

**Explicit warnings reduce but do not eliminate the continued
influence of misinformation**

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Running head: REDUCING THE MISINFORMATION EFFECT

Explicit warnings reduce but do not eliminate the continued influence of misinformation

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Abstract

When information that is initially presumed to be correct is later retracted or corrected, it often continues to influence memory and reasoning. This occurs even when the retraction itself is well remembered. The present study investigated if the continued influence of misinformation can be reduced by explicitly warning people at the outset that they may be misled. A specific warning—giving detailed information about the continued-influence effect—succeeded in reducing the continued reliance on outdated information but did not eliminate it. A more general warning—reminding people that facts are not always properly checked before information is disseminated—was even less effective. In an additional experiment, a specific warning was combined with the provision of a plausible alternative explanation for the retracted information. This combined manipulation further reduced the continued influence effect but still failed to eliminate it altogether.

Explicit warnings reduce but do not eliminate the continued influence of misinformation

There is abundant evidence that human memory is reconstructive (cf. Roediger & McDermott, 1995), and that those reconstructions can induce errors into our recollections. For example, people readily form “memories” for information that was never presented but merely hinted at. When presented with a list of words such as ‘bed, rest, awake, tired, dream’, roughly half the participants will recall the non-presented word ‘sleep’, due to its strong association with the studied items (Deese, 1959; Roediger & McDermott, 1995; Seamon et al., 2002). There is also much evidence that people’s memories, once formed, are susceptible to post-event suggestions. For example, witnesses of a traffic accident may remember a non-existent traffic sign if it was mentioned after the event (e.g., if people were asked “...did the red car slow down at the ‘Yield’ sign?”, when in fact there was a ‘Stop’ sign; cf. Ayers & Reder, 1998; Loftus, 1975; Loftus & Palmer, 1974).

This article deals with another source of potential memory errors, namely the failure to correct initially-believed information that later turns out to be false. Contrary to the ease with which false memories can be created and true memories altered, the *elimination* of memories for information that is later revealed to be false—we will refer to this type of information as *misinformation*¹—has proven considerably more difficult. Misinformation continues to affect behavior even if people explicitly acknowledge that this information has been retracted, invalidated, or corrected (Ecker, Lewandowsky, & Apai, in press; Ecker, Lewandowsky, Swire, & Chang, 2010; Gilbert, Krull, & Malone, 1990; Gilbert, Tafarodi, & Malone, 1993; H. Johnson & Seifert, 1994, 1998; Seifert, 2002; van Oostendorp, 1996; van Oostendorp & Bonebakker, 1999; Wilkes & Leatherbarrow, 1988; Wilkes & Reynolds, 1999).

For example, H. Johnson and Seifert (1994) presented subjects with a story about a fictitious warehouse fire, allegedly caused by volatile materials that were carelessly stored in a closet. Subjects were later told that the closet had actually been empty. Even though

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3 participants later remembered this retraction, they still used the outdated misinformation to
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5 make inferences; for example, people might argue that the fire was particularly intense
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7 because of the volatile materials, or that an insurance claim may be refused due to negligence.
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9 H. Johnson and Seifert (1994) termed this reliance on misinformation the *continued influence*
10
11 *effect* (CIE). The CIE is robust and occurs in a variety of contexts, regardless of the particular
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13 story being presented and the test applied (Ecker et al., in press; H. Johnson & Seifert 1994,
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15 1998; Wilkes & Reynolds, 1999).
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20 The continued influence of misinformation is also detectable in real-world settings.
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22 For example, during the 2003 invasion of Iraq, the public was exposed to countless hints that
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24 Weapons of Mass Destruction (WMDs) had been discovered in Iraq. Even though no such
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26 report was ever confirmed, these constant hints were powerful enough to engender
27
28 longstanding belief in the existence of WMDs in a substantial proportion of the U.S. public,
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30 which persisted even after the non-existence of WMDs became fully evident (Kull, Ramsay,
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32 & Lewis, 2003; Lewandowsky, Stritzke, Oberauer, & Morales, 2005). Unconfirmed hints can
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34 thus engender false memories in the public (analogous to the ‘sleep’ example presented at the
35
36 outset) that resist subsequent correction (analogous to the ‘warehouse fire’ example above).
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41 People’s continued reliance on misinformation can have obvious adverse
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43 consequences in other settings relevant to the public’s welfare, for example when jurors are
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45 instructed to disregard tainted evidence. In laboratory analogs of court proceedings, it has
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47 been repeatedly shown that mock jurors continue to rely on inadmissible evidence even when
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49 they claim to obey instructions to ignore it (Fein, McCloskey, & Tomlinson, 1997; Kassin &
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51 Sukel, 1997). In light of these adverse consequences, the question of how the CIE might be
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53 reduced or eliminated takes on particular urgency.
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3 *Previous Attempts to Eliminate Continued Influence*
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6 The CIE has typically been explained by reference to a mental event model that people
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8 build when trying to understand an unfolding event (H. Johnson & Seifert, 1994; van
9
10 Oostendorp, 1996; Wilkes & Leatherbarrow, 1988). On this view, a retraction of central
11
12 information creates a gap in the model, and because people are apparently more willing to
13
14 accept inconsistencies than voids in their event model, they continue to rely on
15
16 misinformation. That is, people prefer to retain *some* information in crucial model positions
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18 (e.g., what caused something to happen, who was involved, etc.) even if that information is
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20 known to be discredited (H. Johnson & Seifert, 1994; van Oostendorp & Bonebakker, 1999).
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24 Previous efforts to reduce the CIE have been pursued along various different lines,
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26 most of which remained unsuccessful. Those efforts included attempts to increase the impact
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28 of a retraction (1) by wording it in a particularly clear and direct way (H. Johnson & Seifert,
29
30 1994), (2) by repeating it (van Oostendorp & Bonebakker, 1999), or (3) by supplementing the
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32 retraction with explanations that clarified the contradiction (i.e., giving reasons why the
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34 misinformation was first assumed to be factual but then discarded; Bush, H. Johnson, &
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36 Seifert, 1994). In other attempts to reduce the CIE, (4) subjects were admonished to read the
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38 materials carefully (van Oostendorp, 1996), or (5) the retraction was presented immediately
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40 after the misinformation (rather than some time later) to limit its impact on the on-line
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42 construction of the event model (H. Johnson & Seifert, 1994; Wilkes & Reynolds, 1999).
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44 None of those attempts was successful.
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51 To date, only two factors have been identified that can reliably reduce reliance on
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53 misinformation: First, the effect is reduced—but rarely eliminated—if the correction goes
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55 beyond a mere retraction by also providing a *causal alternative*. Thus, if a fire is initially
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57 linked to careless storage of volatile materials, a later correction stating that no such materials
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59 had been found will be particularly effective (i.e., reduce references to negligence in
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3 subsequent recall and inference tests) if the correction additionally states that arson-related
4 materials were discovered (Ecker et al., in press; H. Johnson & Seifert, 1994; Rapp &
5 Kendeou, 2007; but see van Oostendorp & Bonebakker, 1999). In terms of the mental event
6 model theory, the alternative can be used to fill what would otherwise be left void by the
7 retraction in the event model.
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15 Unfortunately, however, there are many real-life situations in which plausible
16 alternatives may not be available (e.g., in a court case there may not be an alternative
17 suspect). Furthermore, H. Johnson and Seifert (1999) demonstrated that the causal alternative
18 needs to be provided within the event context. They instructed subjects to self-generate causal
19 alternatives after reading the retraction, but this did not make the retraction more efficient.
20 Thus, it appears that people do not revise their event model and replace the misinformation
21 with alternative information even when those alternatives are demonstrably accessible.
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32 The second factor that seems to reduce the CIE is *suspicion* towards the source of the
33 misinformation. In the WMD studies discussed earlier, belief in the existence of WMDs in
34 Iraq was correlated with support for the war and was especially pronounced in those people
35 who obtained news from sources that supported the invasion (e.g., Fox news; Kull et al.,
36 2003). Lewandowsky et al. (2005) uncovered a more direct link between suspicion and the
37 ability to update misinformation related to the Iraq war. They operationalized suspicion as the
38 extent to which respondents doubted the official WMD-related reasons for the invasion. When
39 this measure was used as a predictor variable, Lewandowsky et al. found that it explained
40 nearly a third of the variance in people's belief in misinformation. Moreover, once suspicion
41 was entered as a predictor, previously striking mean differences between respondents in the
42 U.S. and two other countries (Germany and Australia) disappeared and were instead found to
43 reflect differing degrees of suspicion between those countries. Lewandowsky, Stritzke,
44 Oberauer, and Morales (2009) extended the notion of suspicion by suggesting that it may be
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3 related to a more stable personality trait of skepticism—skeptics will generally tend to
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5 question the motives behind the dissemination of information.
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8 Likewise, in mock jury studies, subjects' reliance on inadmissible evidence was
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10 reduced if immediately after presentation of the inadmissible evidence (e.g., libelous
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12 newspaper reports or hearsay testimony), subjects were reminded that the media may publish
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14 biased reports to raise sales or that hearsay evidence may be deliberately introduced to
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16 manipulate the jury's thinking (Fein et al., 1997).
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20 The literature thus suggests that suspicion may be capable of reducing the CIE.
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22 However, suspicion will be useful to reduce the CIE only in situations where people believe
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24 there are reasons to be suspicious in the first place, and in many situations it will not be
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26 feasible to plausibly induce suspicion. Moreover, as discussed earlier, the effectiveness of
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28 induced suspicion may be moderated by a person's level of skepticism, which may represent a
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30 stable personality trait (Lewandowsky et al., 2009) and is hence difficult to manipulate. Given
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32 these constraints, we investigated a novel but related avenue to reduce people's reliance on
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34 misinformation by examining the effects of explicit prior warnings about potentially
35
36 misleading information. Participants in the present study received one of two different types
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38 of warning. One was designed to induce a general sense of *alertness* that information is
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40 frequently presented as factual but then retracted. We believe that this type of induced
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42 alertness is similar to induced suspicion (cf. Fein et al., 1997), but without requiring people to
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44 assume that someone is willfully trying to mislead them. The other type of warning was
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46 designed to additionally provide specific information about the CIE, on the assumption that
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48 explaining the exact nature of the effect should enable participants to avoid it..
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55 The notion that direct warnings featuring specific information can counteract memory
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57 and reasoning errors has found some support in previous research. Like CIEs, false memories
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59 in the Deese-Roediger-McDermott paradigm have proven extremely difficult to eliminate. For
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3 example, even after five study-test trials (of the same list), the rate of false recall of unstudied
4 words (e.g., 'sleep') after studying strong associates (e.g., 'dream, bed, ...') has been found to
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6 be as high as 32% (McDermott, 1996). This effect can be reliably reduced, however, by
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8 telling subjects about the effect before list presentation (Gallo, Roberts, & Seamon, 1997; Jou
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10 & Foreman, 2007; McDermott & Roediger, 1998; McCabe & Smith, 2002; Peters et al., 2008;
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12 Watson, McDermott, & Balota, 2004). Warnings presented after list presentation and prior to
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14 recall are less effective (Anastasi, Rhodes, & Burns, 2000; Gallo, Roediger, & McDermott,
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16 2001; McCabe & Smith, 2002; Neuschatz, Payne, Lampinen, & Toggia, 2001).
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22 Similarly, the power of post-event suggestions in the Loftus paradigm (e.g.,
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24 suggesting there was a 'Yield' sign when there was not) can be abated by warning subjects
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26 before the suggestion is administered (Chambers & Zaragoza, 2001; Greene, Flynn, & Loftus,
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28 1982). The effect of post-suggestion warnings appears more mixed, with some authors
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30 reporting a reduction of false memories (Chambers & Zaragoza, 2001; Christiaansen &
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32 Ochalek, 1983; Echterhoff, Hirst, & Hussy, 2005; Zaragoza & Koshmider, 1989; see also
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34 Lindsay & M. Johnson, 1989) and others not (Belli, Lindsay, Gales, & McCarthy, 1994;
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36 Greene et al., 1982). This state of affairs suggests that warnings alter processing both at
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38 encoding (e.g., by leading subjects to infer what the suggested concept is in a false-memory
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40 paradigm) and at retrieval (e.g., by boosting source monitoring efforts).
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46 Should explicit warnings prove able to reduce the CIE, this would be interesting for
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48 both applied and theoretical reasons. In applied settings, briefings of jurors and media
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50 education measures could be used to reduce the unwanted effects of outdated information on
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52 people's inferences. From a theoretical perspective, the effects of warnings could shed more
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54 light on the mechanisms underlying misinformation effects. For example, it has been
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56 suggested that misinformation effects result mainly from automatic retrieval processes; that is,
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58 inadequate reliance on active but invalid information paired with insufficient retrieval control
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3 (Ayers & Reder, 1998; H. Johnson & Seifert, 1994; M. Johnson, Hashtroudi, & Lindsay, 1993;
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5 Schwarz, Sanna, Skurnik, & Yoon, 2007). Warnings might lead to an increase in strategic
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7 retrieval monitoring and should therefore prove effective in reducing the CIE.
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10 We present two experiments that explored the effects of general and more specific
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12 warnings on the CIE. Given previous research, we chose to present warnings before the
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14 encoding of the relevant materials to maximize their effectiveness. Materials consisted of a
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16 fictitious accident report that contained a correction of an initial false statement, and a
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18 subsequently administered inference and fact recall questionnaire.
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22 Experiment 1

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24 Experiment 1 utilized a standard ‘continued influence’ paradigm (cf. H. Johnson &
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26 Seifert, 1994) featuring four retraction conditions plus a baseline no-retraction control
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28 condition in a between-subjects design. Participants read a fictitious account of a minibus
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30 accident whose victims were initially said to be elderly people. In the four retraction
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32 conditions, this information was later revoked. The retraction conditions differed in terms of
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34 whether the story contained a warning at the outset or an alternative account of who the
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36 passengers were later in the story. Participants were ultimately given a questionnaire to probe
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38 their understanding of the story and the extent of reliance on the misinformation.
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43 *Method*

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46 *Participants.* One hundred twenty-five undergraduate psychology students (mainly
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48 first-year students; 30 males; mean age 19.1 years) participated for partial course credit.
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50 Participants were tested individually and were randomly assigned to the five conditions
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52 ($N = 25$ in each condition).
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56 *Stimuli.* Participants were presented with a folder, containing a series of 14 statements,
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58 each printed on a separate sheet of paper, which provided a fictitious account of a minibus
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60 accident. (Materials are provided in Appendix A.)

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3 In all conditions, message 4 provided the (mis-)information that the passengers were
4 elderly people: “*Police have stated that the passengers on the bus were a group of elderly*
5 *people who were on their way back to their nursing home...*”. In the No-Retraction control
6 condition, this initial information was not challenged, thus providing a baseline measure for
7 the final inference test. In all four retraction conditions, the misinformation was retracted in
8 message 11: “*...police stated that the passengers on the minibus were not elderly people.*” In
9 the Retraction-Only condition, this was the only correction. In the Alternative condition, the
10 retraction was accompanied by a plausible alternative piece of information within the same
11 message: “*...passengers on the minibus were not elderly people but college hockey players*
12 *returning from a victory party...*”. This condition aimed to replicate the effect of providing an
13 alternative for the retracted misinformation (H. Johnson & Seifert, 1994) and to compare the
14 effects of warnings with the ‘gold standard’ of previous research.
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31 In the two remaining retraction conditions only the simple retraction was presented in
32 message 11, but subjects additionally received a written warning before reading the scenario.
33 In the General-Warning condition the warning stated that sometimes reported ‘facts’ are not
34 double-checked before they are released (see Appendix B for the exact wording of both
35 warnings). Finally, in the Specific-Warning condition, the warning explained the CIE very
36 specifically and provided two concrete examples of its operation.
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45 *Procedure.* Subjects read the statements at their own pace without backtracking,
46 although encoding time was limited to five minutes (none of the subjects approached this
47 limit). Subjects were aware of an upcoming memory test. People then engaged in an unrelated
48 15-minute distractor task before responding to a questionnaire comprising 9 inference
49 questions, 9 fact recall questions, and 2 manipulation-check questions. All questions are given
50 in Appendix C.
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3 Inference questions were designed to elicit inferences about aspects of the incident
4 that were directly or indirectly linked to the misinformation, viz. the age of the passengers.
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6 For example, the question “*Why do you think it was difficult getting both the injured and*
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uninjured passengers out of the minibus?” could be answered by referring to the passengers’
old age, although one could also come up with alternative explanations, such as—in the
Alternative condition—the hockey players being intoxicated after their victory party.

The fact recall questions were designed to check for adequate encoding and assess overall memory for details of the scenario, but were not directly related to the age of the passengers. The final recall question was an exception because it directly asked who was on the minibus.

The manipulation-check questions targeted participants’ awareness and understanding of the retraction. The questionnaire items were always given in this order to avoid carry-over effects from recall and the manipulation check to the inference part.

Results

Coding procedure. Questionnaires were scored by a trained scorer who was blind to experimental conditions, following a standardized scoring guide. Another scorer scored 20 randomly selected questionnaires (4 from each condition) for an inter-rater reliability check. Reliability was found to be high ($r = .97, .84, \text{ and } .94$ for inference, fact, and manipulation check questions, respectively).

Analysis focused on three dependent measures: participants’ reliance on misinformation (inference score), the accuracy of their recall (fact-recall score), and acknowledgment of the retraction (manipulation-check score). For the inference score, any reference to elderly people or items clearly related to the elderly stereotype incremented the inference score by 1. Examples of such inferences include: “*The people found it difficult to exit the bus because they were frail and weak*” or “*The passengers’ children were informed*

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3 *about the accident*". Inferences that were contained in fact-recall or manipulation-check
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5 responses also contributed to the inference scores, hence the maximum inference score was 20
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7 (1 possible inference per item).
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10 Fact questions were given a recall score of 1 for a correct response and 0 for an
11
12 incorrect response. The fact-recall responses were used to ensure that all participants had read
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14 and understood the story; no one scored below 2 (out of 8)² and thus all participants were
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16 retained for analyses.
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19 Manipulation-check questions were given a score of 1 if participants remembered a
20
21 retraction and 0 if they did not. The maximum score was 2.
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24 *Inferences.* The mean numbers of references to misinformation in all conditions are
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26 shown in Figure 1. As expected, the No-Retraction control condition had the highest score;
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28 the Specific-Warning and Alternative conditions had the lowest scores.
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31 Instead of an undirected omnibus ANOVA that would have required multiple follow-
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33 up tests, we used our a priori hypotheses to guide a contrast analysis, following Rosenthal,
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35 Rosnow, and Rubin (2000). The results are summarised in Table 1.
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38 First, we specified a set of contrasts that reflected our coarse initial hypothesis, based
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40 on previous research, that a mere retraction would not significantly reduce the number of
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42 references to misinformation, whereas a general warning would moderately reduce continued
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44 influence and a specific warning or provision of an alternative would maximize the reduction.
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46 We therefore assigned lambda weights 1, 1, 0, -1, -1 to the conditions No-Retraction,
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48 Retraction-Only, General-Warning, Specific-Warning, and Alternative, respectively. This
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50 contrast (C1 in Table 1) yielded a highly significant (directed) main effect of condition.
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53 Further planned contrasts showed that a mere retraction reduced the number of
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55 references to misinformation numerically but this was not significant at the conventional .05
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57 alpha level (C2 in Table 1). This is in line with previous research, which has variously found
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3 significant effects of retractions (e.g., Wilkes & Reynolds, 1999) as well as clear null effects
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5 (e.g., H. Johnson & Seifert, 1994); the reasons for this inconsistency remain unclear and are
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7 outside the scope of this article. Second, an additional general warning was not capable of
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9 reducing the level of continued influence found with a mere retraction (C3). Finally, both a
10
11 specific warning and the provision of an alternative were not only able to strongly reduce the
12
13 CIE, but also proved more efficient in this regard than the general warning (C4, C5).
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17 It is noteworthy that the reduction of the CIE by a specific warning or alternative
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19 occurred quite uniformly across all items carrying the effect. References to misinformation
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21 were mainly made in response to inference questions 1-5, and fact question 9 (these items had
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23 between 14 and 24 references in the No-Retraction condition, summed over all participants;
24
25 all other items scored below 10). The alternative and the specific warning reduced references
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27 to misinformation in response to these items by 51-65 % (42-67 % in the Alternative
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29 condition, 53-63 % in the Specific-Warning condition).
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34 Further analyses dealt with the alternative interpretation that our warnings did not
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36 specifically reduce references to misinformation but rather overall output more generally (cf.
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38 Goldsmith, Koriat, & Weinberg-Eliezer, 2002). To address this possibility, a naïve scorer
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40 quantified subjects' responses to the inference questionnaires by means of a propositional
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42 analysis (i.e., a count of "idea units"; Kintsch, 1978) and also a more fine-grained count of
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44 lexical information units (LIUs, i.e., all informative, well-formed content and function words
45
46 that carry semantic meaning and are relevant to the narrative; Marini, Boewe, Caltagirone, &
47
48 Carlomagno, 2005). We then compared the output of the Retraction-Only group with the two
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50 Warning groups (because all three conditions featured a retraction and differed only in the
51
52 administration of a warning). The data are summarized in Table 2. To test the directed
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54 hypothesis that warnings reduced overall output, we contrasted the Retraction-Only condition
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56 with the combined Warning conditions (lambda weights 2, -1, -1), but found no significant
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3 effects on the mean number of propositions or LIUs (both F s < 1). Hence, we found no
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5 reduction in output quantity in the Warning groups relative to the Retraction-Only group. It
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7 follows that warnings reduced the CIE without reducing general output or—as will be shown
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9 next—correct recall.
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12 *Recall.* We did not expect our manipulations to affect fact recall. Mean fact recall
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14 scores across all conditions ranged from 4.92 to 5.40 (out of 8). A one-way ANOVA revealed
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16 no main effect of Condition, $F < 1$, thus obviating the need for a contrast-based analysis.
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19 *Awareness of retraction.* Mean manipulation-check scores across conditions
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21 (excluding the No-Retracton control condition for which the questions were meaningless)
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23 ranged from 1.00 to 1.24 (out of 2). A one-way ANOVA failed to reveal a main effect of
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25 Condition, $F < 1$.
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29 Next, we re-analyzed the inference results after removing 32 participants who scored 0
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31 on the manipulation-check questions and hence may not have noticed the retraction in the first
32
33 place. Inference scores of this restricted sample are also shown in Figure 1, and results of the
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35 contrast analysis are also shown in Table 1. The overall pattern was similar and there was still
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37 a main effect of Condition in the directed contrast analysis (C1 in Table 1). However, in this
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39 subsample, the general warning was apparently more effective in reducing the CIE; that is,
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41 there was now a significant difference in the number of references to misinformation between
42
43 the General-Warning and the Retraction-Only conditions (C3), but no longer a difference
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45 between the General-Warning vs. the Specific-Warning and Alternative conditions (C5).
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50 *Discussion*

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52 Experiment 1 replicated previous research in several important ways. First, we again
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54 showed that a mere retraction can be insufficient to significantly reduce continued reliance on
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56 misinformation (H. Johnson & Seifert, 1994; but see also Bush et al., 1994; Ecker et al., 2010;
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58 Wilkes & Reynolds, 1999). The CIE persisted even when only those subjects were considered
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3 who remembered the correction, implying that the continued influence of misinformation was
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5 not due to a trivial failure to encode and/or retain the retraction. Second, when the retraction
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7 was accompanied by a plausible alternative, participants were able to reduce their reliance on
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9 misinformation (Ecker et al., 2010; H. Johnson & Seifert, 1994; Rapp & Kendeou, 2007). The
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11 fact that we replicated those two pervasive aspects of previous research permits us to interpret
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13 the novel results with greater confidence.
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17 The novel finding of Experiment 1 was that a specific warning, by providing a detailed
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19 account of the CIE, reduced people's reliance on misinformation. In doing so, the specific
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21 warning was as successful as the provision of an alternative account—the principal factor
22
23 hitherto known to effectively reduce the CIE. A general warning designed to induce non-
24
25 specific alertness was only effective in subjects who also explicitly remembered the retraction.
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27 This implies that only subjects who became fully aware of the retraction during encoding
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29 were able to associate it with the initial warning. We discuss this pattern more extensively in
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31 the General Discussion.
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35 We also showed that even with a specific warning and even when an alternative was
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37 provided, the CIE still persisted. None of the manipulations used in Experiment 1 were
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39 sufficient entirely to eliminate the continued influence of misinformation. This is also in line
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41 with previous research: H. Johnson and Seifert (1994) reported that the provision of an
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43 alternative eliminated the CIE in their “thematic inference” measure (comprising only
44
45 references to misinformation made on their inference questionnaire) but not in their “direct
46
47 reference” measure, which additionally included references to misinformation made in their
48
49 tests of recall (and which is hence comparable to the misinformation measure used here).
50
51 Ecker and colleagues (in press) reported three experiments featuring a causal-alternative
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53 condition and found persistent residual reliance on misinformation in all three, as did van
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55 Oostendorp and Bonebakker (1999).
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3 In the next experiment, we asked whether by combining the two most powerful
4 manipulations known—provision of an alternative plus a specific warning—we can entirely
5 eliminate reliance on misinformation.
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10 Experiment 2

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12 According to the mental event model account of the CIE, an alternative serves to fill
13 the gap in the event model left behind by a retraction. This explains both the failure of a
14 direct, specific warning to completely eliminate continued influence and the efficiency of an
15 alternative in reducing the effect. However, the question remains why significant levels of
16 continued influence still persist even when an alternative is made available. Ayers and Reder
17 (1998) and H. Johnson and Seifert (1998) have argued that representations of valid and
18 invalid information co-exist in memory and compete for activation. Hence the retracted
19 information is most likely not completely removed from the event model but rather either
20 tagged as invalid, or suppressed. In some instances, the remaining activation of invalid
21 information then seems sufficient to produce residual reliance on misinformation.
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36 Experiment 2 was designed to examine whether alerting people to the effects of
37 misinformation could eliminate the CIE in cases where there is alternative information
38 available (for instance by boosting suppression of invalid information or enhancing strategic
39 retrieval monitoring; the likely mechanisms will be discussed more thoroughly in the General
40 Discussion). The study featured the same scenario as Experiment 1, using a between-subjects
41 design with three conditions, all of which featured the specific warning at the outset. The
42 main condition of interest combined the specific warning with the provision of an alternative;
43 that is, the most effective manipulations of Experiment 1 (Specific-Warning + Alternative
44 condition). The two remaining conditions simply served to provide upper and lower
45 comparison baselines—in one condition the passengers were elderly people throughout (the
46 No-Retraction condition, identical to Experiment 1 except that subjects received the specific
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3 warning), whereas in the other condition the passengers were young hockey players
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5 throughout (the Alternative-Throughout condition).
6

7 8 *Method*

9
10 *Participants.* Ninety-two undergraduate psychology students (mainly first-year
11 students; 26 males, mean age 19.9 years) participated in this study for partial course credit.
12
13 None of them had taken part in Experiment 1. Participants were tested individually; the first
14
15 75 subjects were randomly assigned to the three experimental conditions. We then conducted
16
17 an initial analysis and decided to stock up the Specific-Warning + Alternative condition to
18
19 ensure that the results were not driven by a small number of outliers and to administer an
20
21 additional debriefing questionnaire. In this extension, a further 17 subjects were tested in the
22
23 Specific-Warning + Alternative condition (hence there were 42 subjects in this condition and
24
25 25 in each of the two control conditions). Results from the initial subsample ($N = 25$) are not
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27 reported separately, but were in accordance with the results obtained with the full sample,
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29 which are reported below.
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37 *Materials and procedure.* The materials and procedures used in this experiment were
38
39 identical to Experiment 1 with two exceptions. First, the specific warning was presented in all
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41 conditions. Second, in the Alternative-Throughout condition, the passengers were initially
42
43 (message 4) reported to be young instead of old and no further correction was presented. For
44
45 the extension sample in the Specific-Warning + Alternative condition, a four-question
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47 debriefing questionnaire was administered at the end of the experiment to more thoroughly
48
49 assess understanding of and belief in the correction (see Appendix C for questions).
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52 53 *Results*

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55 *Coding procedure.* The data were scored as in Experiment 1. Using the same inclusion
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57 criterion as before (fact recall rate $> .25$), all participants were retained for analysis.
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3 *Inferences.* The Alternative-Throughout condition was excluded from analysis as it—
4 quite expectedly—did not contain any references to the elderly theme because this
5 information was never presented (i.e., an inference score of zero). This implies that any
6 references to misinformation made in the Specific-Warning + Alternative condition can be
7 safely interpreted as a true continued-influence effect; they would not have been made
8 without the misinformation being presented in the first place.³

9
10 Data from the two remaining conditions are shown in Figure 2. Scores in the Specific-
11 Warning + Alternative condition were significantly lower than those in the No-Retraction
12 condition, $F(1,65) = 56.81$, $MSE = 3.58$, $p < .0001$.

13
14 Of greatest interest is whether the remaining small extent of reliance on
15 misinformation in the Specific-Warning + Alternative condition was significantly greater than
16 zero. A one-sample t -test confirmed this for the sample overall, $t(41) = 3.78$, $p < .001$, and
17 also with the restricted sample of subjects who recalled the retraction (i.e., with a
18 manipulation-check score > 0 ; $N = 37$, Mean = .84, $SE = .26$; $t(36) = 3.17$, $p < .01$).⁴

19
20 Altogether, almost half of the subjects in the Specific-Warning + Alternative condition
21 made at least one reference to misinformation (17 out of 42). The debriefing questionnaire
22 administered to the extension sample revealed that virtually all subjects correctly considered
23 the experiment to be about event memory and memory updating. Two subjects demonstrated
24 clear source confusion, in that they classified misinformation as correct information and vice
25 versa. Some subjects correctly identified the misinformation and the correction, but indicated
26 that they did not believe the correction. Interestingly, though, the number of reference to
27 misinformation seemed completely independent of subjects' belief in the correction, with
28 those subjects expressing doubts about the validity of the correction ("I didn't believe it" and
29 "Not sure" responses) making as many references to misinformation ($n = 7$; Mean = 1.29,
30 $SE = .53$) as subjects indicating that they did believe the correction ($n = 10$; Mean = 1.30,
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3 $SE = .72$). None of the subjects indicated that they tried to “outsmart” the experimenter by
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5 purposefully responding in accordance to misinformation because they thought the correction
6
7 was a “trick”.
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10 *Comparing inference scores to Experiment 1.* Finally, we compared the Specific-
11
12 Warning + Alternative condition of Experiment 2 with the two corresponding individual
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14 conditions of Experiment 1 (Specific-Warning and Alternative, respectively). A planned
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16 contrast confirmed that the Specific-Warning + Alternative condition (of Experiment 2)
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18 differed statistically from the two conditions of Experiment 1, $F(1,89) = 6.52$, $MSE = 4.50$;
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20 $p = .01$.
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24 *Discussion*

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27 Experiment 2 showed that the combined effect of the specific warning and the
28
29 provision of an alternative account reduced reliance on misinformation more than the
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31 constituent strategies alone. Notwithstanding, the CIE still persisted despite the combined
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33 power of both variables.
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36 General Discussion

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39 This study investigated if prior warnings can reduce the continued influence of
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41 misinformation. In replication of previous research we found that a retraction alone failed to
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43 substantially reduce reliance on misinformation, even though participants acknowledged and
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45 remembered the retraction itself (H. Johnson & Seifert, 1994). Also in line with previous
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47 research, providing an alternative for the retracted misinformation strongly reduced but did
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49 not fully eliminate reliance on misinformation (cf. Ecker et al., 2010; H. Johnson & Seifert,
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51 1994; Rapp & Kendeou, 2007).
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56 The novel finding of our study was that a specific warning—that is, informing
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58 participants about the CIE up front in some detail—reduced reliance on misinformation after
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60 its retraction to about the same extent as the provision of an alternative account. We also

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3 found that by combining a specific warning with an alternative account, reliance on
4
5 misinformation could be further reduced. Nonetheless, even when both of these manipulations
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7 were combined, misinformation lingered and a significant (though small) number of
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9 inferences were still present, with more than a third of subjects making at least one reference
10
11 to corrected misinformation. A general warning also reduced the CIE, although this reduction
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13 was only significant in participants who demonstrably remembered the retraction. This result
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15 suggests that inducing alertness might be another effective way of reducing reliance on
16
17 misinformation but that its effectiveness may be limited.
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22 In contrast to the unsuccessful efforts to enhance the effectiveness of retractions
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24 (discussed in the Introduction), the present study demonstrated that a large reduction in the
25
26 CIE can be achieved by a simple but specific up-front warning. The question then arises—
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28 how and why does a warning work?
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31 *Mechanisms that Mediate the Effects of Warnings*

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34 To our knowledge, this is the first study to examine the effects of warnings in the
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36 continued-influence paradigm. By contrast, as reviewed at the outset, warnings have been
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38 used extensively in the Deese-Roediger-McDermott paradigm and also in the Loftus post-
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40 event suggestion paradigm. Various processes have been put forward by which warnings exert
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42 their protective effect, and these could prove informative for the present study.⁵
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46 First, warnings could reduce potential demand characteristics (Eakin et al., 2003;
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48 McCloskey & Zaragoza, 1985). Subjects might have some naïve theory about what is
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50 expected of them—for instance, that they should not believe unsubstantiated corrections—and
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52 this could lead to continued reliance on misinformation. Warnings could be effective because
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54 they clarify that subjects are expected not to rely on outdated information. However, demand
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56 characteristics seem an unlikely source of the CIE. In a study by Rantzen and Markham
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58 (1992), misinformation was introduced either by a fellow subject or by the experimenter. The
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3 authors reasoned that social demand effects should be higher in the latter case, but found no
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5 effect of this manipulation. Moreover, our debriefing questionnaire in Experiment 2 yielded
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7 no evidence that subjects referred to misinformation in order to either please or outsmart the
8
9 experimenter.
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12 Second, the salience of misinformation at the time of retrieval could lead to output
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14 inhibition; that is, retrieval of misinformation might make retrieval of alternatives less likely
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16 (Eakin et al., 2003). In the case of retracted misinformation with no alternative provided, one
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18 could argue that salient misinformation could inhibit the spontaneous generation of alternative
19
20 accounts at retrieval, leading to higher reliance on misinformation. Warnings may serve to
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22 counteract this retrieval inhibition, for instance by enhancing alternative-generation efforts.
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24 Again, this appears rather unlikely: H. Johnson and Seifert (1999) found that (a) subjects who
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26 had received a retraction were able to generate as many alternative accounts as control
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28 subjects who were never presented with misinformation, and (b) this generation of
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30 alternatives did not reduce the CIE in the first place.
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36 Third, warnings could induce a shift in response criterion. If references to
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38 misinformation are based on weaker evidence than references to correct information, subjects
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40 could become more accurate by becoming more conservative. However, in the false-memory
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42 and post-event suggestion literature warnings tend to affect only false alarms and not correct
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44 responses (Echterhoff et al., 2005; Gallo et al., 2001; Jou & Foreman, 2007; Peters et al.,
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46 2008; Watson et al., 2004). Also, if these false memory phenomena were based on criterion
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48 setting at retrieval, it would be unclear why post-encoding warnings are generally found to be
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50 ineffective (Anastasi et al., 2000; Gallo et al., 2001; Greene et al., 1982; Neuschatz et al.,
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52 2001; cf. also Peters et al., 2008). Consistent with those precedents, we likewise found no
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54 group differences in overall response output or fact recall: Warned subjects produced as many
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3 ideas and recalled as many event details as unwarned subjects. This is inconsistent with a
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5 criterion-shift explanation.
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8 Fourth, warnings could lead to selective rehearsal of correct information (Greene et al.,
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10 1982). In the present case, after a retraction, subjects could focus on rehearsing the retraction.
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12 This seems rather unlikely, however, given Greene et al.'s findings from the Loftus paradigm
13
14 that (a) increasing the time between a warning (given immediately after the encoding of an
15
16 event) and misleading suggestions did not reduce the subsequent effects of misinformation on
17
18 a recognition test, and that (b) warned subjects did not remember valid information any better
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20 than unwarned subjects even if there was no misinformation. Also, Eakin et al. (2003) found
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22 immediate post-misinformation warnings that explicitly identified the piece of misinformation
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24 (hence allowing selective rehearsal of the corresponding correct piece of information) as
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26 effective as warnings that did not specify the misleading information.
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31 Fifth, warnings could lead to more efficient encoding (e.g., Gallo et al., 2001;
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33 Neuschatz, Benoit, & Payne, 2003). Consistent with this notion, warnings given before
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35 encoding are typically more effective than post-encoding warnings. In the false memory
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37 paradigm, it is likely that this encoding effect occurs selectively for the unrepresented
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39 “misinformation” because only the false alarm rate is lowered with no effect on retrieval of
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41 actual study items (Gallo et al., 2001; Jou & Foreman, 2007; Peters et al., 2008; Watson et al.,
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43 2004). This pattern of findings is explained by an activation-monitoring account (cf.
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45 Neuschatz et al., 2003; Peters et al., 2008): Study list items activate the common associate,
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47 but a monitoring process can be used at encoding to “figure out” the non-presented associate
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49 and then consciously “tag” it as unstudied. Fittingly, Neuschatz et al. (2003) reported that
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51 warnings were mainly effective in preventing false memories for unstudied words if the
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53 concept was easy to identify given the list of studied associates. In contrast, a generally
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55 enhanced encoding (e.g., more strategic encoding of item-specific information; McCabe &
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3 Smith, 2002) should affect both hit and false alarm rates. To our knowledge, there is only one
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5 study reporting such an effect (Westerberg & Marsolek, 2006) but this study used many lists,
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7 presumably making the proposed tagging operation less efficient. In the continued influence
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9 paradigm, misinformation is arguably also active when it is corrected, and at that point in time
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11 subjects can presumably tag it as misinformation, which will facilitate its rejection at retrieval.
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15 Sixth, Eakin et al. (2003) have suggested that warnings may lead to active suppression
16
17 of the misinformation's activation. As mentioned before, representations of valid and invalid
18
19 information may co-exist in memory and compete for activation (Ayers & Reder, 1998; H.
20
21 Johnson & Seifert, 1998). It follows that inhibition of misinformation should lead to
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23 prevalence of correct information. Eakin et al. supported their claims by demonstrating that
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25 warnings were less successful if misinformation was repeated; they argued that suppression
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27 could no longer be achieved if misinformation is strengthened via repetition. In the context of
28
29 the CIE, suppression of misinformation could make it less salient and available and could
30
31 hence indirectly facilitate retrieval monitoring. In support, findings that the effectiveness of
32
33 post-misinformation warnings correlates positively with working memory capacity and
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35 negatively with age (McCabe & Smith, 2002; Watson et al., 2004) add weight to the
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37 assumption that active suppression processes (which should covary with working memory
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39 abilities) are invoked by warnings. However, these working memory correlations are also in
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41 line with the following, final alternative, namely that warnings foster processing-intensive
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43 monitoring processes at retrieval.
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50 This final alternative, which we find most convincing, assumes that warnings affect
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52 retrieval processes directly (McCabe & Smith, 2002; Watson et al., 2004). According to the
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54 source-monitoring account (M. Johnson et al., 1993; cf. Chambers & Zaragoza, 2001;
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56 Echterhoff et al., 2005; McCabe & Smith, 2002; Zaragoza & Lane, 1994), references to
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58 incorrect information stem from source confusion. For example, people could falsely
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3 remember that information given in a post-event suggestion was actually contained in the
4 original event. An alternative but complementary account was proposed by Ayers and Reder
5 (1998), who suggested that in memory, chunks of information (including both 'correct' and
6 'incorrect' concepts) compete for activation; people are spontaneously aware only of activated
7 concepts, whereas the links between concepts and their context (e.g., their source) need to be
8 retrieved strategically. A warning might therefore lead subjects to rely less on automatic
9 processing at retrieval, thus guarding against the unfiltered use of strongly activated but
10 misleading information (Schwarz et al., 2007; Whittlesea & Williams, 2001), and instead lead
11 subjects to engage in more strategic retrieval processing with a focus on source monitoring.
12 Consistent with this notion, in a post-event suggestion study, Echterhoff et al. (2005) reported
13 that warned subjects rated veridical event memories to be more vivid than subjects that
14 received no warning, and also took longer to reject incorrect information. Overall, the
15 behavior of warned subjects mimicked that of subjects receiving explicit source monitoring
16 instructions. In further support of the source monitoring notion, misinformation effects are
17 usually reduced when source memory tests (rather than recall or recognition tasks) are used,
18 even without warnings (Lindsay & M. Johnson, 1989; Zaragoza & Lane, 1994; but see Belli
19 et al., 1994, and for a review, Chambers & Zaragoza, 2001).

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After a retraction of misinformation, rather than a misattribution of information to an incorrect source (e.g., witnessed vs. suggested), it is the outdated association of a piece of information with a causal role within a mental event model that produces references to misinformation. Hence it is this association to a role (rather than a specific source) that subjects need to monitor at retrieval.

In summary, a warning most likely reduces the CIE by allowing subjects to tag misinformation as outdated at encoding, and putting subjects in an altered retrieval mode (cf. Ayers & Reder, 1998). The altered retrieval mode boosts monitoring processes at retrieval

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3 (which in turn profit from tagging at study and active suppression of misinformation's
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5 activation; cf. Jou & Foreman, 2007; Peters et al., 2008).
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8 Another interesting question is: Why was our specific warning more successful than
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10 our general warning? By giving concrete examples, the specific warning made the temporal
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12 dynamics of the situation more explicit (misinformation...retraction...reliance on
13
14 misinformation). Hence one could argue that the specific warning may have been more
15
16 successful during both encoding and retrieval. However, the fact that the general warning
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18 worked as well as the specific warning in subjects who acknowledged the retraction suggests
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20 that it is the encoding stage in particular where the specific warning was more efficient. This
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22 would imply that the tagging of misinformation would profit most from specific instructions,
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24 whereas more non-specifically induced alertness will mainly lead to more strategic
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26 monitoring at retrieval. Although this remains speculative, a connection between induced
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28 alertness and source monitoring is consistent with previous research using similar suspicion-
29
30 inducing warnings (cf. Echterhoff et al., 2005, who used suspicion-inducing post-encoding
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32 warnings and found that the performance of warned subjects in a post-event misinformation
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34 paradigm mimicked that of subjects explicitly instructed to do source monitoring).
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40 41 *Continued Influence of Misinformation—Unavoidable?* 42

43 Wilson and Brekke (1994) argued that mental contamination—the unintentional
44
45 impact of inappropriate information—mainly occurs because people are unaware of it, and
46
47 that warnings can help inasmuch as they make people aware of a bias or contamination. This
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49 is obviously only the first step in a cascade because people must also be able to counteract
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51 processing of the misinformation. This ability cannot be taken for granted: For example,
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53 Schul and Manzury (1990) showed that mock jurors who successfully avoided reliance on
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55 inadmissible information when asked to judge a defendant's guilt could not do so when asked
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57 to judge the defendant's aggressiveness or give their evaluative impression of the defendant.
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3 Similarly, Payne, Lambert, and Jacoby (2002) reported that a specific warning failed to
4 reduce the ‘weapons false alarm’ effect (a higher rate of false perception of a weapon when
5 primed with a Black vs. White face), which is based on automatic stereotype activation, even
6 though the warning did affect participants’ self-reported goals.
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12 We, too, found it impossible to eliminate the CIE in its entirety. Even when combining
13 what are now known to be the two best strategies, misinformation lingered to a significant
14 degree—so why is this effect so difficult to overcome? One possibility is that, as in false
15 memory studies, the impact of automatic retrieval processes (implicit activation, fluency,
16 familiarity) may be very difficult to neutralize. ‘Inoculation by knowledge’ (Gallo et al., 1997)
17 will thus be successful, but only to the degree that these powerful cognitive mechanisms can
18 be overcome strategically, as discussed in the previous section.
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29 *Real-World Implications*

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31 Our study has clear implications for real-world issues. Up until now, the provision of
32 an alternative account was the only known way to reliably reduce continued reliance on
33 misinformation. The utility of this strategy is limited because when information must be
34 corrected, an alternative account may not always be available. Warnings, by contrast, can
35 provide a very powerful strategy to reduce people’s reliance on misinformation.
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43 The script we used in our studies resembled a newspaper article. Notably, although
44 retractions and corrections also appear in newspapers from one day to the next, the media
45 abound with cases in which news items are qualified and corrected even within a single report,
46 as when the title of an article does not exactly match its content. For example, the title of a
47 front-page New York Times article in December 2008, “*Dollar shift: Chinese pockets filled*
48 *as Americans’ emptied*” (Landler, 2008) suggested that China had directly profited from the
49 U.S. economy’s crisis. This was corrected in a subsequently published “postscript” (and the
50 title of the online article changed) to better match the topic of the article; namely, that U.S.
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3 consumption had largely relied on money borrowed from other countries, including China.⁶
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5 Our study shows that specific information about the existence of the CIE, which could be
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7 included in media education, can help inoculate people against excessive reliance on
8
9 misinformation.
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12 In judicial settings, warnings seem to be a promising and economic way to reduce the
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14 rate at which jurors continue to rely on outdated or inadmissible information. Specific up-
15
16 front warnings could be given to jurors routinely to build the expectation that they may face
17
18 information in the media or the actual trial that they will later have to disregard. Importantly,
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20 as our fact recall data have again shown, such warnings will specifically decrease reliance on
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22 misinformation without impacting on memory for veridical information.
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26 *Conclusion*

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28 Warnings have been found to be effective in reducing unwanted cognitive effects
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30 including false memories (Gallo et al., 1997; McDermott & Roediger, 1998), the impact of
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32 post-event suggestions (Echterhoff et al., 2005; Greene et al., 1982) and misleading questions
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34 (Warren, Hulse-Trotter, & Tubbs, 1991), acquiescent responding in children (Saywitz &
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36 Moan-Hardie, 1994), imagination inflation effects on recognition confidence (Landau & von
37
38 Glahn, 2004), and even cross-race effects in face recognition (Hugenberg, Miller, & Claypool,
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40 2007). The present study found that informing people about an unwanted but prevalent
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42 cognitive effect—the continued influence effect of misinformation—can likewise help them
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44 reduce or even avoid this processing error.
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Appendix A – Account of Minibus Accident

Messages Used in Experiment 1 (Critical Messages Italicized)

Message 1. A report has come in to the police headquarters on Sunday about a serious accident involving a minibus. The report came from a driver who was driving passed the scene of the accident.

Message 2. The minibus had crashed into a steep embankment near Spring Street and had rolled on its side. This resulted in injuries to some of the passengers on board.

Message 3. A rescue crew was dispatched to the scene immediately upon report of the accident. They arrived at the scene within ten minutes.

Message 4. [Misinformation] Police have stated that the passengers on the bus were a group of elderly people who were on their way back to their nursing home after a bingo game. The weather was reportedly fine and visibility was good. No other vehicles seem to have been involved.

Message 5. The rescue crew started evacuation of the minibus and wanted to reach the injured passengers first but found it difficult to tell them apart from the uninjured.

Message 6. The rescue crew also reported difficulty in getting both injured and uninjured passengers out of the minibus even though the exits were clear.

Message 7. Authorities are desperately trying to reach the family members of the victims involved in the accident and managed to trace the minibus license number to a rental company.

Message 8. The rescue crew reported that the rescue efforts were slow and would take more time and advised bystanders not to crowd around the area. Due to building-up traffic, the local radio station advised drivers to avoid the Spring Street area.

Message 9. Local television shows live footage of uninjured passengers having problems getting up the embankment.

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3 Message 10. Rescue crew can be heard remarking that the uninjured passengers were
4 unable to help in the rescue efforts.
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8 *Message 11 [No-Retraction control condition]. A second statement from the police*
9 *has confirmed that all passengers were successfully rescued.*
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13 *Message 11 [Retraction-Only, General-Warning, and Specific-Warning conditions]. A*
14 *second statement from the police stated that the passengers on the minibus were not elderly*
15 *people.*
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20 *Message 11 [Alternative condition]. A second statement from the police has stated*
21 *that the passengers on the minibus were not elderly people but college hockey players*
22 *returning from a victory party after the state hockey final.*
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27 Message 12. Some passengers with injuries were taken to the nearby St Joseph's
28 hospital for treatment.
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32 Message 13. At the hospital, 3 passengers with more serious injuries had to be warded
33 for observation while the others were discharged after treatment.
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37 Message 14. Some of the uninjured passengers interviewed at the scene of the accident
38 remarked how helpless and dependent they were on the rescue crew during the accident and
39 expressed their gratitude to them.
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43 *Alternative Message Used in Alternative-Throughout Condition of Experiment 2*
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46 Message 4. Police have stated that the passengers on the bus were college hockey
47 players returning from a victory party after the state hockey final. The weather was reportedly
48 fine and visibility was good. No other vehicles seem to have been involved.
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Appendix B – Warnings

General Warning

In their desire to sensationalize, the media sometimes does not check facts before publishing information that turns out to be inaccurate. It is therefore important to read the following story and answer the questions at the end carefully.

Specific Warning

Research has shown that people continue to rely on outdated information even when it has been retracted or corrected. An example of this is the fact that some people today still believe that Iraq had weapons of mass destruction even though none have been found.

Another example is court proceedings, where jurors continue to use information that has been deemed inadmissible. Please read the following story carefully and answer the questions at the end without relying on any outdated information.

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Appendix C – Questionnaire

Inference Questions

1. Why do you think it was hard telling apart who the injured and uninjured passengers were?
2. Why do you think it was difficult getting both the injured and uninjured passengers out of the minibus?
3. Which family members of passengers are authorities most likely to contact to inform them about the accident?
4. Why do you think it was difficult getting the uninjured passengers up the embankment?
5. Why do you think the uninjured passengers were unable to help with the rescue efforts?
6. Why do you think some passengers were injured while others were not?
7. How could such an incident be avoided in the future?
8. Why did the uninjured passengers feel helpless and dependent on the rescue crew?
9. Why do you think the minibus crashed?

Fact Questions

1. On which day did the accident occur?
2. Who reported the accident to the police?
3. Where did the minibus land after the accident?
4. Where did the accident occur?
5. How was the weather like on that day?
6. Which hospital were the injured taken to?
7. How many injured passengers were warded in the hospital?
8. Where were the uninjured passengers interviewed?

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3 9. Who was on the minibus during the accident?
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6 *Manipulation-Check Questions*
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8 1. What was the purpose of the second message from the police?
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10 2. Were you aware of any corrections in the messages that you read?
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12 *Debriefing Questions (Used Only in Extension of Experiment 2)*
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14 1. What do you think was the purpose of this experiment?
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16 2. What was the false information given in the story?
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18 3. What was the corrected information given in the story?
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20 4. Did you believe the corrected version of the event?
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Author Note

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Footnotes

¹ We use the label “misinformation” for a piece of information that is corrected after its initial dissemination, without meaning to imply that it was initially introduced in order to intentionally mislead the receiver.

² The last recall question that directly queried who was on the bus was not included in the fact recall score as there was no unambiguously correct response to this question in most conditions (this question did contribute to the inference score though). Thus, the maximum recall score was 8.

³ This is not always the case (e.g., Ecker et al., in press) so the establishment of the true baseline was considered an important control factor.

⁴ This pattern of results was also obtained in the less powerful analysis on the initial smaller sample with $n = 25$ in the Specific-Warning + Alternative condition and $n = 22$ in the corresponding restricted subsample (subjects who remembered the retraction).

⁵ Some of the explanations put forward, however, do not apply to the current paradigm. For example, it has been suggested that warnings lead to more shallow encoding of misinformation (Echterhoff et al., 2005). Subjects in a continued-influence paradigm cannot strategically encode misinformation less deeply because at the time of encoding the misinformation status is not evident.

⁶ We thank Craig Silverman (www.craigsilverman.ca) for pointing out this example.

Tables

Table 1

Contrasts Calculated on Inference Scores in Experiment 1

Contrast	Lambda coefficients for conditions					Full sample		Restricted sample	
	No-R	R-Only	GW	SW	Alt	<i>F</i> (1,120)	<i>p</i>	<i>F</i> (1,88)	<i>p</i>
C1	1	1	0	-1	-1	24.91	< .0001	29.51	< .0001
C2	1	-1	0	0	0	2.29	.13	1.48	.23
C3	0	1	-1	0	0	1.02	.32	5.23	.025
C4	0	2	0	-1	-1	10.25	.002	13.95	< .001
C5	0	0	2	-1	-1	4.15	.04	.97	.33

Note. R, Retraction; GW, General Warning; SW, Specific Warning; Alt, Alternative. Restricted sample consists of participants that did recall the retraction.

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Table 2

Lexical Output in Experiment 1

Condition	Propositions		LIUs	
	Mean	<i>SE</i>	Mean	<i>SE</i>
Retraction-Only	24.48	1.49	58.68	5.50
General-Warning	27.80	1.35	64.88	4.69
Specific-Warning	22.80	1.52	57.20	5.13

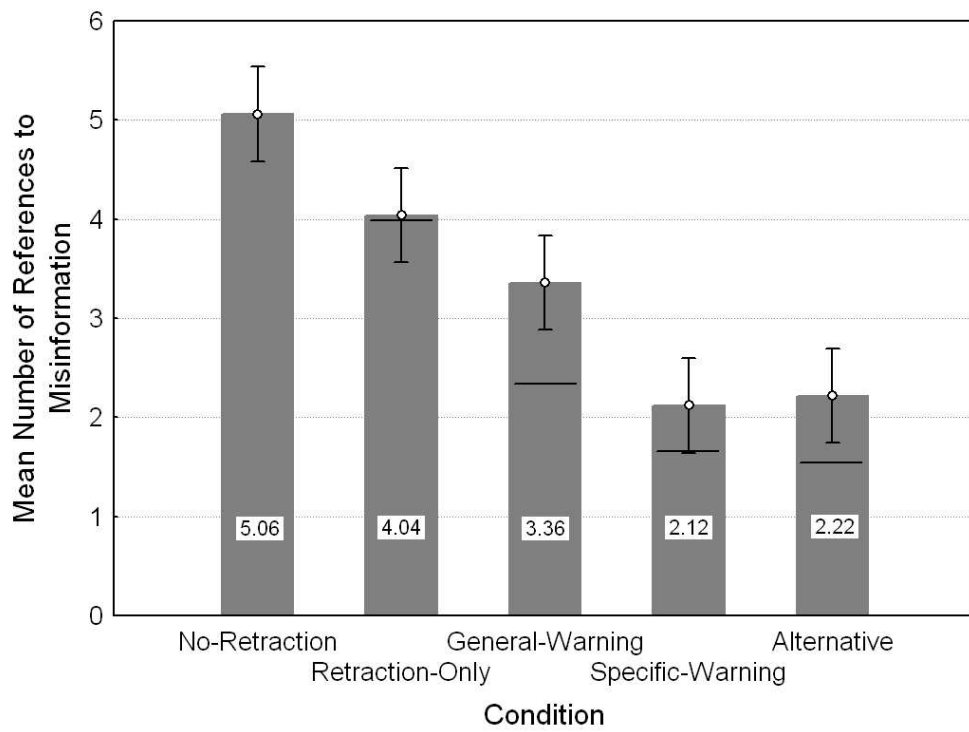
Note. $N = 25$ in each condition; LIUs, Lexical Information Units.

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Figure Captions

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8 *Figure 1.* Mean number of references to misinformation across experimental conditions in
9 Experiment 1. Each data point is based on 25 participants. Maximum score is 20. Error bars
10 show standard errors of the mean. Horizontal lines inside the bars of the four conditions
11 featuring a retraction indicate mean reference-to-misinformation scores based on subsamples
12 of subjects remembering the retraction; these data points are based on 19, 17, 20, and 18
13 participants (left-right).
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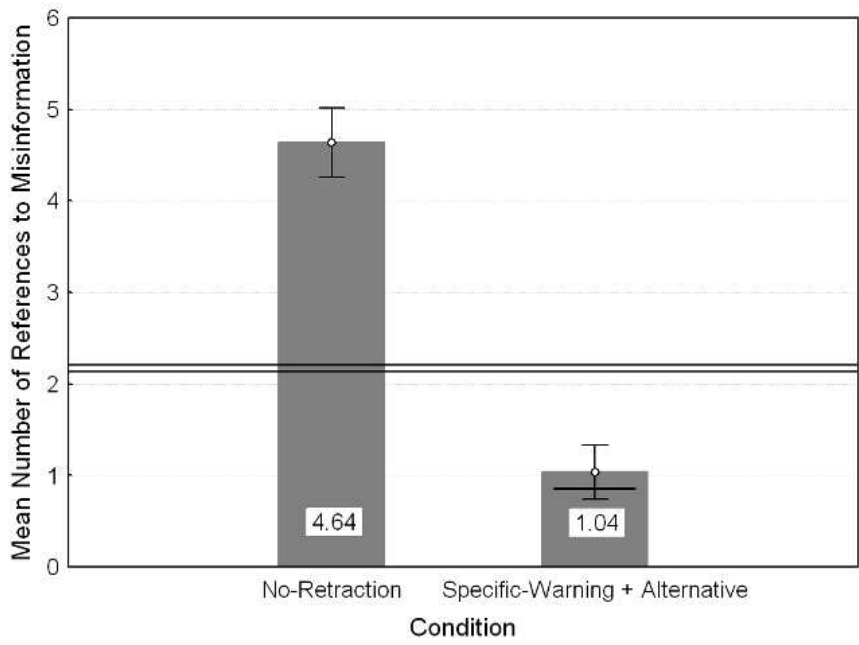
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24 *Figure 2.* Mean number of references to misinformation across experimental conditions in
25 Experiment 2 (note that the mean of the Alternative-Throughout control condition was zero).
26 The data points of the No-Retraction and Specific-Warning + Alternative conditions are based
27 on 25 and 42 participants, respectively. Error bars show standard errors of the mean. The
28 horizontal line inside the Specific-Warning + Alternative bar indicates the mean reference-to-
29 misinformation score based on the subsample of subjects remembering the retraction; this
30 data point is based on 37 participants. To allow across-experiment comparison, the two
31 horizontal lines spanning the entire graph refer to the means of the Specific-Warning (lower
32 line) and Alternative (upper line) conditions of Experiment 1.
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