyses, what is convincing about the findings is the overall pattern of results. Taken together, the results of the present experiments tell a compelling story when contrasted with the matched conditions (note/note and conversation/conversation) in Klin et al. (2007, 2009) and Klin and Drumm (2010), as well as when compared with the mismatched conditions (note/conversation) in Klin and Drumm (see Fig. 2 for the full set of results). The three condition means are almost perfectly linear: matched (160 ms), partially matched (73 ms), and mismatched (16 ms), $F(1,486) = 6.03$, $MSE = 134,525$. Furthermore, in each of the three conditions, the effects were replicated at least twice, with very little variability across experiments. In fact, the means within each condition were exceptionally stable; the effect of experiment (within a condition) did not approach significance, $p = .98$. In contrast, the means differed reliably across the three conditions, $F(2,482) = 3.08$, $MSE = 135,544$.

So, why was there a disruption in repetition effects when there was a change in the nature of the characters' social interaction or in the perceptual characteristics of the critical phrase? Because the large effects found by Klin and colleagues (Klin & Drumm, 2010; Klin et al., 2009, 2007) are in some ways more striking than the reduced effects found in the present experiments, we start by asking why there was a repetition effect when these features matched in stories A and B. Although the repetition line in story B was

in no way difficult to understand, readers did not compute the meaning of the phrase but, instead, reactivated the phrase and its interpretation from memory. This occurred even though the phrase had appeared in an earlier, unrelated passage and, in fact, occurred even when an additional unrelated passage intervened between story A and story B (Klin et al., 2009). What makes this finding all the more impressive is that the meaning of the phrase that readers instantiated was the subordinate meaning. In a norming study, Klin et al. (2007) found that readers judged the phrase to be sincere 89% of the time when there was no disambiguating context. Despite this, readers interpreted the phrase as sarcastic, rather than sincere, in story B, solely on the basis of its retrieved meaning from an unrelated passage.

Why didn't readers simply compute the meaning of the critical phrase in story B, rather than retrieving it from memory? We assume that retrieval was used because it was effortless. According to Rawson and Middleton's (2009) memory-based theory of automaticity, comprehension involves a race between two parallel routes; people can use an "algorithmic" process to compute meaning, or they can retrieve a previously stored instance of the item's meaning. The final interpretation of a stimulus is based on whichever of the two processes finishes first. Furthermore, according to this account, any factor that increases the speed of retrieval, such as an increase in an item's salience or familiarity, should increase the probability that comprehension is retrieval based. Given this framework, we assume that in the present set of experiments, retrieval of the stored meaning of the repetition line in story B occurred more quickly than the computation of its meaning, because the repetition line in story A was highly salient and, thus, highly familiar; it was presented in quotation marks, it was used in its figurative, sarcastic meaning, and it was highly elaborated. This explanation is consistent with other memory-based models, such as Myers and O'Brien's (1998) resonance model. According to the resonance model, each text input acts as a cue to memory, automatically activating related information in memory through a passive, fast-acting resonance process (cf. Gillund & Shiffrin, 1984; Hintzman, 1986; Ratcliff, 1978). Related concepts should resonate as a function of the degree of their activation and as a function of the number of semantic and conceptual features that overlap with the current segment of text. Again, given the salience of the repetition line in story A, we assume that retrieval was fast and effortless.

Rawson and Middleton (2009) provided support for their theory of automaticity using materials that are somewhat similar to ours. Participants read short passages that included conceptual combinations (e.g., *paper dog*) whose meanings were biased toward either their subordinate meaning (e.g., *dog trained to fetch the paper*) or their dominant meaning (e.g., *paper shaped to look like a dog*). These conceptual

Fig. 2 Times indicate mean facilitation (in milliseconds) on the disambiguation line in the repeated condition (repeated minus not repeated). [†]Klin, Ralano, and Weingartner (2007). [‡]Klin and Drumm (2010)

combinations were then presented repeatedly throughout the experiment. As is predicted by the memory-based theory of automaticity, with increasing repetitions, participants' early reliance on algorithmic processing gave way to retrieval: With increasing familiarity with the subordinate instantiation of a conceptual combination, this meaning was retrieved quickly and, critically, more quickly than the computation of its dominant meaning. Similarly, in our experiments, when the repetition line was encountered for a second time in story B, its subordinate, sarcastic meaning was highly familiar, due to its salience in story A. Therefore it was retrieved from memory more quickly than the dominant meaning could be computed.

Given this, why was a mismatch in the description of the social interaction between the two characters or in the perceptual characteristics of the phrase disruptive to retrieval? As Rawson and Middleton (2009) predicted, "instances are slow to be retrieved due to changes in the context in which stimuli are encountered" (p. 357). Similarly, according to Myers and O'Brien (1998), a reduction in the number of overlapping traces between a cue to memory and the stored information will reduce the amount of resonance and, thus, the probability of retrieval.

In the present experiments, we asked what features in these passages constituted context—that is, what features of the passages were encoded into memory and used in retrieval. Klin et al. (2009) concluded that the prosody associated with the sarcastic utterance in story A may have been included in readers' representations. When readers encountered the repetition line in story B, they retrieved from memory not only the words of the phrase, but also the sarcastic prosody, leading them to interpret the repeated phrase in story B sarcastically. Consistent with this, there have been several recent findings indicating that readers' text representation may include some characteristics of spoken language. For example, Kurby, Magliano, and Rapp (2009) found that after listening to an audio presentation of two characters interacting, readers were faster to respond to an aurally presented probe word in a matched condition—when the probe word was pronounced in the voice of the character whose dialogue was being read (see also Alexander & Nygaard, 2008).

The present data indicate that readers encoded the perceptual characteristics of story characters' linguistic exchanges and the social context in which they took place. Klin and Drumm (2010) found that transfer effects were eliminated when the repetition line was described as being written in story A and spoken in story B even though the stimuli were within a modality for the readers. That is, the participants in the experiments simply read; nothing was ever said or heard. The present experiments extend these findings by demonstrating that the social interactions inherent in the linguistic exchanges were also encoded by

readers and were important for retrieval. If these features were not salient and had not been encoded, the mismatch in story A and story B would not have disrupted retrieval. After all, the scenarios surrounding the critical phrase in stories A and B mismatched in a multitude of other ways that did not disrupt retrieval. For example, in story A, the "great company" referred to a dog, and in story B, it referred to a person.

Whether the perceptual and social features of characters' linguistic exchanges are always salient is not clear. We suspect that the salience of this information and, thus, the probability that it will be encoded and retrieved is influenced by a complex array of variables, including the amount of elaboration and the pragmatic function it plays in the text. However, the present data demonstrate that readers are exquisitely tuned to subtle aspects of characters' linguistic exchanges and, as argued by Van Berkum et al. (2008), that an understanding of language comprehension is incomplete without consideration of the social aspects of its use.

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