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The "memory" misinformation effect may not be caused by memory failures: Exploring memory states of misinformed subjects

***Abstract**: In experiments concerning the misinformation effect, participants first watch some original material, e.g. a video clip, and read a description that in the experimental group contains information inconsistent with the video clip. Afterwards, all participants answer questions about the video. Typically, the misled group more often reports erroneous misleading information than the non-misled one.Theoretical explanations of this effect are usually formulated in terms of the cognitive theories of memory. This article presents three experiments that demonstrate that the misinformation effect can occur even if the memory of the original and postevent materials is correct. In the experiments, after watching a video clip, reading a narrative about it, and answering questions about the video, the participants were debriefed and required to indicate questions in which they noticed differences between the video and the narrative, as well as provide answers about the original and postevent materials. A substantial number of the participants yielded to the misinformation effect in the memory test even though they had correct memory about the original (and postevent) materials. The discussion emphasizes the need of the social influence framework to explain these results.*
Key message: the misinformation effect is important for applied forensic eyewitness psychology. To get a better understanding of this effect, there is a need to study it not only in terms of the cognitive psychology of memory, but also from the perspective of social psychology, because in many cases witnesses give wrong answers even when remembering the correct information.

***Key words**: memory, misinformation effect, social influence, compliance, conformity*

Introduction

The term "memory misinformation effect" refers to decreased accuracy of memory reports resulting from exposing witnesses to inconsistent information about the witnessed event. It is usually studied within a three-stage framework (Loftus, Miller, & Burns, 1978), in which participants are exposed to an original event (e.g. a video clip). Afterwards, the postevent information is presented, e.g. in the form of a text, which in the experimental group contains some details that are inconsistent with the original event. Finally, participants are tested for their memory of the original event. Typically, the accuracy of memory reports of misled participants is lower than those from the non-misled control group (see Pickrell, Bernstein, & Loftus, 2004; Zaragoza, Belli, & Payment, 2006 for reviews).

Many theories that aim to explain the mechanisms of the misinformation effect have been proposed. According to one of the earliest explanations, it results from the constructive nature of human memory (Loftus, 1975): external information may alter the representation of the original event. The resulting memory trace is based on both original and external information and thus the memory report may be distorted.

A more contemporary and widely accepted theory of the misinformation effect is based on the source monitoring idea. This posits that misled participants misidentify the source of the memory of the suggested detail, erroneously ascribing it to the original material (Lindsay, 1990; Lindsay & Johnson, 1989; Zaragoza & Lane; 1994). In other words, participants may correctly remember something but do not realize that their memory originates from the postevent,

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not the original material. In most research, the finding that many participants fail to correctly monitor the source of information in the misinformation paradigm has been confirmed (e.g. Ackil & Zaragoza, 1995; Belli, Lindsay, Gales, & McCarthy, 1994; Lindsay, 1990; Mitchell & Zaragoza, 1996, 2001; Niedźwieńska, 2002). However, some research has failed to replicate it (e.g. Lindsay & Johnson, 1989; Multhaup, de Leonardis, & Johnson, 1999; Zaragoza & Koshmider, 1989; Zaragoza & Lane, 1994) (see Lindsay, 2008 for a review).

A number of other theories of the misinformation effect have been proposed, including the parallel traces theory (Bekerian & Bowers; 1983; Bowers & Bekerian, 1984), the CHARM model (Metcalfe, 1990); the fuzzy-trace theory (Titcomb & Reyna, 1995); activation-based framework (Ayers & Reder, 1998) and retrieval-induced forgetting (Saunders & MacLeod; 2002).

All the aforementioned theories share one fundamental assumption: the misinformation effect mechanism is based on cognitive processes related to memory and involves some memory functioning failure, be it encoding, storage, or the retrieval phase of the memory process. In contrast, few researchers have tried to explain the misinformation effect without referring to distortions of memory. However, their contributions seem extremely important for our understanding of the very reasons why many eyewitnesses rely on external misinformation while providing memory reports. Firstly, McCloskey and Zaragoza (1985) made a strong theoretical and empirical case for the thesis that the misinformation effect may occur even if postevent information does not have any effect on participants' ability to remember the original information. To explain the fact that some subjects answer in accordance with the misleading information, it is enough to assume that some subjects did not encode the original information at all, but remembered the postevent material and – not realizing that it contained misinformation – relied on it while answering questions about the original material. Secondly, it is possible that other subjects remembered both the original and postevent information, and selected the latter because they trusted the experimenter's narrative more than their own memory.

McCloskey and Zaragoza (1985) presented a series of experiments based on a paradigm in which, in the critical question, they choose between the original alternative and a new one. Fox example, if the original detail was "hammer", the misleading one "screwdriver", then in the final test the participants choose between "hammer" and "wrench", not between "hammer" and "screwdriver". McCloskey and Zaragoza pointed that if it is true that reading about a screwdriver has a negative impact on the memory of "hammer", then in the modified procedure misled subjects should less often pick the correct alternative (the hammer) than non-misled ones. As this was not the case, McCloskey and Zaragoza (1985) concluded that there is no evidence for the negative influence of misinformation on the memory of the original information, and the results obtained in previous research, especially those found by means of procedures in which the participants chose between the original and misled alternatives, should be interpreted without referring to memory processes.

Other research which clearly showed that it is possible that some subjects give answers consistent with misinformation, even when realizing that it is contradictory with the original information, was presented by Blank (1998). He proposed an "Integrative model of memory and performance in interference situations" (Blank, 2005) in which he showed that subjects taking part in an experiment on the misinformation effect actually face a problem-solving task in which many of them have to find a solution for perceived discrepancies between parts of the experiment. In the first experiment presented by Blank (1998), the subjects, after being exposed to the original and postevent materials, were given a forced-choice memory test in which they had to choose between the original and suggested false alternative. Half the participants were made aware of the possible discrepancies before the memory test, the other half were not. Afterwards, they were again given the questions they had just answered, and were requested to indicate any discrepancies they had noticed and to describe everything they were thinking about them. In sum, Blank (1998) found that in up to 50% of cases the participants detected discrepancies between the original and postevent materials. Moreover, Blank found that the non-warned subjects who detected discrepancies gave an answer consistent with misinformation in over 40% of cases. Further analyses showed that the main reason for this behavior was that participants doubted their own memory. The finding that trusting one's memory may be an important predictor of accepting misinformation was confirmed by van Bergen, Horselenberg, Merckelbach, Jelicic and Beckers (2010).

The results obtained by Blank (1998) seem an important breakthrough in the research on the mechanisms of the misinformation effect, as it was the first empirical demonstration of participants who rely on the postevent material in spite of its perceived incongruences with the original material. It is surprising that this interesting direction, i.e. exploring the non-memory-based mechanisms of yielding to misinformation, has been largely ignored.

In the light of this, the main aim of the research presented in this article is to replicate and extend the findings of Blank (1998): *to demonstrate that it is possible that a participant correctly remembers what was in the original and postevent material, yet, when asked about the original material, gives an answer consistent with the postevent one*. Theories of memory are of little use in explaining the behavior of such participants, because the memory works correctly in this case. Approaches rooted in social psychology, especially in the psychology of influence and compliance may be more useful.

On the other hand, it is also hypothesized that subjects aware of discrepancies would be less willing to accept misinformation than those not aware of them. This is in accordance with the discrepancy detection theory (Tousignant, Hall, & Loftus, 1986), which posits that discrepancy detection reduces the misinformation

effect. However, for the present research it is important to hypothesize that detecting discrepancies by no means *prevents* the misinformation effect from occurring.

Apart from demonstrating the existence of subjects yielding to misinformation in spite of knowing the correct answer, the second main aim of the presented research is to explore the effects of warning and the effects of the distinctiveness of the original detail. Both these factors seem to be strictly related to the problem of detecting discrepancies between the original and postevent materials. The research on warning concerns the problem of immunizing eyewitnesses against misinformation. This is an important problem in applied forensic psychology, as misinformation may seriously distort eyewitness testimonies, obviously with serious consequences. Warning consists of informing participants about possible discrepancies between the original and postevent materials before the final memory test. Research in this area has produced mixed results, from a total elimination of the misinformation effect (Blank, 1998, 2005; Lindsay & Johnson, 1989), through reduction (Greene, Flynn, & Loftus, 1982), to a complete lack of the efficacy of warning (Neuschatz, Payne, Lampinen, & Toglia, 2001; Zaragoza & Lane, 1994). Excellent reviews of research concerning the impact of warning on the misinformation effect were presented by Oeberst and Blank (2012) and Blank and Launay (2014).

This article contains the hypothesis that the effectiveness of warning depends largely on discrepancy detection. Put simply, if the subject knows that something was different between a film he/she saw and the narrative, and is warned against these discrepancies before the final test, he/she has no more reason to rely on the postevent material. The warning provides adequate and sufficient explanation for the discrepancies. In contrast, when the participant does not know what was different in the film and the narrative, he/she also does not know what to be wary of, and the warning should be less effective.

As for the distinctiveness of the original detail, this is an important problem *per se* in research on the misinformation effect. It is now well established that the more visible, vivid, and central the critical item, the more difficult it is to mislead the participants about it (Dalton & Daneman, 2006; Heath & Erickson, 1998; Loftus, 1979; Roebers & McConkey, 2003; Roebers & Schneider, 2000; Wright & Stroud, 1998). This problem has raised a heated discussion, because in everyday life and in the context of forensic testimony, the information reported by eyewitness is rarely very peripheral and trivial. As in laboratory experiments, the critical items are usually peripheral and not very visible; therefore, a question about the generalizability of the research on the misinformation effect and even of the general laboratory research on eyewitness testimony arises (see Flowe, Finklea, & Ebbesen, 2009). In the context of the research presented in this article, the distinctiveness of the critical item is important because it may impact discrepancy detection. A hypothesis is stated that the more visible and central a critical item in the original material, the more subjects will detect that it was inconsistently described in the postevent material compared to the original one. It follows that the more central an item, the more effective the warning about it would be (because the efficacy of warning depends on the discrepancy detection, which in turn depends on the visibility of the critical item).

The third aim of the present research was to explore possible individual differences between participants aware of discrepancies yielding to misinformation and those also aware of discrepancies, but resisting misinformation. Assuming that there would be subjects who correctly detected the discrepancies between the original and postevent materials, and assuming that some of them would give an answer consistent with misinformation, while others would correctly respond in accordance with the original material, an interesting question arises: what are the differences between these two groups of subjects. In other words, *why* do some participants yield to the misinformation, even when they remember the correct answer, while others do not? The hypothesis examined in the present research stated that these two types of participant would differ on influenceability, suggestibility, compliance, and need for closure. Need for closure (Webster & Kruglansky, 1994) is defined as an individual's desire to come to a quick closure in decisions a(nd judgments, and an aversion towards ambiguity (Kruglanski & Webster, 1996). In cases of doubt, people with high need for closure should be more willing to rely on external sources of information which can be considered as providing true information, such as the narrative prepared and provided by the experimenter.

To sum up, the following hypotheses will be tested:

1. The misinformation effect was expected, that is, the participants from the misled group would provide answers consistent with misinformation more often than those from the non-misled control group (Experiments 1, 2, and 3)
2. Participants who correctly detected discrepancies will less often answer in accordance with the misinformation in the memory test about the original material than those who did not detect them (Experiments 1, 2, and 3).
3. **Some participants will be aware that there were discrepancies between the original and postevent materials as regards the critical answer, and will give an answer consistent with the postevent material. Depending on the procedure, this hypothesis may be stated even more strongly: There will be subjects who correctly remembered a critical item from the film and from the postevent material, yet give an answer consistent with the latter (Experiments 1, 2, and 3).**
4. In the case of central critical misled items, more subjects will correctly detect that they are incongruent with the postevent material than in the case of peripheral ones (Experiments 2 and 3).

5. In the case of central critical misled items, less subjects will give an answer consistent with misinformation than in the case of peripheral items (Experiments 2 and 3).
6. The warning against inconsistencies between the original and postevent materials will be more effective in the group of participants who discovered the discrepancies regarding the critical item than in the group who did not (Experiments 2 and 3).
7. The main reason for giving an answer consistent with the postevent material even when the memory for the original item is correct will be participants' doubt in their own quality of memory (Experiment 2).
8. In the group of participants aware of discrepancies, the subgroup who in the memory test answered in accordance to misinformation will have higher results on measures of influenceability, suggestibility, compliance, and need for closure (Experiments 1 and 2).

Experiment 1

Method

Participants

Students of various universities in Kraków, Poland, took part in the experiment ($N = 424$, 377 women, 45 men, two subjects did not indicate their gender). The mean age of the sample was 20.5 years ($SD = 1.6$). Most of the participants were unpaid volunteers; some received university credit points for their participation.

The most important hypotheses referred to the misled subjects. It was assumed that they would split into groups that were aware and unaware of the discrepancies between the original and postevent materials, and each group would further split according to whether subjects were yielding or unyielding to misinformation. Therefore, a large group of misled subjects was included ($n = 407$), and only a small control non-misled group ($n = 17$), which only served to confirm that the misinformation effect, was present at all.

Materials

A video clip of about 4 minutes' duration showing a robbery of a jeweler shop committed by two men and a woman.

The postevent material – a narrative (140 words) summarizing the video. The critical misled item was the color of a car that was yellow in the video and red in the text.

The memory test comprised eight open-ended questions about the video clip. The critical question was "What was the color of the car which hit the other car at the moment of the explosion?"

The discrepancy detection test comprised the same eight questions, with two YES options, meaning that the participants detected discrepancies between the video and the information in the narrative, and NO, meaning no discrepancies were detected.

Questionnaires

Measure of Susceptibility to Social Influence (MSSI; Bobier, 2002; Polish adaptation: Polczyk, 2007). This is a 34-item tool designed to assess three possible responses to social influence pressure: independence (Principled Autonomy), conformity/compliance (Social Adaptability), and anticonformity (Social Friction). The questions are answered on a 5-point Likert scale, from "strongly disagree" to "strongly agree". Cronbach's alphas for the three dimensions were .80, .82, and .67, respectively.

Gudjonsson Compliance Scale (GCS, Gudjonsson, 1989, 1997; Polish adaptation: Wilk, 2004) was designed to measure compliance, defined as the tendency to conform to requests made by others, particularly people in authority, in order to please them or to avoid conflict and confrontation. It consists of 20 statements answered true or false, e.g. "I give in easily when I am pressured". The reliability of this tool in the present research was .80.

Inventory of Suggestibility (IS, González-Ordi & Miguel-Tobal, 1999; Polish translation: Pasek, unpublished manuscript) is a self-report assessment of suggestibility. It provides a measure of yielding to suggestive influence. As the factor structure reported by González-Ordi & Miguel-Tobal (1999) did not replicate in Polish research, the factor solution reported by Polczyk (2007) was used, consisting of four factors: Absorption – the tendency to immerse in dreaming and fantasy; Suggestibility – the tendency to yield to influence; Emotional Involvement – the tendency to respond to emotional stimuli; Concentration – the ability to ignore stimuli unrelated to current activity. The respective reliabilities were .76, .78, .53, and .51.

Need for Closure Scale (Webster & Kruglansky, 1994; Polish adaptation: Kossowska, 2003) is a questionnaire measuring the need for cognitive closure, defined as an individual's desire to come to a quick closure in decisions and judgments, and an aversion towards ambiguity (Kruglanski & Webster, 1996). A shortened 32-item version with a 6-point Likert scale as the answers was used which measures five domains: (1) preference for order and structure, (2) predictability of future, (3) decisiveness of judgments and choices, (4) affective discomfort caused by ambiguity, and (5) closed-mindedness. The reliabilities for the five dimensions in the present research, as indicated by Cronbach's alphas, were .80, .78, .58, .29, and .68. Thus, the reliability for decisiveness and affective discomfort are somewhat lower and the respective results should be treated with caution. The reliability for the whole scale was .80.

Procedure

The experiment was run in groups from 3 to about 20 participants, always in a room equipped with a video

projector and a screen. The experimenter announced that the experiment was about information processing and instructed the participants to watch to video clip carefully. A video was then presented. The participants were then given all the questionnaires and began to complete them in a random order. After 7 minutes, the experimenter told the participants to stop filling out the questionnaires and to read the postevent narrative. Afterwards, the subjects continued to fill out questionnaires for another 7 minutes and were given the memory test. Immediately after this, the experimenter took away the memory test and distributed the discrepancy detection questionnaire, with the following instruction:

"Listen carefully now so you understand what is expected from you now. Some details in the text you have read were in fact different than they were in the video. You will now be given the same questions you have just answered. Your task now is to indicate each question in which you noticed inconsistencies between the video you watched and the text you read". The task was illustrated with an example. After the participants finished this part of the experiment, they were given time to finish the questionnaires.

Results

In the misled group, 123 out of 407 (30.2%), when asked about the video, answered the critical question in accordance with the misinformation, whereas among the 17 non-misled ones, only one did so (chi^2 (1, N = 424) = 4.67, p = .031; Fisher exact test: p = .030, phi = .11, odds ratio with 95% confidence intervals (OR) = 6.93 [0.91, -42.83]. Thus, hypothesis 1, which postulates the misinformation effect, was confirmed.

From the 407 misled subjects, 248 (60.9%) correctly indicated the critical item (yellow *vs*. red car). The remaining 159 participants (39.1%) were not aware of the discrepancies between the video and the narrative concerning the critical item.

To test hypothesis 2, the number of answers consistent with misinformation was compared between subjects who did and did not detect the discrepancy between the video and the narrative as regards the critical item. The results indicated that out of 248 participants who detected the discrepancy, 24.2% yielded to misinformation, whereas out of the 159 who did not notice it, 45.3% gave an answer consistent with the misinformation. The difference was statistically significant (chi^2 (1, N = 407) = 19.66, p < .001; Fisher exact test: p < .001, phi = .22, OR = .39 (.25–.59). This means that detecting discrepancies reduces the tendency to yield to misinformation. However, for the main hypothesis 3 tested in this experiment, it is important that almost one quarter of those subjects who were aware of the critical discrepancy still gave an answer consistent with the misinformation. This confirms the hypothesis that it is possible to correctly detect discrepancies and still yield to misinformation.

From the participants who correctly detected the critical discrepancy, about a quarter yielded to misinformation, and three quarters resisted it. The next analysis explored whether these two groups of participants differ regarding various indices of susceptibility to social influence. The results, obtained by means of Student t tests, are presented in Table 1.

Table 1. Differences between participants who yielded and resisted the misinformation, in the group who correctly detected discrepancies - means, standard deviations, and Student *t* tests (Experiment 1)

Questionnaire	Subscale	Yielded	Resisted	*t*	*df*[1]	*eta*^{2}	*p*
Measure of Susceptibility to Social Influence	Principled autonomy	52.30 (6.47)	54.15 (7.80)	1.48	212	.01	.142
	Social adaptability	33.00 (7.15)	32.05 (7.11)	-.82	220	<.01	.412
	Social friction	24.69 (4.52)	25.02 (4.55)	.44	218	<.01	.661
Need for Closure	Preference for order	29.27 (5.80)	28.84 (5.39)	-.48	213	<.01	.631
	Predictability of future	30.67 (7.04)	29.55 (5.73)	-1.13	216	.01	.261
	Decisiveness	16.84 (4.28)	17.87 (4.44)	1.45	216	.01	.149
	Discomfort with ambiguity	25.86 (3.48)	25.76 (3.90)	-.16	219	<.01	.870
	Closed-mindedness	18.06 (3.05)	18.55 (2.82)	1.06	215	.01	.291
	General score	119.93 (15.97)	119.98 (12.33)	.02	195	<.01	.983
Gudjonsson Compliance Scale	General score	7.94 (3.83)	7.20 (4.00)	-1.14	219	.01	.254
Inventory of suggestibility	Absorption	15.24 (4.82)	14.82 (4.94)	-.54	216	<.01	.592
	Suggestibility	16.91 (4.04)	16.04 (4.30)	-1.25	214	.01	.214
	Emotional involvement	7.57 (2.73)	7.88 (2.45)	.77	218	<.01	.445
	Concentration	8.59 (1.71)	8.48 (1.79)	-.38	219	<.01	.704

[1] The variation in the number of dfs is caused by subjects who failed to fill out some tests.

The comparison between participants yielding to and resisting misinformation produced no statistically significant effects. Thus, hypothesis 8 was not confirmed.

Discussion

The misinformation effect was demonstrated in this experiment, despite the fact that the control group only comprised 17 subjects. This confirms good replicability of this effect.

The successful discrepancy detection reduced the vulnerability to misinformation, thus confirming hypothesis 2. This means that misinformation may be particularly dangerous when the witness does not realize that an additional source provides information that is inconsistent with what has actually happened. It is possible that a sort of filling of memory gaps takes place here. If the participant answered in accordance with the misinformation, he/she must have encoded and remembered it, because the questions in the memory test were open-ended, thus practically reducing correct guessing to a trivial level. If he/she does not remember the relevant information from the original source, meaning no discrepancy detection can take place, he/she simply assumes that the information from the additional source of information is correct. It seems that eyewitnesses in real life should be warned and instructed to rely only on their own memory, and not report information that they know stems from any source other than their own memory. This of course assumes that eyewitnesses are able to monitor the source of their information correctly, which certainly is not always true.

In sum, 60.9% of misled subjects were able to detect the critical discrepancy correctly. Of central importance to the theses researched in the present article is the fact that 24.2% of them gave an answer consistent with misinformation. Giving that the level of guessing in open-ended questions is trivial, this means that a substantial proportion of aware participants made a wrong decision when deciding whether their memory for the original material was right or wrong. Therefore, the main hypothesis 3 was confirmed in this experiment.

The next analysis concerned the participants who were proved to have detected the discrepancy between the original and postevent materials. Among those, some gave an answer consistent with misinformation, while some did not. Both these groups were compared by means of a battery of tests measuring various aspects of influence, compliance, and need for closure. No difference was statistically significant. Although it is difficult to reject the hypothesis on the basis of nonsignificant results, this may nevertheless suggest that the hypothesized traits did not in reality vary between both groups of participants.

Experiment 2

Method

Participants

In this experiment, 325 participants were tested: 260 women and 64 men (one participant did not indicate gender), with a mean age of 21.1 years ($SD = 4.3$). The participants were students of various universities in Kraków, Poland, including first year students of psychology. Some subjects participated for credit points; others were unpaid volunteers.

Materials and procedure

The materials and procedure were essentially the same as in Experiment 1, with the following modifications introduced to test hypotheses 4, 5, and 6:

Centrality vs. periphery of the critical item: To verify hypotheses 4 and 5, two critical items were used which differed in their distinctiveness. The more central item was the same as in Experiment 1: the color of the car, which was yellow in the video and red in the narrative. The more peripheral item was the time visible on a street clock, which showed 8:55am in the video and 2:55pm in the narrative. About half of the subjects received the postevent material with the misinformation referring to the red color as the critical item, the other half received misinformation about the hour. The color proved to be more central and visible than the hour in other research (Polczyk, 2007).

Warning: To test hypothesis 6, about half of the participants received the following warning: "ATTENTION: the narrative you have read might have contained some information which was incongruent with what really happened in the video clip. While answering the following questions, you should only rely on information remembered from the video". The warning was written at the top of the answer sheet containing the questions about the video.

Processing of discrepancies: The aim of this tool was to gain some information about the cognitive processes of participants coping with the perceived discrepancies between the film and the text. The participants had to indicate one or more options about what they were thinking about the reasons for the discrepancies between the narrative and the video. The following reasons were offered to choose from: doubting own memory, a mistake by the experimenter, a deliberate method of the experimenter, a deception by the experimenter, and being sure about own memory (this referred to subjects who did not yield to misinformation in the previous memory test). The ideas were copied from the results obtained in similar research by Blank (1998). In contrast to Blank (1998), who asked his participants to write down what they were thinking, in the present research a set of options was provided. However, the subjects also had a chance to write down their own thoughts. This part of the procedure took place immediately after the discrepancy detection test.

Table 2. The impact of the vividness of the critical item on yielding to misinformation and on discrepancy detection (non-warned participants only; *n* = 178; *df* = 1) - numbers, percentages, and the *chi*^{2} tests (Experiment 2)

	Vividness of the detail		Total (*n* = 178)	*chi*^{2}	*phi*	OR (95% CI)	*p*	Fisher exact *p*
	More distinct (*n* = 70)	Less distinct (*n* = 108)						
Yielding to misinformation	27 (38.6)	67 (62.0)	94 (52.8)	9.38	.23	.38 (.21–.71)	.002	.003
Discrepancy detection	40 (57.1)	36 (33.3)	76 (42.7)	9.84	.24	2.67 (1.44–4.96)	.002	.002

Table 3. Number and percentages of subjects yielding to misinformation as a function of warning and disrepancy detection - numbers, percentages, totals, and the *chi*^{2} tests (Experiment 2)

Detected discrepancies	Warning		Total	*chi*^{2}	*phi*	OR (95% CI)	*p*	Fisher exact *p*
	Warned	Non-warned						
Yes	13 (15.1) (86)	31 (40.8) (76)	44 (27.2) (162)	13.44	.29	.26 (.12–.55)	<.001	<.001
No	20 (32.8) (61)	63 (61.8) (102)	83 (50.9) (163)	12.83	.28	.30 (.15–.59)	<.001	<.001

Table 4. Processing of disrepancies - subject ideas about the reasons for discrepancies - numbers, percentages, and *chi*^{2} tests (Experiment 2)

		Yielded *n* = 23	Resisted *n* = 37	Total *n* = 60	*chi*^{2}	*phi*	OR (95% CI)	*p*	Fisher exact *p*
Non-warned	Doubting own memory	17 (73.9)	27 (73.0)	44 (73.3)	<.01	.01	1.02 (.65–1.59)	.936	.999
	Mistake of the experimenter	2 (8.7)	7 (18.9)	9 (15.0)	1.16	.14	2.45 (.46–12.98)	.281	.460
	Method of the experimenter	11 (47.8)	25 (67.6)	36 (60.0)	2.30	.20	2.27 (.78–6.62)	.129	.177
	Deception	5 (21.7)	15 (40.5)	20 (33.3)	2.26	.19	2.45 (.75–8.06)	.133	.166
	Sure about own memory	2 (8.7)	9 (24.3)	11 (8.3)	2.13	.20	3.38 (.66–17.28)	.128	.178
		Yielded *n* = 13	**Resisted *n* = 73**	**Total *n* = 86**	***chi*^{2}**	***phi***	**OR (95% CI)**	***p***	**Fisher exact *p***
Warned	Doubting own memory	13 (100.0)	49 (67.1)	62 (72.1)	5.93	.26	1.27 (1.11–1.44)	.015	.016
	Mistake of the experimenter	1 (7.7)	8 (11.0)	9 (10.5)	.13	.04	1.48 (.17–12.91)	.723	.999
	Method of the experimenter	3 (23.1)	44 (60.3)	47 (54.7)	6.16	.27	5.06 (1.28–19.96)	.013	.017
	Deception	2 (15.4)	43 (58.9)	54 (52.3)	8.38	.31	7.88 (1.63–38.16)	.004	.005
	Sure about own memory	2 (15.4)	25 (34.2)	27 (31.4)	1.82	.15	2.86 (.59–13.94)	.177	.214

Results

To test the misinformation effect, two analyses were performed. In the first, answers to the question about the color of the car were compared between subjects misled as to the color of the car and the hour, the latter group serving as the non-misled control group. Next, the answers to the question about the hour were also compared between subjects misled about the color of the car and the hour, the former serving as the non-misled control group. Both analyses confirmed the misinformation effect: 24.4% vs. 3.4% of answers consistent with misinformation (chi^2 (1, $N = 325$) = 28.13, $p < .001$, Fisher exact test: $p < .001$, $phi = .29$, $OR = 9.19$ (3.54–23.86); and 50.3% *vs.* 0.6% (just one person), (chi^2 (1, $N = 325$) = 113.47, $p < .001$, Fisher exact test: $p < .001$, $phi = .59$, $OR = .01$ (.01–.04).

To analyze hypotheses 2 and 3, the number of answers consistent with misinformation was compared between subjects who did and did not correctly detect the discrepancy between the video and the narrative. This analysis was done in the non-warned group only. 56.5% of participants detected the discrepancy, 41.5% did not. Among the former, 13 (15.1%) gave an answer consistent with the misinformation. This confirmed the main hypothesis 3.

Out of the 61 participants who did not detect the discrepancy, 32.8% yielded to misinformation. The difference between this percentage and the one from the group who did detect the discrepancy was statistically significant (chi^2 1, $N = 147$) = 6.40, $p = .011$, Fisher exact test: $p = .016$, $phi = .21$, $OR = .37$ (.16–.81). Thus, hypothesis 2 was confirmed.

The next analysis verified whether details that were more distinct than less visible ones produced a lesser misinformation effect and better discrepancy detection. The results are presented in Table 2.

As is clear from Table 2, less subjects gave answers consistent with misinformation in the case of the more distinct (visible) item than in the case of the less distinct one. In contrast, in the case of the more distinct item, more participants correctly detected discrepancies than in the case of the less visible one. Thus, hypotheses 4 and 5 were confirmed.

Next, the effects of warning on the misinformation effect were analyzed. The analysis took into account discrepancy detection. The results are presented in Table 3.

Table 3 clearly indicates that the warning was effective both in groups that did and did not detect discrepancies, reducing the number of answers consistent with misinformation from 40.8% to 15.1% and from 61.8% to 32.8%, respectively. For hypothesis 6, of particular value is the interaction between warning and detecting discrepancies. As indicated by Table 3, over twice as many warned subjects yielded to misinformation when they were not aware of the discrepancies than when they were aware of them (32.8% *vs.* 15.1%). This difference was statistically significant (chi^2 1, $N = 147$) = 6.41, $p = .011$; Fisher exact test: $p = .016$, $phi = .21$, OR = .37 (.15–.87). Thus, hypothesis 6, which states that warning is more efficient when the participant realizes that there was a difference between the video and in the narrative, was confirmed.

The next analysis concerned cognitive processing of the discrepancies. This consisted of the participants indicating their perceived reasons for the discrepancies (Table 4).

In the non-warned sample, about three quarters of the subjects selected the option "doubting own memory". Surprisingly, both the group that yielded to misinformation and the one that resisted it chose this reason equally often.

The situation was interpreted as being a mistake by the experimenter by 15% of participants. Sixty percent thought that the discrepancy must be part of the experiment. One third believed that it was a deliberate deception made by the experimenter. Finally, about 8% was sure that their own memory was right. The frequency of choosing of these reasons was not statistically significantly different between participants who gave an answer consistent with misinformation and those who did not.

The pattern of results was different in the group of warned subjects. All subjects who yielded to misinformation despite the warning doubted their own memory. Among those who resisted the misinformation, about two thirds doubted their memory. In sum, the results do not appear to support hypothesis 7, stating that the main reason for subjects aware of the discrepancies to give an answer consistent with misinformation was doubting their own memory. If this were true, in the non-warned group more subjects yielding to misinformation should doubt their memory than subjects resisting misinformation. This was not the case.

Surprisingly, about 10% of subjects interpreted the situation as the mistake of the experimenter, despite the fact that they were warned about the possible discrepancies. About 23% of participants yielding to misinformation believed the discrepancies resulted from the experimental method; among those resistant, 60% believed the same, the difference being statistically significant. About 15% of participants yielding to misinformation thought that the discrepancies were a result of deception; among those resisting the misleading suggestion significantly more, almost 60%, believed the same. Finally, about one third of the warned participants were sure that their own memory was right.

The analysis of the open commentaries of the participants did not lead to any interpretable results.

Finally, the analysis comparing subjects who yielded to misinformation and resisted it was performed in the sample of non-warned participants and those who were aware of discrepancies. The same battery of tests as in Experiment 1 was used. The results are presented in Table 5. Similar to Experiment 1, no effects were statistically significant and hypothesis 8 was not confirmed.

Table 5. Differences between participants who yielded and resisted the misinformation, in the non-warned group who correctly detected discrepancies - means, standard deviations, and Student *t* tests (Experiment 2)

Questionnarie	Subscale	Yielded	Resisted	*t*	*df*[1]	*eta*[2]	*p*
Measure of Susceptibility to Social Influence	Principled autonomy	57.30 (7.29)	56.93 (9.00)	-.17	53	<.01	.869
	Social adaptability	30.96 (7.92)	31.50 (9.15)	.23	55	<.01	.816
	Social friction	25.34 (6.24)	26.42 (5.34)	.72	58	.01	.475
Need for Closure	Preference for order	27.97 (6.47)	28.84 (7.28)	.50	59	<.01	.622
	Predictability of future	30.10 (8.62)	28.42 (8.89)	-.74	58	.01	.460
	Decisiveness	16.68 (4.99)	15.88 (4.50)	-.66	58	.01	.514
	Discomfort with ambiguity	26.55 (5.06)	25.59 (4.93)	-.75	59	.01	.457
	Closed-mindedness	18.17 (3.21)	18.82 (3.16)	.80	60	.01	.428
	General score	119.07 (16.20)	118.90 (18.82)	-.04	55	<.01	.970
Gudjonsson Compliance Scale	General score	7.61 (3.93)	6.38 (4.04)	-1.16	55	.02	.250
Inventory of suggestibility	Absorption	16.71 (4.71)	18.06 (5.83)	.98	59	.02	.331
	Suggestibility	15.57 (5.54)	16.82 (4.93)	.93	59	.01	.356
	Emotional involvement	8.24 (3.35)	8.03 (2.84)	-.27	60	<.01	.789
	Concentration	8.97 (2.01)	9.00 (2.08)	-.17	53	<.01	.947

[1] The variation in the number of *dfs* is caused by subjects who failed to fill out some tests.

Discussion

The misinformation effect was replicated in this experiment. This confirms the universality and good replicability of this phenomenon.

In Experiment 2, it was confirmed that some participants were aware of the discrepancy between the original and postevent materials as regards the critical item. Furthermore, among the participants who correctly detected discrepancies, 15.1% gave an answer consistent with the misinformation. This is a percentage somewhat smaller than Experiment 1, in which 24.2% of participants aware of the discrepancy yielded to misinformation; however, this still means that almost one sixth of the participants gave in to misinformation in spite of detecting discrepancies correctly. Thus, this is the second experimental result that confirms that it is not enough for a participant to realize that he saw and read something different. Still, it is possible that, when asked about what he saw, he answers in accordance with what he read. To explain the mechanisms of such behavior, the cognitive theories concerning memory may not be enough.

The percentage of answers consistent with misinformation was greater in the group that was not aware of the discrepancy, which confirms the respective result from Experiment 1. Still, the misinformation effect was not eliminated.

In the case of a vivid and distinct original detail, participants were less likely to give answers consistent with misinformation than in the case of a less distinct detail. At the same time, items that were more visible produced better discrepancy detection than less visible ones. Although it is difficult to prove directly by means of a path analysis (as this would require continuous variables, not categorical ones), it is possible that the influence of the vividness of the original detail on the possibility to be misled is related to the discrepancy detection. The more vivid the original detail, the easier the discrepancy detection, which in turn reduces the tendency to rely on the additional postevent information.

Warning participants against possible discrepancies between the original and postevent materials was more successful in the case of participants who noticed the discrepancies. This confirms the hypothesis that in the case of such subjects, the warning is more effective because it provides an explanation of the differences between parts of the experiment. Participants who did not notice the differences between the video and the narrative could not take full advantage of the warning, because it did not inform them of which piece of information from the narrative they should be wary.

The analysis of the reasons for the discrepancies perceived by the subjects produced complicated results. Surely, most subjects doubted their own memory when they saw discrepancies. However, doubting memory seemingly did not affect the responses in the memory test. However, one result from this analysis certainly deserves attention: over half of the subjects in the warned group and about one third in the non-warned group suspected that the inconsistencies between the video and the narrative were of result of deliberate deception on the part of the experimenter. This is a substantial amount, and may raise concerns as to what extent and how many subjects correctly

guessed the real purpose of the study. If many subjects did, this may certainly raise some concerns about the external validity of the experimental procedure. As Orne (1962) put it, the demand characteristics of it may be high; that is, it is relatively easy to guess its real purpose. Unsuccessful deception in the case of experiments on the misinformation effect is dangerous and deserves attention. Certainly, post-experimental enquiries would be very useful to establish to what extent the participants guessed the real purpose of the study.

Experiment 2, just as Experiment 1, failed to detect any differences concerning individual traits relating to influenceability and need for closure between participants yielding to misinformation and resisting it (out of those who were aware of the discrepancy between the video and the narrative). This disappointing result may suggest that the reasons why somebody answers incorrectly even if he/she knows that he saw and read something different are not caused by influenceability. Further exploration of individual traits that differentiate between subjects relying on their own memories and those trusting external information seems one of the most interesting directions for future research on the mechanisms of the misinformation effect.

Experiment 3

Method

Participants

487 subjects took part in Experiment 3: 316 women and 169 men (two subjects did not indicate their gender), with a mean age of 22.6 years ($SD = 3.1$). The participants were students of various universities in Kraków, Poland, including first year students of psychology. Some of the subjects participated for credit points; others were unpaid volunteers.

Materials and procedure

The materials and procedure were similar to those in Experiment 2, with the following modifications:

- no processing of discrepancies was applied;
- The discrepancy detection test was modified to overcome some limitations of the method used by Blank (1998) and in Experiments 1 and 2. The limitations lie in the fact that in this procedure the researcher does not know the actual content of a participant's memory regarding the critical item. If he/she indicated some question as referring to a detail that was different in the video and in the text, it is still unclear whether the subject actually correctly remembered the relevant content of both materials. In the present research, the original critical item was the yellow color of the car, depicted in the narrative as red. It is possible that a subject, when asked about the discrepancies, indicated the question "What was the color of the car", but in fact he/she thought that the car in the video was, say, green, and in the text, for example, blue.

To overcome this, in Experiment 3 the task of participants was not to merely indicate the question if they suspected a discrepancy, but to answer a question concerning what was in the video and narrative, separately. Let us again consider the example with the color of the car that was yellow in the video and red in the narrative. After the participants read the narrative, they answered questions about the video, including the question "What was the color of the car?" Immediately afterwards, the participants were told that there were discrepancies between the video and the narrative. They were then given the same questions, including the question about the color of the car. Below each question, a space was provided inviting an answer to two additional open-ended questions: "What answer would follow from the film?", and "What answer would follow from the text?"

This method allows for an exact diagnosis of whether a participant indeed correctly remembered what was in the video and in the narrative. In the example with the color of the car, a participant was only diagnosed as "aware of the discrepancies" if he/she provided correct answers: it would follow from the film that the car was yellow, and it would follow from the text that it was red. If a participant only remembered the film, but not the text, or *vice versa*, or did not remember either source, he/she was not considered aware of the discrepancies. The task was carefully explained to participants and illustrative examples were provided.

Results

The misinformation effect was replicated in this experiment in the case of both critical details. In the case of non-warned subjects and the question about the color of the car, an answer consistent with the misinformation was given by 54 (45.0%) misled subjects and by two (1.2%) non-misled ones. In the case of the question about the hour, respective results were 106 (65.8%) *vs*. one (0.8%). Both effects were highly statistically significant: chi^2 1, $N = 281) = 82.50$, $p < .001$, Fisher exact test: $p < .001$, $phi = .54$, $OR = .02$ (.01–.06); and chi^2 1, $N = 281) = 123.24$, $p < .001$; Fisher exact test: $p < .001$, $phi = .66$, $OR = 229.35$ (31.20–1686.11), respectively.

Out of the 281 non-warned subjects, 27 (9.6%) correctly remembered the content of the video and the narrative in the case of the critical items. Of these, four (14.8%) gave an answer consistent with the narrative when asked about the film. Out of the 254 subjects not diagnosed as fully remembering the content of the video and the film, 155 (61.0%) yielded to misinformation. Again, the hypothesis postulating the existence of subjects who give a wrong answer consistent with misinformation in spite of their untouched memory for the original and postevent materials was confirmed. Of course, the discrepancy detection reduced the vulnerability to misinformation (chi^2 1, $N = 281) = 21.21$, $p < .001$, Fisher exact test: $p < .001$, $phi = .28$, $OR = .11$ (.04–.33).

As in the previous experiment, the next analysis explored the impact of the vividness of the critical item on yielding to misinformation. This analysis was done in the subsample of non-warned participants. The results are presented in Table 6.

Table 6 The impact of the vividness of the critical item on yielding to misinformation and on discrepancy detection (non-warned participants only; *n* = 178; *df* = 1) – numbers, percentages, and the *chi*² tests (Experiment 3)

	Vividness of the detail		Total (*n* = 281)	*chi*²	*phi*	OR (95% CI)	*p*	Fisher exact *p*
	More distinct (*n* = 120)	Less distinct (*n* = 161)						
Yielding to misinformation	54 (45.0)	105 (65.2)	159 (56.6)	11.44	.20	.44 (.27–.71)	.001	.001
Discrepancy detection	21 (17.5)	6 (3.7)	27 (9.6)	15.02	.23	5.48 (2.14–14.05)	<.001	<.001

Table 7. Number and percentages of subjects yielding to misinformation as a function of warning and discrepancy detection – numbers, percentages, totals, and the *chi*² tests (Experiment 3)

Detected discrepancies	Warning		Total	*chi*²	*phi*	OR (95% CI)	*p*	Fisher exact *p*
	Warned	Non-warned						
Yes	9 (26.5) (34)	4 (14.8) (27)	13 (21.3) (61)	1.22	.14	2.07 (.56–7.65)	.270	.352
No	56 (32.6) (172)	155 (61.0) (254)	211 (49.5) (426)	33.24	.28	.31 (.21–.46)	<.001	<.001

As in Experiment 2, a more visible critical item produced a less pronounced misinformation effect and a much bigger discrepancy detection.

Next, the effects of warning on the misinformation effect were analyzed separately in groups of participants who did and did not correctly remember the critical items from the video and the narrative (Table 7).

The results of this analysis indicate that, contrary to the hypothesis, the warning was not statistically significantly effective in the sample of participants correctly remembering the content of the video and the narrative when answering questions about the film. In contrast, the warning was very effective in the group of subjects who were not aware of the discrepancies between the original and postevent materials.

The comparison between subjects giving answers consistent with misinformation and the original material was not performed in this experiment, because the number of participants available in the non-warned group who yielded to misinformation while being aware of the discrepancies was only four.

Discussion

In Experiment 3, a different method of detecting the discrepancies was applied which allowed for direct verification of what the subject remembered from the video and the narrative about the critical item at the moment of answering questions from the memory test. Only subjects who remembered the information from the video and the text were considered to have detected the discrepancies. This seems a better method than just having the subjects indicate the questions if they noticed discrepancies between the original and postevent materials. In this light, it is worth noticing that in Experiment 3 the percentage of participants diagnosed as being aware of the discrepancies was strikingly lower than in Experiments 1 and 2. It was 9.6% in the present experiment, 60.9% in Experiment 1, and 56.5% in Experiment 2. Given the fact that the materials and the procedure were virtually the same, it means that apparently different groups were formed using both methods.

To some extent, this may explain the differences between the results of Experiments 2 and 3 regarding warning. In Experiment 2, it was more effective in the group that discovered the differences between materials, and less in the group that did not. In Experiment 3, the effect of warning was nonsignificant in the group that did discover discrepancies, but significant in the group that did not. Clearly, more research is needed on the methods of identifying subjects who correctly discovered the critical inconsistencies between parts of the procedure. The present experiments are just the beginning of such research.

With all differences between both procedures, the results concerning the main hypotheses were similar (apart from those concerning the warning): the misinformation effect was replicated, there were participants who responded in accordance with the misinformation despite the fact that they remembered the correct answer, and more visible critical items produced a smaller misinformation effect and greater discrepancy detection.

General discussion

The misinformation effect consists of including in memory reports erroneous details that stem from sources other than the original information. Since the seminal research by Loftus et al. (1978), it has been studied mainly by experts in the psychology of memory. This is understandable. But in the light of the research by Blank (1998), which has been fully replicated and extended in the present article, it is possible that at least some subjects yield to misinformation for reasons unrelated to memory. The framework of the cognitive psychology of memory may not be enough to explain the behavior of such participants. The

framework of social psychology, especially the psychology of social influence, may be more suitable.

The experiments on conformity by Asch (1951) come to mind, in which people denied what they saw and answered in accordance with obviously wrong responses given by members of the group. There are of course important differences between conformity and misinformation effect frameworks. In the research on conformity, the pressure is social in nature as it is exerted by a group of people. In the misinformation framework, the pressure is just a piece of paper (although in some research the misinformation is communicated by other people, e.g. Dalton & Daneman, 2006; Szpitalak, Polak, Polczyk & Dukała, 2015; Roediger, Mead & Bergman, 2001; Meade & Roediger, 2002; see also Blank et al., 2013). The second difference is the fact that in experiments on the misinformation effect, participants are usually not confronted with a group and do not need to overtly disagree with others. With all these differences, the framework of conformity may be a place to start finding an explanation of the behavior of participants aware of the discrepancies and yielding to misinformation. The distinction between public conformity and private acceptance (Kiesler & Kiesler, 1969) is also useful: the misinformation effect seems to be more related to private acceptance.

In sum, the results of the three experiments clearly indicate that some people who are aware of discrepancies yield to misinformation. In addition, less vivid details produced a greater misinformation effect and lesser discrepancy detection. On the other hand, the results concerning the warning were inconclusive. Moreover, clearly no individual traits were discovered, which would explain why some people aware of the discrepancies chose an answer consistent with the truth, while others chose an answer consistent with the misinformation. Obviously, influenceability, compliance, and need for closure do not explain differences between both groups of subjects.

For future research of this kind, traits connected with self-confidence may be the next candidate. The hypothesis would be that self-confident people rely on their own memory, while those with lower self-confidence rely on external sources, and yield to misinfomration more often. Results of some research are promising for such an idea. For example, induced self-confidence was shown to reduce susceptibility to social pressure (MacBride & Tuddenham, 1965) and to be a predictor of the reliance of oneself as a source of information (Barber, 2008). Also, self-confidence was proved to reduce to vulnerability to interrogative suggestibility, that is, the tendency to yield to misleading cues included in the questions, and the tendency to change answers after negative feedback (Szpitalak & Polczyk, 2016). Most importantly, Szpitalak and Polczyk (2015) were able to show that enhanced self-confidence reduced vulnerability to misinformation mainly among the participants who were aware that there were discrepancies between the original and postevent misinformation. Szpitalak and Polczyk (2015) argued that enhanced self-confidence caused the participants to rely more on their own memories, instead of depending on information provided be external sources, but this is only possible when the participants are able to distinguish between their own knowledge and information stemming from external sources.

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