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The misinformation effect revisited: Interactions between spontaneous memory processes and misleading suggestions

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ABSTRACT

Recent findings indicate that retained information tends to converge at the basic level (BL). The aim of the present study was to apply these findings to the investigation of misinformation phenomena. In three experiments, we examined the extent to which the contaminating effects of misinformation are influenced by its consistency with the accessible representation of the original information. Following different retention intervals, participants were misled with items that either shared the same BL with the target items (Same-BL condition) or did not (Different-BL condition). Misinformation was found to interfere with subsequent correct recall of event information only in the Same-BL condition. Suggestibility was more pronounced and more affected by the timing of misinformation presentation in the Same-BL condition. Moreover, Same-BL distortions were more often misattributed to the event than Different-BL distortions. These findings are interpreted in terms of the interaction between the misinformation and the accessible (BL) representations of the event information at the time the misinformation is introduced.

Introduction

Recent findings have shown that information reported from memory tends to converge at an intermediate level of abstractness – the basic level (hence, BL), particularly over time (Pansky & Koriat, 2004). In the present study, we applied these findings to the investigation of misinformation phenomena. We examined the extent to which the contaminating effects of misleading post-event information (MPI) are influenced by the consistency between the MPI and the accessible representation of the original information (i.e., its BL) following a normal degrading process (i.e., BL convergence).

The misinformation effect

One of the most researched topics in the eyewitness testimony literature is the contaminating effect of MPI. Following the seminal study of Loftus, Miller, and Burns (1978), numerous studies have shown that exposure to misleading information presented after an event can distort the memory for that event in what is known as *the misinformation effect* (see Ayers & Reder, 1998). In a prototypical experiment, participants who are exposed to an event are later misinformed about some details, and are finally tested for their memory of the original details. Loftus et al. (1978) presented participants with slides depicting a car accident and later asked them a series of questions about these slides. Embedded in one of these questions was the misleading presupposition that the car stopped at a yield sign, although the slides had shown a stop sign. On a subsequent memory test, the participants who received the misleading question were less likely to correctly report having seen the original stop sign than were the participants whose intervening question contained the

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correct target information (STOP SIGN) or neutral information (INTERSECTION). Most experiments investigating the misinformation effect have used some variant of this three-stage paradigm (for reviews, see Ayers & Reder, 1998; Belli & Loftus, 1996; Zaragoza, Belli, & Payment, 2007).

A close examination of the vast misinformation literature reveals that the term *misinformation effect* has been used to refer to the influence of MPI from two different perspectives. The first perspective focuses on the potentially interfering effect of MPI on correct retrieval of the event items (e.g., Belli, Lindsay, Gales, & McCarthy, 1994; Chandler, 1989; Eakin, Schreiber, & Sergent-Marshall, 2003; Lindsay, 1990; Paz-Alonso & Goodman, 2008; Schreiber & Sergent, 1998), which we will refer to as *misinformation interference* (following Belli, 1989; Chandler, Gargano, & Holt, 2001). The second perspective focuses on the potential effect of MPI in inducing false reports of the misleading items (e.g., Ayers & Reder, 1998; Blank, 1998; Cann & Katz, 2005; Higham, 1998; Lindsay, 1990; Pansky & Tenenboim, in press; Paz-Alonso & Goodman, 2008; Tousignant, Hall, & Loftus, 1986; Zaragoza & Koshmider 1989; Zaragoza & Lane, 1994), which we will refer to as *suggestibility* (following Chambers & Zaragoza, 2001). Obviously, the two perspectives are strongly related. In fact, for memory tests that allow a single response per test item, reporting the suggested item necessarily implies a failure to correctly report the event item. However, when such memory tests also allow reporting items other than the original and the misleading items (e.g., a recall test), the two perspectives are not necessarily complementary. Previous studies have demonstrated cases in which suggestibility involved misinformation interference (e.g., Belli, 1989; Paz-Alonso & Goodman, 2008; Tversky & Tuchin, 1989) as well as cases in which it did not (e.g., Chan, Thomas, & Bulevich 2009; Frost, 2000, delayed condition; Underwood & Pezdek, 1998).

In the present study, we examined the effects of MPI from both perspectives because we were particularly interested in: (1) cases of suggestibility that involve misinformation interference, a focus that is guided by the first perspective, and (2) cases of suggestibility in which the rememberer believes that the falsely reported item was part of the original event, a focus that is guided by the second perspective.

Much of the theoretical debate on misinformation interference has focused on the type of impairment that underlies it, if any (see, Ayers & Reder, 1998; Belli & Loftus, 1996). Initially, misinformation interference was attributed to a storage-based impairment by which the MPI replaces or alters the stored memory traces for the original information, rendering the original traces unavailable for consequent retrieval (e.g., Loftus, 1979; Loftus & Loftus, 1980). This approach was challenged by McCloskey and Zaragoza (1985), who attributed misinformation interference to response biases rather than to memory impairment of the event information. They suggested that inferior performance for misleading than for control items derives from cases in which the event items are not remembered even in the absence of misinformation (either due to forgetting or because they were not encoded in the first place) but the more recently presented MPI is remembered. Thus, with certain memory tests (such as the standard recognition test used by Loftus et al., 1978), apparent misinformation interference could result from an increased tendency to report the MPI in the misleading condition, without any effect on the accessibility of the memory representation of the event information. Subsequent studies have convincingly shown that misinformation interference can be temporary (e.g., Chandler, 1989, 1991) or reduced using retrieval manipulations (e.g., Bekerian & Bowers, 1983; Bowers & Bekerian, 1984; Kroll, Ogawa, & Nieters, 1988), suggesting that the MPI does not impair the stored representation of the original information but rather impairs its accessibility relative to that of the misleading information (see also Eakin et al., 2003). According to fuzzy-trace theory (FTT), misinformation interference depends on the relative accessibility of verbatim and gist representations of the original information and the verbatim representation of the misleading information. Accessing either the gist representation of the original information or the verbatim representation of the misleading information (instead of the verbatim representation of the original information) can result in suggestibility, whereas accessing the verbatim representation of the misleading information can also result in misinformation interference, but this does not imply a storage-based impairment of the original trace (see Brainerd & Reyna, 1998; Reyna & Brainerd, 1995; Reyna & Titcomb, 1997; Titcomb & Reyna, 1995). Finally, an influential account of suggestibility views it as a result of an error in source monitoring by which the misleading item is misattributed to the original event (e.g., Johnson, Hashtroudi, & Lindsay, 1993; Lindsay & Johnson, 1989; see Lindsay, 2008, for a recent review).

An additional approach to misinformation interference that is consistent with ideas suggested within the source-monitoring framework (SMF; e.g., Lindsay, 1994; Lindsay & Johnson, 2000) and FTT (e.g., Reyna & Brainerd, 1995; Titcomb & Reyna, 1995), views a memory representation as consisting of features that are bound together to a certain degree (see also Cowan, 1998). Memory traces differ in the number of encoded features and in the strength of the bonds between them, both determining their memorability. Over time, the bonds that connect the features together are assumed to weaken or disintegrate, causing some of the features to become "lost", and resulting in a partial degradation of the original trace (see Belli, Windschitl, McCarthy, & Winfrey, 1992; Brainerd, Reyna, Howe, & Kingma, 1990). Another factor that may cause the disintegration of the original memory traces is the introduction of MPI. If the MPI weakens the bonds below a certain threshold, the original features may be lost, resulting in misinformation interference. Belli et al. (1992) have proposed such a storage-based, partial-degradation account of misinformation interference (see also Belli & Loftus, 1996). According to this account, with short retention intervals, the bonds between the features are assumed to be quite strong, and although the MPI weakens them, they are likely to remain strong enough to resist any loss of features. However, with long retention intervals, the additional weakening caused by the MPI can result in lost features and may thus yield misinformation interference.

The timing of exposure to MPI is not presumed to affect misinformation interference because any weakening of featural bonds caused by the misinformation is expected to eventually show its effects. This account was supported by findings of misinformation interference for long retention intervals, but not for short ones (Belli et al., 1992). However, in these experiments, the MPI was always presented close in time to the final memory test. In other words, the differential findings could be attributed to the timing of MPI introduction rather than to the timing of the memory test.

Similar to the Belli et al.'s (1992) partial degradation account, we also hypothesized that externally induced suggestion may interact with degrading processes that occur spontaneously. However, in contrast to the partial degradation account, we propose that the potentially contaminating effect of MPI is influenced by the relationship between the suggested MPI and the current state of the memory representation of the event information, at the time that the MPI is introduced. Consistent with the discrepancy detection principle (Hall, Loftus, & Tousignant, 1984; Tousignant et al., 1986; see also Loftus, 2005), we suggest that memory representations that have undergone spontaneous degradation by the time that MPI is introduced are more susceptible than non-degraded representations to contaminating effects of MPI because one would be less likely to detect discrepancies between these representations and the MPI in the former case. In the present study, we examine one such degrading process – convergence to the BL (Pansky & Koriat, 2004).

The basic-level convergence effect (BLCE)

Following Rosch, Mervis, Gray, Johnson, and Boyes-Braem's (1976) findings documenting the advantages of the intermediate level of abstractness—the BL—in many cognitive domains (e.g., perception, categorization, and communication), Pansky and Koriat (2004) examined whether it was also optimal for retaining episodic information over time. They presented participants with a narrative that contained target items, each of which appeared at one of three hierarchical levels: subordinate (e.g., SPORTS CAR), BL (e.g., CAR), or superordinate (e.g., VEHICLE). They found that irrespective of the original level at which an item was presented, the participants tended to report it at the BL. In other words, memory for both subordinate and superordinate items converged at the BL. The BL convergence effect was obtained at immediate testing, but was especially pronounced following a one-week retention interval. One plausible account for the BL convergence effect that is consistent with principles of FTT (see Brainerd & Reyna, 2001) claims that items are encoded at multiple levels of abstraction in parallel. However, compared to subordinate-level representations, BL (gist) representations have several cognitive advantages such as simplicity, flexibility, ease of processing (see Reyna & Brainerd, 1995), and achieving the optimal balance between informativeness and distinctiveness (Murphy & Brownell, 1985; Rosch et al., 1976), that may make them more accessible than subordinate representations, particularly over time. If MPI that is consistent with the accessible BL representation of the target information is introduced, no discrepancy is likely to be detected between the two. Consequently, the suggested item is likely to be reported (i.e., suggestibility) instead of the event item (i.e., misinformation interference) and it is likely to be believed to have been part of the original event. In contrast, if the suggested information is not consistent with the accessible BL representation of the target information, the occurrence of such phenomenologically compelling suggestibility and misinformation interference is less likely, as a result of successful discrepancy detection.

The majority of misinformation studies have tested memory for concrete items (e.g., VOGUE MAGAZINE) presented in the context of a certain event. A close examination of the experimental materials used in these studies (including, in particular, those that obtained misinformation interference) reveals that, in many cases, both the event items (e.g., VOGUE MAGAZINE) and the misleading items (e.g., GLAMOUR MAGAZINE) were presented at the subordinate level,[1] sharing the same BL (e.g., MAGAZINE; see, e.g., Belli, 1989; Belli et al., 1994; Campbell, Edwards, Horswill, & Helman, 2007; Chandler et al., 2001; Eakin et al., 2003; Lindsay, 1990; McCloskey & Zaragoza, 1985; Tversky & Tuchin, 1989). Assuming that the BL is the preferred level for retaining episodic information (Pansky & Koriat, 2004), perhaps the poorer performance of participants on misleading items compared to control items is, at least partly, a result of the spontaneous convergence to the BL coupled with the suggestion of subordinate items belonging to the same BL as the original items.

The present study

The main aim of this study was to clarify the conditions under which suggestibility that involves misinformation interference is expected to occur, focusing on the interaction between the MPI and the accessible representation of the event information at the time that the MPI is introduced. We attempted to show that misinformation interference is more likely to occur if the MPI is consistent with an accessible representation of the original information (i.e., its BL) following a spontaneous degrading process (i.e., BL convergence). By contrast, we predicted that misinformation interference would be less likely to occur when this condition is not met, that is, when the MPI is not consistent with the BL of the original information. Note, though, that our participants were not likely to remember or even encode all the target items in the first place. Therefore, some cases of suggestibility (but not misinformation interference) were expected, regardless of BL consistency between the MPI and the original information, as a result of misinformation acceptance in cases in which one did

[1] Throughout this paper, the *subordinate level* refers to a level of specificity that is more detailed than the BL, including both the type of items that are typically used in categorization research (e.g., KITCHEN TABLE, POODLE; see Markman & Wisniewski, 1997; Rosch et al., 1976) and the type of items that are typically used in misinformation studies (e.g., GLAMOUR MAGAZINE, FOLGERS COFFEE; see McCloskey & Zaragoza, 1985).

not encode the target item at all or had completely forgotten it by the time that the MPI was introduced (see McCloskey & Zaragoza, 1985).

The three experiments outlined below all employed an adaptation of Loftus et al.'s (1978) three-stage paradigm, which included the introduction of contradictory misinformation. In the first stage, the target event, containing several target items (e.g., SILVER RING), was presented. In the second stage, the misinformation stage, misleading information was introduced for some of the target items by means of questions about the event, presented in a presupposition format (e.g., "Did Efrat yell when she accidentally stepped on her GOLD RING?"). The type of misleading items was manipulated such that half of them shared the same BL as the target items (Same-BL condition, e.g., GOLD RING), whereas the other half did not (Different-BL condition, e.g., SILVER EARRING). In the third stage, memory for the original target event was assessed using a cued-recall test. This test format was chosen because it lacks the shortcomings of both standard (e.g., Loftus et al., 1978) and modified (e.g., McCloskey & Zaragoza, 1985) recognition tests. Whereas the former was criticized for encouraging response bias (e.g., McCloskey & Zaragoza, 1985), the latter was criticized for lack of sensitivity (see Belli & Loftus, 1996; Loftus, Schooler, & Wagenaar, 1985). In addition, the option to respond with an item other than the target or suggested items on a recall test, allows the examination of both misinformation interference and suggestibility without the two necessarily going hand in hand. In fact, our findings include cases in which they do not (see also Roediger, Jacoby, & McDermott, 1996).

Throughout the experiments of the present study, *misinformation interference* was measured as the difference between misleading and control conditions in the proportion of correctly recalled target items. *Suggestibility* was measured as the difference between misleading and control conditions in the proportion of falsely recalled suggested items (see, e.g., Lindsay, 1990; Roediger et al., 1996; Tversky & Tuchin, 1989, for previous implementation of these two measures).

The experimental design of all three experiments was set up to maximize the potential influence of MPI, based on previous research. Experimental conditions thus included: Misinforming about peripheral rather than central items (e.g., Cassel & Bjorklund, 1995; Heath & Erickson, 1998), delaying the presentation of MPI (e.g., Belli et al., 1992; Loftus et al., 1978; Paz-Alonso & Goodman, 2008), and presenting the MPI in questions rather than in a narrative (Zaragoza & Lane, 1994) and in a presupposition format (e.g., Fiedler, Walther, Armbruster, Fay, & Naumann, 1996; Zaragoza & Lane, 1994). Under these conditions, we expected: (1) stronger misinformation interference in the Same-BL than in the Different-BL condition (2) stronger suggestibility in the Same-BL than in the Different-BL condition, (3) stronger misinformation interference and suggestibility in the Same-BL condition following a longer retention interval until the presentation of misinformation (and testing), and (4) more misattributions of misled items to the event in the Same-BL condition than in the Different-BL condition.

In the present study, we were interested in establishing the role of BL convergence in accounting for any of the expected differences we would find between the Same-BL and Different-BL conditions. Obviously, had we attempted to mislead participants about the target items using perceptually similar Same-BL items and perceptually dissimilar Different-BL items, obtaining the expected differences between the two conditions could have been attributed to reduced discrepancy detection (e.g., Loftus, 2005; Tousignant et al., 1986) or to greater source confusion (e.g., Johnson et al., 1993; Lindsay, 1990; Mitchell & Johnson, 2000) regarding the Same-BL items, simply due to their stronger perceptual similarity to the event items. We attempted to rule out these alternative interpretations of such a pattern of results by equating the lexical (Experiment 1) and visual (Experiments 2 and 3) similarity of the Same-BL and Different-BL misleading items to the respective event items.

Experiment 1

As in most misinformation studies, Experiment 1 consisted of three stages. In the first stage, participants read a narrative containing 16 target items presented at the subordinate level (e.g., LEATHER BOOTS). Following a retention interval (of either 24 or 48 h), the participants returned for a second session to perform the second and third stages. In the second stage, the participants received MPI for half of the target items, in the form of different subordinate items from the same taxonomy (e.g., FOOTWARE), embedded in questions that appeared in a presupposition format. The remaining target items were assigned to a (non-misleading) control condition, and were not referred to at all in the second stage of the experiment.[2] Following 10-min non-verbal filler tasks, the participants were tested for their memory of the target items. Sentences from the narrative (with the target items missing) were presented in a pseudo-random order and the participants were requested to recall each target item (in two words), exactly as it had appeared in the original narrative.

There were two critical manipulations. The first concerned the type of MPI given to the participants. For participants in the Same-BL group, the misleading items belonged to the same BL as the original items (e.g., rubber boots), whereas for the other half they belonged to a different BL (e.g., leather sandals). Importantly, both types of misleading items shared one word with the original target item and differed on the other word, in an attempt to equate the lexical similarity to the target items in the two conditions. The second manipulation concerned the retention interval between the exposure to the initial event

[2] In an alternative control condition that was used in several previous studies (e.g., McCloskey & Zaragoza, 1985), the target items are referred to in the interpolated stage, but in a generic form (e.g., TOOL, MAGAZINE). Such a control condition was not appropriate in our study, because referring to the target items at the BL would create a different baseline for the Same-BL and Different-BL conditions, whereas referring to them at the superordinate level (e.g., WRITING UTENSIL) might seem artificial and attract unduly attention. Therefore, following several previous studies (e.g., Frost, 2000; Lindsay, 1990; Loftus et al., 1978; Zaragoza & Lane, 1994), we chose to use a control condition that did not refer to the target items at all.

and the exposure to the MPI (and subsequent testing), which was either 24 or 48 h.

Method

Participants

One hundred and twenty-eight Hebrew-speaking students from the University of Haifa participated in the experiment for either course credit or payment. Retention interval (24 h, 48 h) and BL consistency (Same-BL, Different-BL) were manipulated orthogonally between participants, creating 4 experimental groups. Thirty-two participants were randomly assigned to each group.

Materials

The target event was a 574-word narrative (in Hebrew) depicting a day in a family's life. Embedded in the narrative were 16 target items belonging to different taxonomic categories (e.g., furniture, fruit). Each target item appeared at the subordinate level and consisted of two words (see Appendix A).

Misinformation was introduced via eight yes/no questions concerning the narrative that contained MPI about half of the target items. Each misleading item appeared in a separate question and was referred to in a presupposition format (see Appendix B). The correct answer to half of the questions was 'yes', and the correct answer to the other half was 'no'. The eight unquestioned target items served as control items. The assignment of items to misleading or control condition was counterbalanced across participants, using a Latin Square Design, such that each item served equally as a control item and as a misleading item. In order to obscure the misinformation manipulation, 12 filler questions that contained no misinformation were also presented, for a total of 20 questions that were presented in random order. For half of the participants (Same-BL condition), the misleading items (e.g., GOLD RING) shared the same BL with the original items (e.g., SILVER RING). For the remaining participants (Different-BL condition), these items (e.g., SILVER EARRING) belonged to a different BL. Note that both the Same-BL items and the Different-BL items shared one word with the original items, in an attempt to match the lexical similarity between the target and misleading items in the Same-BL and the Different-BL conditions.

The final memory test consisted of 24 sentences taken from the narrative, presented in a pseudo-random order. Sixteen sentences tested for memory of the target (eight misleading and eight control) items and eight additional sentences served as fillers. In each sentence, two blank lines replaced the two words from the narrative that constituted the target item (e.g., "She stooped down and picked up the _________ _________ that she had misplaced two weeks ago").

Procedure

The participants were run in small groups of one to six people, in two experimental sessions. In the first session, the participants read the target narrative at their own pace and were informed that they would be asked to answer questions about it at a later stage. They then performed a non-verbal filler task of completing number series for approximately 10 min.

The second experimental session took place either 24 h or 48 h later. The participants were asked to answer 20 yes/no questions about the narrative, eight of which contained misleading information. The questions appeared on a computer screen and the participants responded using a response box by pressing either the button marked 'yes' or the button marked 'no'.

Finally, following 10 min of an additional non-verbal filler activity of solving Raven's Progressive Matrices, the participants took the cued-recall test. They were given a booklet containing four sentences on each page and were instructed to complete all the sentences by filling-in-the-blanks with the missing words, exactly as they had appeared in the narrative they had read. The participants were asked to make their best effort to recall and to refrain from responses such as "I don't know". They were requested to complete all the sentences in the memory test and to resort to guessing only if they had no memory for a certain detail from the narrative.

Results and discussion

Two independent judges classified the responses on the final memory test as correct responses, Same-BL distortions, Different-BL distortions, or other intrusions. Classification instructions were strict in order to maintain consistency both within and across conditions. Responses were classified as correct only if they completely matched the target items that had appeared in the narrative. Responses were classified as Same-BL or Different-BL distortions only if they included a full specification of the respective misleading suggestions. The judges also determined for each response whether it was correct at the BL. The classifications made by these two judges were identical in 99% of the cases. A third judge determined the scoring of the controversial 1% of the responses. The mean proportion recalled of each response type in each experimental condition is presented in Table 1.

Misinformation interference

To examine misinformation interference, the proportion of correct responses was compared between the misleading and control conditions. An analysis of variance (ANOVA) was conducted on these means with retention interval until the introduction of MPI (24 h, 48 h) and BL consistency (Same-BL, Different-BL) serving as between-subject factors and misinformation condition (control, misleading) serving as a within-subject factor.

A significant misinformation interference effect was found, with a lower tendency to report the target items for misleading ($M = .28$) than for control items ($M = .35$), $F(1, 124) = 16.203$, $MSE = .020$, $p < .001$, $\eta_p^2 = .116$. Thus, overall, memory for the event items suffered interference from the presentation of MPI. However, as predicted, this effect was obtained in the Same-BL condition but not in the Different-BL condition, with a significant interaction between misinformation condition and BL consistency, $F(1, 124) = 15.316$, $MSE = .020$, $p < .001$, $\eta_p^2 = .110$. Whereas participants in the Same-BL group recalled significantly

Table 1
Recall probabilities of target items and intrusions (Same-BL, Different-BL, other intrusions) as a function of retention interval until the introduction of MPI (24 h, 48 h), BL consistency condition (Same-BL, Different-BL) and misinformation condition (Control, Misleading), Experiment 1.

Retention interval	BL consistency condition	Misinformation condition	Response type			
			Target items	Same BL	Different BL	Other intrusions
24 h	Same-BL	Control	.40	.02	.00	.58
		Misleading	.30	.36	.00	.34
	Different-BL	Control	.37	.02	.00	.61
		Misleading	.38	.01	.23	.38
48 h	Same-BL	Control	.32	.03	.02	.63
		Misleading	.14	.49	.00	.37
	Different-BL	Control	.30	.02	.01	.67
		Misleading	.29	.01	.27	.43
Total	Same-BL	Control	.36	.03	.01	.60
		Misleading	.22	.43	.00	.35
	Different-BL	Control	.33	.02	.00	.65
		Misleading	.33	.01	.25	.41

fewer target items in the misleading condition ($M = .22$) than in the control condition ($M = .36$), $t(63) = 5.709$, $p < .001$, $d = .71$, those in the Different-BL group recalled the same proportion of targets in the misleading ($M = .33$) and control condition ($M = .33$), $t(63) = .077$, *ns*, $d = .01$.

The effect of retention interval was significant, $F(1, 124) = 13.951$, $MSE = .024$, $p < .001$, $\eta_p^2 = .101$, with fewer target items recalled following a 48-h retention interval ($M = .26$) than following a 24-h retention interval ($M = .36$). As expected, the longer retention interval produced a larger misinformation interference effect, $F(1, 62) = 19.949$, $MSE = .015$, $p < .001$, $\eta_p^2 = .243$, with more event items being recalled for control ($M = .31$) than for misleading ($M = .21$) items. For the short retention interval, on the other hand, no significant differences were found between control ($M = .39$) and misleading ($M = .34$) performance, $F(1, 62) = 2.651$, $MSE = .024$, *ns*, $\eta_p^2 = .041$.

A separate ANOVA, examining misinformation interference over time in each of the two BL-consistency conditions, yielded the expected differential pattern of findings. In the Same-BL condition, greater misinformation interference was found for the longer retention interval, with a marginally significant interaction between retention interval and misinformation condition, $F(1, 62) = 2.939$, $MSE = .018$, $p < .10$, $\eta_p^2 = .045$ ($p < .05$ when the effect of retention interval on misinformation interference is tested directionally, one tailed). As shown in Fig. 1 (panel A), the difference between recall of control and misleading items following a 48-h retention interval (diff. = .18), was larger than the respective difference following a 24-h retention interval (diff. = .10), although both the misinformation interference effect at the shorter retention interval, $t(31) = 2.443$, $p < .05$, $d = .43$, and the misinformation interference effect at the longer retention interval, $t(31) = 6.835$, $p < .001$, $d = 1.21$, were significant. In contrast, no misinformation interference effect was found in the Different-BL condition regardless of retention interval (see Fig. 1, panel B), with a non-significant interaction between retention interval and misinformation condition, $F < 1$. Although the pattern of results was consistent with our predictions,

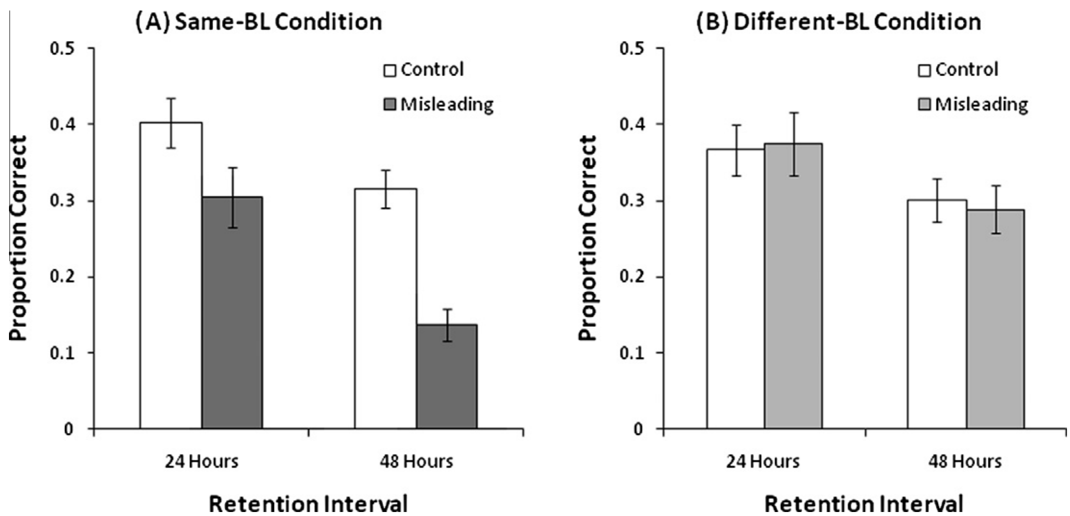

Fig. 1. Mean proportion of correct recall of target items for Same-BL (panel A) and Different-BL (panel B) conditions as a function of retention interval until the introduction of MPI (24 h vs. 48 h) and misinformation condition (Control vs. Misleading), Experiment 1. Error bars indicate 1 SEM.

the three-way interaction between retention interval, BL consistency, and misinformation condition, was not significant, $F < 1$.

Suggestibility

We also examined the extent to which exposure to misleading information induced participants to report that information (i.e., suggestibility). An ANOVA was conducted on the proportion of suggested items recalled with retention interval until the introduction of MPI (24 h, 48 h) and BL consistency (Same-BL, Different-BL) as between-subject factors, and misinformation condition (control, misleading) as a within-subject factor.

Not surprisingly, the effect of misinformation condition was significant, $F(1, 124) = 390.055$, $MSE = .017$, $p < .001$, $\eta_p^2 = .759$, with a high proportion of suggested items recalled in the misleading condition ($M = .34$), and nearly none recalled spontaneously in the control condition ($M = .01$). More importantly, a significant interaction was found between BL consistency and misinformation condition, $F(1, 124) = 23.079$, $MSE = .017$, $p < .001$, $\eta_p^2 = .157$. Thus, although participants in both conditions more often reported suggested items for misleading than for control items, this effect was larger in the Same-BL condition (diff. = .40) than in the Different-BL condition (diff. = .25).

As predicted, suggestibility was significantly greater following a 48-h retention interval ($M = .36$) than following a 24-h retention interval ($M = .29$), $F(1, 124) = 5.350$, $MSE = .017$, $p < .05$, $\eta_p^2 = .041$. Examination of the effect of retention interval on suggestibility separately for the Same-BL and Different-BL conditions yielded the expected differential pattern of results. In the Same-BL condition, the interaction between retention interval and misinformation condition was significant, $F(1, 62) = 7.728$, $MSE = .015$, $p < .01$, $\eta_p^2 = .111$. Thus, as can be seen in Fig. 2 (panel A), the difference in reporting the suggested items between misleading and control conditions was larger following a 48-h retention interval (diff. = .46) than following a 24-h retention interval (diff. = .34). In contrast, in the Different-BL condition (Fig. 2, panel B), suggestibility was not significantly higher following a 48-h retention interval ($M = .26$) than following a 24-h retention interval ($M = .23$), $F < 1$. However, the three-way interaction between retention interval, BL consistency, and misinformation condition did not reach significance, $F(1, 124) = 1.861$, $MSE = .017$, *ns*, $\eta_p^2 = .015$.

BL memory over time

Arguably, the stronger suggestibility found in the Same-BL than in the Different-BL condition could simply be due to higher a priori memorability of the items selected for the Same-BL condition than for those selected for the Different-BL condition, irrespective of the memory representation for the target information. To render such an artifact as unlikely to account for the findings and to ensure that our hypothesis regarding the effect of BL consistency was plausible, it was important to verify that the accessibility of BL memory for the event items at the time of MPI presentation was relatively high at both retention intervals.

As an approximation of BL memory for the target items at the time of MPI presentation, the proportion of responses that were correctly recalled at the BL in the control (non-misleading) condition was calculated for each experimental group. An ANOVA was performed on these proportions with retention interval (24 h, 48 h) and BL consistency (Same-BL, Different-BL) serving as between-subject factors. Not surprisingly, BL consistency, which was irrelevant in the control condition, did not have a significant main effect, nor did it interact with retention interval, $F < 1$ for both. Thus, BL memory for the target items at the time of MPI introduction did not differ for the Same-BL and Different-BL groups. However, the main effect of retention interval was significant, with correct BL memory declining from .58 after 24 h to .48 after 48 h, $F(1, 128) = 8.897$, $MSE = .037$, $p < .005$, $\eta_p^2 = .067$. Nonetheless, the BL was accessible for

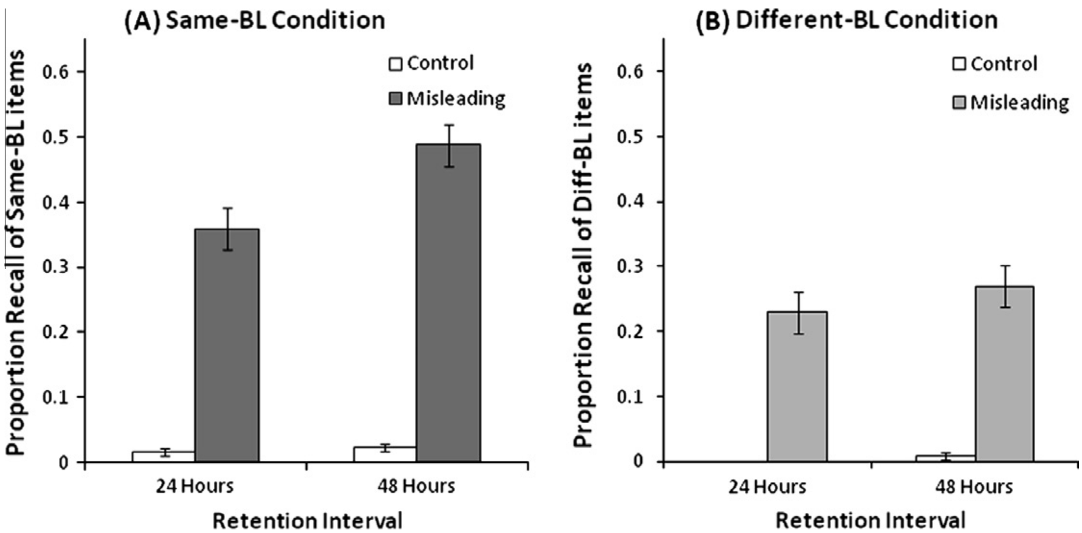

Fig. 2. Mean proportion of suggested items recalled in the Same-BL (panel A) and Different-BL (panel B) conditions as a function of retention interval until the introduction of MPI (24 h vs. 48 h) and misinformation condition (Control vs. Misleading), Experiment 1. Error bars indicate 1 SEM.

about half of the target items even after 48 h, such that BL consistency between the Same-BL suggestions and the accessible BL representations of the target items (at the time the MPI was introduced) applied abundantly and was likely to have played a role in enhancing suggestibility.

To summarize the results of Experiment 1, whether or not misinformation interference occurred was dependent on the consistency between the BL of the MPI and that of the target information. Specifically, when we introduced MPI that shared the same BL as the original information, the tendency to correctly report the original target information was lower than when no such misleading information was introduced. Furthermore, this effect was stronger when the exposure to MPI (and the final memory test) took place following a longer retention interval. However, when the MPI belonged to a different BL than the target information, no misinformation interference was found, regardless of retention interval. The effect of misleading information on the reporting of suggested details was also examined. Whereas suggestibility was apparent in both conditions, it was considerably greater following the exposure to MPI belonging to the same BL as the target information than following the exposure to MPI belonging to a different BL. Furthermore, an increase in suggestibility over time, across the two retention intervals that were used, was obtained only in the former condition.

Experiment 2

Our main goal in Experiment 2 was to extend the findings of Experiment 1 with a slide show serving as the target event (instead of a written narrative), as in most misinformation studies and more closely resembling an eyewitness situation. In addition, we also tested whether our findings would replicate with BL consistency manipulated as a within-subject factor instead of a between-subject factor. Finally, we also examined whether the differences between the Same-BL and Different-BL conditions would also be obtained when the MPI is introduced (and memory is tested) soon after the event. In Experiment 2, MPI was introduced either 15 min or 48 h after the initial event, followed by the final memory test. Given that Pansky and Koriat (2004) found a significant BLCE even at immediate testing, we expected to find the predicted differential effects of Same-BL and Different-BL MPI in the immediate condition, in addition to obtaining more pronounced differences in the delayed condition.

We equated the perceptual similarity between each type of misleading items (Same-BL vs. Different-BL) and the target item by choosing both Same-BL and Different-BL items that bore a strong visual resemblance to the target items. The equivalent perceptual similarity of the two types of misleading items to the target items was validated in a preliminary study.

Method

Participants

One hundred and fifty Hebrew-speaking students from the University of Haifa participated in the experiment for either course credit or payment. Retention interval (15 min, 48 h) was manipulated between participants, whereas BL consistency (Same-BL, Different-BL, control) was manipulated within participants. Seventy-five participants were randomly assigned to each of the two retention interval groups.

Materials

A 6-min slide show containing 37 slides served as the target event. The slide show consisted of still pictures accompanied by a corresponding narration in a female voice, telling a story about a day in a female student's life. Fifteen items (e.g., MUSHROOM PIZZA), each presented visually on a separate slide but not mentioned in the narration, constituted the target items for the experiment. Each slide was presented for 10.1 s.

The other two stages of the experiment were run by a computer program, developed using E-Prime especially for the experiment. As in Experiment 1, the misleading information was introduced by means of yes/no questions (e.g., "Was there a light in the oven in which Inbal spotted a/an OLIVE PIZZA/MUSHROOM QUICHE?"; see Appendix C). Each participant was requested to answer a total of 22 questions at this stage, 10 of which contained misleading information regarding the target items, and 12 of which served as fillers that were added in order to obscure the misinformation manipulation. As previously mentioned, BL consistency was manipulated as a within-subject variable in this experiment. Thus, each participant received five misleading questions that included a suggested item that shared the same BL as the target item (e.g., OLIVE PIZZA; Same-BL condition), and five misleading questions that included a suggested item with a different BL than the target item (e.g., MUSHROOM QUICHE; Different-BL condition). The five remaining target items were not referred to at all in these questions, constituting the control condition. The correct answer to half of the misleading questions was 'yes', whereas the correct answer to the rest was 'no'. The assignment of item to condition was counterbalanced across participants using a Latin Square Design and the questions appeared in random order.

The visual similarity of the misleading items to the original target items was equated for the two types of misleading information by choosing Different-BL items that particularly resembled the target items visually. Our success in equating visual similarity across the Same-BL and Different-BL conditions was validated in a preliminary study. Twenty participants viewed the slide show and rated the target items in terms of their visual similarity[3] to half of the Same-BL misleading items and to half of the Different-BL misleading items, on a scale of 1–7. The

[3] Before soliciting each visual similarity rating, we first requested a conceptual similarity rating between the misleading item and the target item. This was done in order to ensure that the subsequent visual similarity rating would not be outshined by conceptual similarity, which is generally greater between items that belong to the same BL than between items that do not (see Markman & Wisniewski, 1997; Murphy & Brownell, 1985; Rosch et al., 1976). In order to partial out the conceptual similarity and obtain a purer measure of subjective visual similarity, we asked for each type of similarity rating separately.

results showed that the visual similarity ratings of the target items compared to the Same-BL items ($M = 5.14$) did not differ significantly from those compared to the Different-BL items ($M = 5.03$), $t(19) = 0.574$, *ns*, $d = .13$, confirming that the visual similarity between the misleading items and the target items was equivalent in the two BL-consistency conditions.

The final memory test consisted of questions on each of the 15 target items, in a cued-recall format (see Appendix C). Preliminary testing showed that participants presented with such questions often tend to provide responses at the BL (e.g., PIZZA). Unfortunately, such hierarchical level of responding would not be sufficient in this experiment to distinguish between correct verbatim responses (e.g., MUSHROOM PIZZA) and incorrect suggested Same-BL responses (e.g., OLIVE PIZZA). Thus, in order to solicit a response at the more detailed subordinate level, we instructed the participants to answer each target question in two phases. In the first phase, each participant was asked what was the item (e.g., "What was in the oven when Inbal was trying to identify the source of the delicious scent and she accidentally burned her finger?"). In the second phase, the participant was asked what kind of that item it was, with the response that she provided in the first phase (e.g., QUICHE) inserted by the computer program in the second question (e.g., "What kind of quiche?"). An example which was provided in the instructions gave the participants an idea of the level of specificity that was expected for each phase. The questions appeared in the chronological order in which the target items had appeared in the slide show.

Procedure

As in Experiment 1, participants were run in small groups of one to six people, in two experimental sessions. For the immediate-MPI group, the two sessions followed one after the other. For the delayed-MPI group, the second session took place 48 h after the first one.

In the first part of the experiment, the participants were informed that they were going to view a slide show and that they would be asked questions about its content at a later stage. Next, they performed a non-verbal filler task of solving Raven's Progressive Matrices for approximately 10 min, and were then asked to perform 4 short tasks related to the slide show. These tasks did not relate to any of the target items (either directly or indirectly) and were performed by both experimental groups. They were intended to give the delayed-MPI participants the impression that they had completed answering questions about the slide show in the first session, thus minimizing the probability that they would utilize the retention interval between the two sessions to actively prepare for a memory test. Finally, the immediate-MPI group continued immediately to the next part of the experiment whereas the delayed-MPI group performed the next part of the experiment in a second experimental session that took place 48 h later.

In the second part of the experiment, the participants were initially asked to answer a series of yes/no questions, 10 of which contained misinformation as previously specified. The participants were instructed to answer by pressing either the key marked 'yes', or the key marked 'no'. Finally, following 10 min of an additional non-verbal filler task of completing number series, the participants were presented with the final cued-recall memory test, in which they were asked to recall the target items at their subordinate level, using the two-phase procedure described above. The test instructions stressed that the participants were requested to respond to the questions based solely on the slide show they had witnessed. The participants were asked to do their best and to refrain from responses such as "I don't know". They were asked to resort to guessing only if they had no memory for a certain detail from the slide show. The participants typed their answers to both parts of each question on the keyboard at their own pace.

Results and discussion

As in Experiment 1, two independent judges classified the participants' responses on the final memory test as correct verbatim responses, Same-BL distortions, Different-BL distortions, or other intrusions. The judges also determined for each response whether it was correct at the BL. As before, the specifications for these classifications were strict in order to maintain consistency both within and across conditions. Responses were classified as correct only if they matched the expected target response. For example, a response such as BROWN CHAIR, although literally correct, was not considered as a correct verbatim response because it did not contain the necessary attribute to distinguish between a correct verbatim response (WOODEN CHAIR) and a misled Same-BL response (PLASTIC CHAIR). The classifications made by these two judges were identical in 98.5% of the cases. A third judge determined the scoring of the controversial 1.5% of the responses. An examination of these classifications revealed that for one of the target items (i.e., CRISPHEAD LETTUCE), only one participant provided the solicited response in the control condition, yielding verbatim memory at floor level (i.e., less than 1%). Unfortunately, the frequent responses (e.g., GREEN LETTUCE, REGULAR LETTUCE) were not sufficiently detailed to distinguish between a correct verbatim response and a Same-BL distortion. Therefore, this item was omitted from the analyses. The mean proportion recalled of each response type in each experimental condition is presented in Table 2.

BL memory over time

Before turning to the main analyses, let us first examine, for each retention interval, the proportion of responses that were correctly recalled at the BL in the control (non-misleading) condition, as an approximation of BL memory for the target items at the time of MPI presentation. This examination revealed a significant effect of retention interval, with correct BL memory declining from .76 after 15 min to .62 after 48 h, $t(148) = 4.097$, $p < .005$, $d = 0.306$. Nonetheless, one can see that the BL was correctly recalled for the majority of target items even after 48 h. Thus, the BL was accessible in most of the cases at the time the MPI was introduced (whether immediately or after a delay), such that it was plausible that the BL consistency of the Same-BL suggestions would play a role in their contaminating effects.

Table 2
Recall probabilities of target items and intrusions (Same-BL, Different-BL, other intrusions) as a function of retention interval until the introduction of MPI (15 min, 48 h) and BL-consistency condition (Control, Same-BL, Different-BL), Experiment 2.

Retention interval	BL-consistency condition	Response type			
		Target items	Same BL	Different BL	Other intrusions
15 min	Control	.53	.06	.00	.41
	Same-BL	.48	.25	.00	.27
	Different-BL	.51	.06	.10	.33
48 h	Control	.30	.07	.00	.63
	Same-BL	.25	.39	.00	.36
	Different-BL	.28	.06	.15	.51
Total	Control	.42	.07	.00	.52
	Same-BL	.36	.32	.00	.32
	Different-BL	.39	.06	.13	.42

Misinformation interference

Across the two retention intervals, a significant misinformation interference effect was found when one was misinformed with a Same-BL item but not when one was misinformed with a Different-BL item. Thus, the tendency to correctly recall the target items in the misleading Same-BL condition ($M = .36$) was lower than in the control condition ($M = .42$), $F(1, 148) = 4.38$, $p < .05$, $\eta_p^2 = .049$. In contrast, the tendency to correctly recall the target items in the misleading Different-BL condition ($M = .39$) was not significantly lower than that in the control condition ($M = .42$), $F < 1$. The effect of retention interval was significant, $F(1, 148) = 52.156$, $MSE = .025$, $p < .001$, $\eta_p^2 = .339$, with fewer target items recalled following a 48-h retention interval ($M = .28$) than immediately ($M = .50$). However, as shown in Fig. 3, misinformation interference was comparable following immediate and following delayed MPI presentation for both misleading conditions, and the interaction between retention interval and misinformation condition was not significant in either the Same-BL or the Different-BL condition, $F < 1$ for both. Thus, in contrast to our prediction, delaying the presentation of Same-BL suggestions was not found to increase misinformation interference.

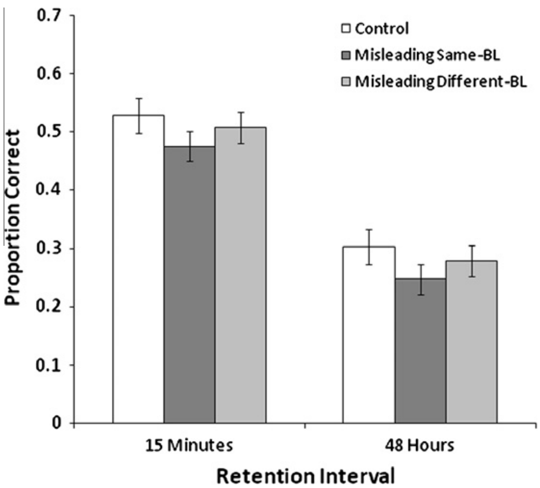

Fig. 3. Mean proportion of correct recall of target items in the Control, Misleading Same-BL and Misleading Different-BL conditions, as a function of retention interval until the introduction of MPI (15 min vs. 48 h), Experiment 2. Error bars indicate 1 SEM.

How can this null finding be accounted for, assuming that our hypothesis regarding the underlying role of BL convergence over time is correct? Consider the fact that the misleading Same-BL condition entailed interpolated questions about the target items, whereas the control condition did not. These interpolated questions reinstated the BL of the target item along with its context, albeit with misleading subordinate information. Such reinstatement, which was absent in the control condition, could serve as a reminder of the BL of the target item, in cases in which even the BL was inaccessible (which constituted about one third of the cases). The correct BL, reinstated shortly before the final memory test, could in turn serve as a retrieval cue for the correct subordinate information. Furthermore, BL memory was found to decline from immediate to delayed testing. Therefore, it is likely that the beneficial effect of the BL reminder in the Same-BL condition compared to the control condition was larger in the longer than in the shorter retention interval, in the opposite direction of the presumed detrimental effect of BL convergence over time, resulting in comparable levels of misinformation interference for the two retention intervals. Due to this unforeseen advantage of the Same-BL condition over the control condition, we believe that the magnitude of misinformation interference as a result of Same-BL suggestions was actually underestimated in our study, particularly in the delayed condition. Nonetheless, as previously mentioned (see footnote 2), using a different type of control condition in the present experiment would have been problematic for other reasons.

Suggestibility

A significant suggestibility effect was found, $F(1, 148) = 262.452$, $MSE = .020$, $p < .001$, $\eta_p^2 = .639$, with a higher proportion of suggested items recalled in the misleading ($M = .22$) than in the control condition ($M = .03$). As predicted, a significant interaction was found between BL consistency and misinformation condition, $F(1, 148) = 34.022$, $MSE = .018$, $p < .001$, $\eta_p^2 = .187$, such that although participants in both conditions more often reported the misleading items when they were suggested than when they were not, this effect was larger in the Same-BL condition (diff. = .25) than in the Different-BL condition (diff. = .13).

As predicted, suggestibility was significantly greater when the presentation of MPI and final testing were delayed ($M = .23$) than when they were immediate ($M = .15$), $F(1, 148) = 13.633$, $MSE = .018$, $p < .001$, $\eta_p^2 = .084$. However, this effect was qualified by a significant three-way interaction between retention interval, BL consistency, and misinformation condition, $F(1, 148) = 3.899$, $MSE = .018$, $p < .05$, $\eta_p^2 = .026$. As can be seen in Fig. 4, the expected differential pattern of results for the Same-BL and Different-BL conditions was found in terms of the effect of retention interval on suggestibility. In the Same-BL condition (Fig. 4, panel A), suggestibility was more pronounced following a 48-h retention interval ($M = .32$) than following a 15-min retention interval ($M = .19$), with a significant interaction between retention interval and misinformation condition, $F(1, 148) = 11.953$, $MSE = .026$, $p < .001$, $\eta_p^2 = .075$. However, in the Different-BL condition (Fig. 4, panel B), the increase in suggestibility over time (from $M = .10$ to $M = .15$) was less pronounced and not statistically significant, $F(1, 148) = 2.806$, $MSE = .012$, *ns*, $\eta_p^2 = .019$. Thus, whereas suggestibility was more pronounced for Same-BL items than for Different-BL items even in the immediate condition, $F(1, 74) = 7.886$, $MSE = .017$, $p < .01$, $\eta_p^2 = .096$, the difference between the two types of misleading items was even more pronounced in the delayed condition, $F(1, 74) = 28.857$, $MSE = .019$, $p < .001$, $\eta_p^2 = .281$.

To summarize the findings of Experiment 2, BL consistency between the original target item and the misleading item was found to affect both suggestibility and misinformation interference. Suggestibility was more pronounced when the misleading suggestions shared the same BL as the target item than when they did not, in both the immediate and the delayed condition. For Same-BL MPI, suggestibility was found to be more pronounced when the presentation of MPI was delayed than when it was immediate, resulting in a larger difference between the two misleading conditions when the MPI was presented following a larger delay. Misinformation interference was obtained only in the Same-BL condition. Although its absolute magnitude was rather small (yet statistically significant), the pattern of results parallels the one obtained in Experiment 1, providing converging evidence for the differential effects of Same-BL and Different-BL misinformation.

Experiment 3

In the first two experiments, significant differences were found between misleading Same-BL and Different-BL suggestions in terms of the misinformation interference and suggestibility that they engendered. However, assuming that our hypothesis regarding the underlying role of BL convergence is correct, we believe that the difference between these two types of misleading suggestions extends beyond differences in forced-report responding, to aspects related to the phenomenological experience when suggestibility occurs. That is, because the Same-BL suggestions are consistent with the presumably accessible BL representations of the target items, we predicted that they would also have a larger contaminating effect than Different-BL suggestions in terms of the extent to which misled participants actually believe that the MPI (which was merely suggested to them) was indeed part of the original event.

A method by which many previous studies have assessed whether participants misremember witnessing suggested information was to explicitly solicit the source of their memory reports by employing a source-monitoring test (e.g., Belli et al., 1994; Higham, 1998; Mitchell & Zaragoza, 1996; Zaragoza & Lane, 1994; Zaragoza & Mitchell, 1996). Explicit attributions of misled responses to the event (rather or in addition to the post-event stage) were taken to indicate that these items were experienced as event items. In the present experiment, we used this method to test for differences in the phenomenology associated

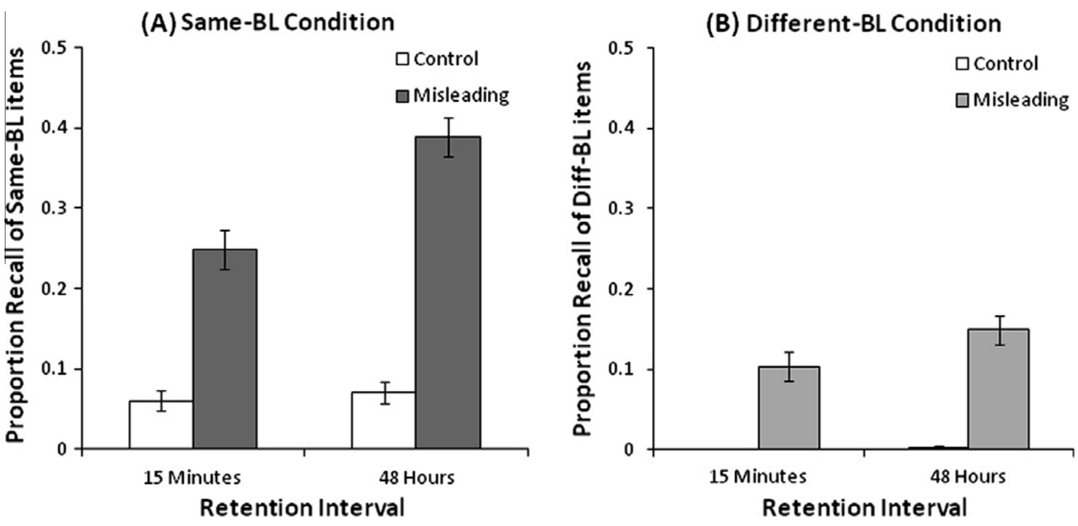

Fig. 4. Mean proportion of suggested items recalled for Same-BL (panel A) and Different-BL (panel B) conditions as a function of retention interval until the introduction of MPI (15 min vs. 48 h) and misinformation condition (Control vs. Misleading), Experiment 2. Error bars indicate 1 SEM.

with falsely recalled Same-BL suggestions compared to falsely recalled Different-BL suggestions. Although some of the participants' attributions to the event on a source-monitoring test might reflect a response bias due to their trust in the source of the suggestions (see, e.g., Lindsay, 2008), this response bias should be comparable in the two misleading conditions. Therefore, any differences found between them in the extent of misattribution to the event can be taken to reflect factors other than response bias.

In Experiment 3, we used the same materials as in Experiment 2. However, based on the data of Experiment 2, in this experiment we employed only the delayed condition, which, in contrast to the immediate condition, was found to generate sufficient suggestibility to allow a breakdown of suggested responses according to source attributions.

In order to assess the extent to which each type of misled response (Same-BL or Different-BL) was experienced as a true event item, the proportion of attributions of recalled items to the event in each of the misleading conditions was compared to that in a control condition. Due to the 48-h delay of the misinformation stage after the original event, had we used the same control condition as in the first two experiments, the proportion of attributions to the event of the misleading items might have been inflated compared to that of the recalled control items, simply because of the much more recent reference to the misleading than to the control items (which would not have been mentioned at all in the misinformation stage). As mentioned before, it would also be problematic to use a control condition in which the target item (e.g., MUSHROOM PIZZA) is referred to only at the BL (e.g., PIZZA), because such a reference would be more similar to the misleading Same-BL item (e.g., OLIVE PIZZA) than to the Different-BL item (e.g., MUSHROOM QUICHE). Therefore, in Experiment 3, we used a different control condition (see, e.g., Campbell et al., 2007; Loftus et al., 1978) in which the correct target items were restated in the interpolated questions (e.g., MUSHROOM PIZZA) in the same manner as the misleading items were suggested in the Same-BL and Different-BL conditions. Such a reference to the original item was equally similar to each of the misleading items as the original item was, and therefore served as an equivalent baseline for the two misleading conditions.

On the final memory test, after reporting an item in response to each cued-recall question (as in Experiment 2), the participants were presented with a source-monitoring test, in which they were asked to indicate whether they remember that item from the target event, the yes/no questions, both, or neither. Following previous studies (e.g., Higham, 1998; Lindsay & Johnson, 1989; Zaragoza & Lane, 1994), attribution of a reported item to either the slide show alone or to both the slide show and the questions was taken as evidence that one experiences it as an original event item. Due to BL consistency with the target information, we hypothesized that not only would Same-BL suggestions be more likely to be falsely recalled than Different-BL suggestions, but that these Same-BL distortions would be more likely to be misattributed to the event.

Method

Participants

Sixty Hebrew-speaking students from the University of Haifa participated in the experiment (for course credit or payment).

Materials and procedure

The materials and procedure were the same as in Experiment 2, except for the following modifications: (1) In the interpolated yes/no questioning stage, one third of the target items (e.g., MUSHROOM PIZZA) were contradicted by misleading Same-BL items (e.g., OLIVE PIZZA), one third were contradicted by misleading Different-BL items (e.g., MUSHROOM QUICHE), and one third were referred to at their true subordinate level (e.g., MUSHROOM PIZZA) as they had appeared in the original event (i.e., the Restated condition). (2) The source-monitoring procedure was applied after each question in the final cued-recall test. The participants were informed that some of the test items they may recall did not appear in the original slide show but in the questions they were asked about the slide show, some items appeared in both slide show and questions, and some may be items that they were forced to guess and actually appeared in neither slide show nor questions. For every test item that they recalled, the participants were asked to indicate its source, that is, whether they remember it from the target event, the yes/no questions, both, or neither.

Results and discussion

Two independent judges classified the participants' responses on the final memory test as in the previous experiments. The classifications made by these two judges were identical in 98.5% of the cases. A third judge determined the scoring of the controversial 1.5% of the responses. Pairwise comparisons were Bonferroni-corrected to the .05 significance level.

Suggestibility

Not surprisingly, as shown in Fig. 5, the participants recalled a higher proportion of suggested items when the suggested items were identical to the target items, in the Restated condition ($M = .64$), than when they were misleading Same-BL items ($M = .33$), $t(59) = 6.183$, $p < .001$, $d = .80$, or Different-BL items ($M = .19$), $t(59) = 11.534$, $p < .001$, $d = 1.49$. More importantly, as predicted, the participants incorrectly recalled the misleading items more often when those items shared the same BL with the original event items, than when those items belonged to a different BL, $t(59) = 4.260$, $p < .001$, $d = .55$.

Attributions of suggested responses to the original event

To what extent are the suggested distortions experienced as event items? We attempted to answer this question by examining the proportion of reported suggested items that were attributed to each source, for each experimental condition (see Table 3). In this analysis, only participants that had recalled at least one suggested item in

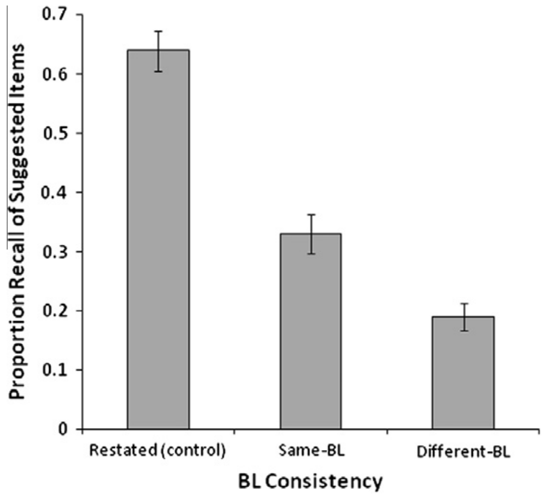

Fig. 5. Mean proportion of suggested items recalled in the Restated, Same-BL and Different-BL conditions, Experiment 3 ($N = 60$). Error bars indicate 1 SEM.

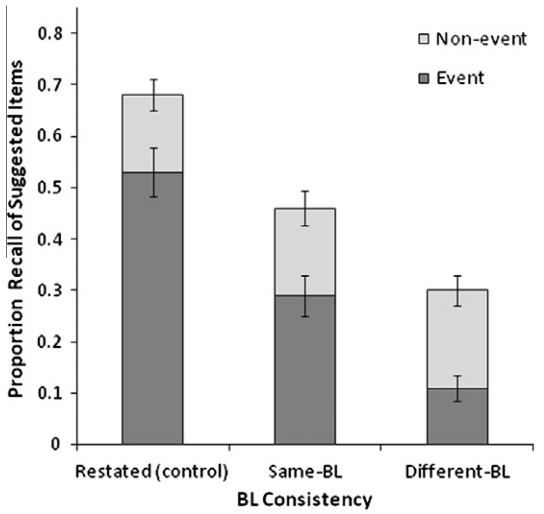

Fig. 6. Mean proportion of suggested items recalled as a function of BL consistency condition (Restated, Same-BL, Different-BL) and type of attribution (Non-event, Event), Experiment 3 ($N = 30$). Upper error bars indicate 1 SEM for non-event attributions; lower error bars indicate 1 SEM for event attributions.

each of the BL-consistency conditions were included, for a total of 30 participants.

We first compared the proportion of attributions to the target event (i.e., attributions to either 'slide show' or 'both slide show and yes/no questions') between the three experimental conditions, as depicted by the dark bars in Fig. 6. Not surprisingly, the participants attributed their recalled suggestions to the target event more frequently in the Restated condition ($M = .53$) than in either the misleading Same-BL condition ($M = .29$), $t(29) = 4.539$, $p < .001$, $d = .83$, or the Different-BL condition ($M = .11$), $t(29) = 7.77$, $p < .001$, $d = 1.42$. A significant difference was also found between the two misleading conditions, $t(29) = 4.360$, $p < .001$, $d = .80$, such that the participants more often misattributed to the target event the misleading Same-BL items they had recalled than the misleading Different-BL items they had recalled, indicating that the Same-BL items were more likely to be experienced as true event items than the Different-BL items.

In order to correct for the differential levels of suggestibility between the three conditions, in a second analysis of participants' source-monitoring attributions, we compared the conditional probabilities of an attribution to the target event (i.e., attributions to either 'slide show' or 'both slide show and yes/no questions'), given that one reported the suggested information. As in the previous analysis, this analysis was also based on the 30 participants that had recalled at least one suggested item in each condition. The conditional probability for an attribution to the target event was significantly lower for misleading Different-BL items ($M = .38$) than for either Restated items ($M = .78$), $t(29) = 4.904$, $p < .001$, $d = .90$, or Same-BL items ($M = .63$), $t(29) = 2.731$, $p < .015$, $d = .50$. In other words, whereas less than 40% of the recalled Different-BL suggestions were attributed to the event, the majority of recalled Same-BL suggestions were attributed to the event as were the majority of recalled Restated items. Interestingly, the difference between the Same-BL and Restated conditions in the tendency to attribute the suggested items to the original event was not significant, $t(29) = 2.002$, *ns*, $d = .37$.

This pattern of results implies that the larger tendency to report the Same-BL than the Different-BL suggestions on the forced recall test cannot be attributed to differential guessing rates of the two types of misleading items. Had this been the case, we would have expected a lower probability of attribution to the original event (i.e., a higher probability of attribution to either 'the yes/no questions' or 'neither the slide show nor the questions') among the Same-BL distortions than among the Different-BL distortions, which is the opposite of what we found.

To summarize, the findings of Experiment 3 support the hypothesis that Same-BL suggestions are not only more likely than Different-BL suggestions to be reported on the final test (i.e., to generate more suggestibility), but that such reported items are also more likely to be experienced as event items, presumably due to the consistency between the BL of the these misleading suggestions and the currently most accessible BL representation of the target information.

Table 3
Absolute probabilities of source attributions of recalled suggestions in the three BL-consistency conditions (Restated, Same-BL, Different-BL) to the four response categories (slide show, questions, both and neither), Experiment 3 ($N = 30$).

Source attribution	Restated condition	Same-BL condition	Different-BL condition
Slide show (event)	.25	.10	.03
Questions (misinformation)	.15	.15	.19
Both	.29	.19	.08
Neither	.01	.01	.01
Total	.70	.45	.31

General discussion

The main goal of the present study was to demonstrate that contaminating effects of MPI are dependent on the relationship between the suggested MPI and the accessible memory representation of the event information, at the time that the MPI is introduced. The findings generally support the predictions. Misinformation interference was found only when the MPI belonged to the same BL as the target item (Experiments 1 and 2) and was more pronounced when such MPI was introduced after 48 h (in Experiment 1, but not in Experiment 2). However, when the MPI belonged to a different BL than the target information, there was no evidence for misinformation interference, regardless of the timing of MPI introduction. Suggestibility, on the other hand, was found whether or not the MPI belonged to the same BL as the target item, but it was significantly greater when the MPI shared the same BL with the event item than when it did not (Experiments 1–3). Furthermore, misled responses were more likely to be misattributed to the original event when the MPI belonged to the same BL as the event item than when it belonged to a different BL (Experiment 3). Finally, suggestibility was found to increase when the delay before the introduction of MPI was extended, but only when the MPI belonged to the same BL as the target information (Experiments 1 and 2), presumably due to increased BL convergence over time.

The finding of no comparable increase in suggestibility with delay when the MPI did not belong to the same BL as the target information was expected had BL memory remained stable over the retention intervals that were employed. However, in the present study, some decline in BL memory was found both in Experiment 1 (.10) and in Experiment 2 (.14). We examined the responses in the Different-BL conditions at the two retention intervals, to learn what the participants reported in the additional cases in the delayed condition in which they apparently did not have access even to a BL representation of the target items. An identical pattern emerged in Experiments 1 and 2. First, in about one third of these cases, the participants reported the suggested Different-BL items, exhibiting misinformation acceptance. The other two thirds were classified by the judges as 'other intrusions' (see Tables 1 and 2). Some of these were responses that contained partial information of the suggested Different-BL items, but were not classified as Different-BL responses due to the strict encoding we had to employ in order to maintain consistency, particularly across the two misleading conditions. The remaining 'other intrusions' consisted of entirely new items, that seemed to reflect guessing in cases in which the participants apparently did not notice the misinformation (which was not the main focus of the question) or did not make the connection between the item that was suggested to them and the test item.

As can be seen in Appendices B and C, both types of suggested items were plausible and congruent with the target scenes of the event (see Perez-Mata & Diges, 2007). The Same-BL and Different-BL items were chosen such that their lexical (Experiment 1) and visual (Experiments 2 and 3) similarity to the event items would be comparable. Furthermore, the gist of both types of suggested items was consistent with the gist of the original item in the sense of belonging to the same superordinate category. Thus, any differences obtained between the Same-BL and Different-BL conditions can only be attributed to differences between the two conditions in terms of conceptual similarity to the target items at an intermediate (basic) level of abstractness.

Several theoretical accounts are consistent with the overall pattern of our findings. According to SMF, eyewitness suggestibility involves source confusions, such that information that was merely suggested is misattributed to the original event (e.g., Johnson et al., 1993; Lindsay & Johnson, 1989). Such source-monitoring errors are especially likely to occur if the sources of the original event and post-event suggestions are not highly discriminable (see Lindsay, 1990; Lindsay, 1994, 2008; Mitchell & Johnson, 2000). From this perspective, the stronger suggestibility found for Same-BL than for Different-BL suggestions, as well as the greater likelihood of the Same-BL suggestions to be misattributed to the event, can be readily explained by the higher conceptual resemblance between the Same-BL suggestions, and the target information, rendering them more difficult to be discriminated from the event information than Different-BL suggestions. The finding of misinformation interference only in the Same-BL condition can also be explained by SMF if the stronger (and more phenomenologically compelling) suggestibility in this condition reduces the likelihood that an additional memory search will be conducted once the recalled suggested detail is misidentified as an event detail (see Lindsay, 1990).

The pattern of findings of the present study can also be persuasively accounted for by FTT, which has been successful in explaining the effects of misinformation on recognition performance (e.g., Brainerd & Reyna, 1998; Reyna & Brainerd, 1998; Reyna, Holliday, & Marche, 2002; Reyna & Titcomb, 1997), and can be extended to account for the recall data of the present study. According to FTT, memories are composed of traces that differ in precision along a fuzzy-to-verbatim continuum, from verbatim traces of a target's surface form to gist traces representing a target's semantic, relational, and elaborative characteristics (Reyna & Brainerd, 1995, 1998; Reyna et al., 2002). When information (whether event or post-event information) is encoded, verbatim and gist traces of that information are stored in parallel and retrieved independently. During testing, suggestibility for gist-consistent MPI can be resisted if the verbatim representations of the original event details are accessed rather than the verbatim or gist representations of the MPI (e.g., Reyna & Brainerd, 1995; Reyna et al., 2002). Over time, the original verbatim memories gradually lose accessibility, and, thus may become less accessible than the more recent verbatim traces of the MPI, and consequently insufficiently accessible to oppose the misinformation, resulting in stronger suggestibility (e.g., Reyna & Brainerd, 1995). These original verbatim memories, however, may be sufficiently accessible to be recalled if no MPI was introduced, such that recall performance in the control condition is superior to that in the misleading condition (i.e., misinformation interference). Thus, according to FTT, stronger suggestibility is expected for longer retention intervals. Indeed, this is the general pattern of results that we found in the present study when the MPI belonged to the same BL as the target item.

How can FTT account for the lower suggestibility and lack of misinformation interference when the MPI belonged to a different BL than the target item? Note that in these cases, the MPI (e.g., MUSHROOM QUICHE) contradicted the original information (e.g., MUSHROOM PIZZA) not only at the verbatim level, but also at the gist level of the BL. Thus, suggestibility could be resisted not only by accessing the verbatim representation of the original item, as in the Same-BL condition, but also by accessing the gist of the original item. Therefore, according to FTT, suggestibility is expected to be less pronounced in the Different-BL than in the Same-BL condition, as was indeed found in the present study. Furthermore, compared to the Same-BL condition, resistance to suggestibility in the Different-BL condition is expected to diminish at a slower rate over time, because the gist representations of the original items are expected to be more stable than the verbatim representations (see Reyna & Kiernan, 1994; see Goldsmith, Koriat, & Pansky, 2005, for a review). The results of Experiments 1 and 2 support this prediction. With regard to misinformation interference, one must take into account that misinformation interference will occur in the Different-BL condition only if there are cases in which one is able to correctly recall the target information at the verbatim level when no MPI is introduced yet is unable to recall the target information even at the gist level when MPI is introduced. Due to the superiority of gist representations, especially over time (see, Brainerd & Reyna, 1993; Reyna & Kiernan, 1994), this is less likely to occur. Indeed, we found no misinformation interference in the Different-BL condition in any of our experiments.

We believe that both SMF and FTT can account for most of the present findings. However, this study was motivated by a third approach that combines some ideas from these two theoretical frameworks, but places a stronger emphasis on the interaction between the MPI and the memory for the original information at the time that the MPI is introduced, following endogenous memory processes (e.g., BL convergence). In accordance with the discrepancy detection principle (see Hall et al., 1984; Tousignant et al., 1986; see also Loftus, 2005), we hypothesized that when MPI is introduced, it is either accepted as consistent with the original event information or is rejected as discrepant, depending on the current state of the memory representation for the original information. Thus, if one remembers the original item at the subordinate level (hence, "subordinate representation"), the MPI will be detected as discrepant and will be rejected, resulting in neither suggestibility nor misinformation interference. By contrast, if one remembers nothing about the original item (either because it was not encoded in the first place or due to forgetting; hence "no representation"), the MPI will be accepted, resulting in suggestibility but not in misinformation interference (because there was no original memory to impair; see McCloskey & Zaragoza, 1985).

Consistent with both SMF (e.g., Lindsay, 1994; Lindsay & Johnson, 2000) and FTT (e.g., Reyna & Brainerd, 1995; Titcomb & Reyna, 1995), we further contend that encoding and forgetting are not all-or-none processes such that even when an item may not be recalled perfectly, some of its features may nonetheless be accessible (see also Koriat, Levy-Sadot, Edry, & de Marcas, 2003). Following previous studies (e.g., Begg & Wickelgren, 1974; Dorfman & Mandler, 1994; Kintsch, Welsch, Schmalhofer, & Zimny, 1990; Reyna & Kiernan, 1994; see Brainerd & Reyna, 1993), it is assumed that the memory representation of the gist of the target information remains more accessible than the verbatim representation of these items. More specifically, the BL representations of the target items tend to be more accessible than their representations at the subordinate level, particularly over time (Pansky & Koriat, 2004). Thus, we propose that in addition to cases of "no representation" and "subordinate representation" of the target details at the time that the MPI is introduced, there are also cases in which the most accessible representation of an original detail is its BL (hence, "BL representation"), particularly (but not only) when the MPI is introduced after a delay. It is in this situation that Same-BL and Different-BL misleading suggestions produce differential effects. When the MPI is consistent with that BL representation (i.e., in the Same-BL condition), the MPI may be perceived as a restatement of the event item, resulting in suggestibility that is particularly likely to be attributed to the event. Furthermore, the subordinate representation of the event item, which the rememberer may have been able to recall without exposure to MPI, may thus become less accessible than the BL-consistent MPI, resulting in misinformation interference. By contrast, when the MPI is inconsistent with the accessible BL representation of the event (i.e., in the Different-BL condition), it is likely to be rejected via discrepancy detection, yielding no suggestibility and no misinformation interference.

Thus, correct recall of target items in both the Same-BL and the Different-BL conditions can largely be attributed to situations in which the "subordinate representations" of the target items are highly accessible, allowing resistance to the MPI. Comparable levels of suggestibility found in both the Same-BL and Different-BL conditions can be attributed to "no representation" situations. The additional cases of suggestibility found in the Same-BL but not in the Different-BL conditions, particularly when the introduction of MPI was delayed, can be attributed to "BL representation" situations. Of course, this description is schematic and we acknowledge that there are cases of partial memory of event details that do not fall exactly into one of the three representational states that we describe. Nonetheless, we believe that these three states encompass the majority of cases, and that this conceptualization captures the commonalities and differences between the two misleading conditions in our study.

Note that in the present study, it was not possible to obtain direct evidence of convergence to the BL because the participants were required to report the test items at the subordinate level. However, another study that was conducted in our lab (Pansky, submitted for publication) has directly demonstrated convergence to the BL using the same experimental materials and retention intervals that were used in Experiment 2 of the present study. In that study, participants were questioned about the event details either immediately or after a 48-h delay, and were free to respond at either the BL or the subordinate level. Over time, the proportion of target items that were correctly reported at the subordinate level decreased from .38 to .16, whereas the proportion of target items that were correctly reported at the BL remained stable (.45 at immediate testing and .48 at delayed testing). Given the same experimental materials and retention intervals of the Pansky (submitted for publication) study and the present study, a comparable BLCE probably occurred in the present study, suggesting that it is plausible to attribute our findings to spontaneous convergence to the BL.

Whereas the notion of BL consistency that we draw upon in accounting for the present findings can be perceived as one form of conceptual similarity, we believe that it has an added value for understanding misinformation phenomena. First, BL consistency has the advantage of bearing a clearer and more precise operational definition than the more obscure notion of conceptual similarity. Consequently, the results of the present study can be seen to pinpoint a limiting condition in which contaminating effects of MPI are most likely to occur. Second, the notion of the superior accessibility in memory of the BL representation of an item is congruent with a rich body of research that demonstrates BL advantages in a multitude of cognitive tasks. For example, the BL is the level at which objects tend to be identified and named, and at which categorization is fastest (e.g., Murphy & Smith, 1982; Rosch et al., 1976). The BL has been claimed to be the superior level of abstractness in terms of cognitive economy and cognitive efficiency (e.g., Mervis & Rosch, 1981; Murphy, 1991; Rosch et al., 1976), and in terms of achieving the optimal balance between the two competing goals of informativeness and distinctiveness (Murphy & Brownell, 1985). It is likely that for these reasons, the BL is also optimal for retaining episodic information in memory, both immediately and (particularly) over time (e.g., Pansky, submitted for publication; Pansky & Koriat, 2004). The notion of BL convergence is fruitful in terms of generating predictions regarding effects of external suggestions, as the suggested information interacts with the products of the spontaneous process of BLCE. In addition to the predictions that were supported in the present study, future research may examine other potential effects of MPI in terms of its BL consistency with the accessible representation of event information (e.g., the extent to which one might be misled by a BL item that is either consistent or inconsistent with the BL item that tends to be instantiated spontaneously; see Pansky & Tenenboim, submitted for publication).

In the present study, we focused on the BL as one type of partial information relating to the target item that tends to remain accessible and to interact with the MPI, when the latter is introduced. Due to the hierarchical, categorical nature of cognitive processes and memory representation (see, Cohen, 2000, for a review), we believe that the BL is a principal and fundamental type of partial information that is retained over time (see also Pansky & Koriat, 2004). However, there are other forms of accessible partial information that may interact with the MPI. For example, one may mainly remember the color of an item (e.g., "something yellow") or its form (e.g., "something round"). If the MPI is consistent with this accessible partial information, it may be accepted, resulting in phenomenologically compelling suggestibility. This can perhaps explain why some cases of Different-BL distortions were attributed to the event (in Experiment 3). Although the interaction between accessible partial information from the event (other than the BL of the event items) and MPI that is consistent with that partial information was not systematically investigated in the present study, we believe it is worthwhile to explore in future research.

To what extent do our findings and interpretation regarding the effect of the passage of time until MPI introduction coincide with earlier findings? Only few studies systematically manipulated the timing of MPI presentation with delays that exceed 24 h (e.g., Belli et al., 1992; Chandler et al., 2001; Higham, 1998; Lindsay, 1990; Loftus et al., 1978; Paz-Alonso & Goodman, 2008). Consistent with the present findings, most of these studies have found that a longer delay between the exposure to the event and the exposure to MPI resulted in greater suggestibility and/or misinformation interference (see Belli et al., 1992; Paz-Alonso & Goodman, 2008; see also Loftus et al., 1978) and more misattributions of MPI to the event (Higham, 1998, Experiment 1). The two exceptions to this pattern are studies that have either manipulated the timing of MPI simultaneously with another important factor (Lindsay, 1990) or used an entirely different testing procedure (Chandler et al., 2001). Overall, the bulk of findings, including those of the present study, are generally consistent with the notion that information that has undergone some forgetting may be more vulnerable to the effects of misleading information compared to information that has remained relatively intact, as Brainerd and Reyna (1988) have argued (see also Loftus, 2005; Reyna & Titcomb, 1997). In the present study, we focused on a particular type of "forgetting" that occurs spontaneously – convergence to the BL.

In conclusion, the present study shows that spontaneous convergence to the BL (Pansky & Koriat, 2004) has a significant role in setting the stage for the contaminating effects of MPI. More generally, we believe that our study demonstrates that examining the interaction between suggestive interventions and the products of normal degrading memory processes, contributes to the understanding of misinformation phenomena.

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Supplementary material

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jml.2010.12.003.

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