THE CONTINUED INFLUENCE OF MISINFORMATION FOLLOWING A DELAYED CORRECTION

A dissertation submitted
To Kent State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy

by

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August 2016

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ACKNOWLEDGEMENTS

My unending gratitude to all those who have supported and believed in me.
Friends and family: Eugene, Elaine, Edward, Brian, Michael, and so many others.
My adviser: Maria, I cannot thank you enough. You have consistently pushed and supported me in a way that only the best mentors can. I would not be where I am without your dedication, advice, and aid. Even when I did not believe in myself, you always did. Thank you.
Emily: I lack words but will soon shape something suitable; perhaps a haiku.
I. Introduction

In a race to report the latest, breaking news, news sources sometimes release reports before all the facts are known. For this reason, early reports can contain errors based on incomplete or mistaken information (hereafter referred to as misinformation). In an effort to undo these errors, news organizations typically release follow-up reports correcting the mistaken information. How effective are corrections at reversing the effects of misinformation in news stories? In recent years, this question has begun to receive considerable empirical attention by cognitive psychologists (see Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012 for a recent review). Considerable evidence indicates that corrections are only partially effective. That is, although corrections effectively reduce belief in the misinformation, they rarely eliminate the influence of the misinformation entirely. Rather, the retracted misinformation continues to influence readers’ judgments and inferences about the events described in the news story, even when the readers can remember and report the correction (a phenomenon known as the continued influence effect, Ecker, Lewandowsky, & Apai, 2011; Ecker, Lewandowsky, Fenton, & Martin, 2013; Ecker, Lewandowsky, Swire, & Chang, 2011; Ecker, Lewandowsky, & Tang, 2010; Guillory & Geraci, 2010, 2013; Johnson & Seifert, 1994, 1999; Rich & Zaragoza, 2016; Seifert, 2002; van Oostendorp & Bonebakker, 1999; Wilkes & Leatherbarrow, 1988; Wilkes & Reynolds, 1999; see Lewandowsky et al., 2012 for a recent review). These findings clearly indicate that corrections do not remove the misinformation from memory; rather, the original mistaken information and the correction co-exist in memory.
These studies of correcting misinformation in news stories have all employed variants of a laboratory paradigm initially developed by Wilkes and Leatherbarrow (1988; see also Johnson & Seifert, 1994), hereafter referred to as the continued influence paradigm. In the typical continued influence study, participants read a series of messages from an unfolding news report in which a target piece of misinformation is corrected toward the end of the story. For example, in a study by Johnson and Seifert (1994, Experiment 3b) participants read a news report describing the theft of valuable jewelry from a couple’s home while the couple was away on vacation. The news story initially reports that the police suspect the couple’s son may have taken the box from the house. Later on, the same news story corrects this initial misinformation and readers learn that the son is no longer a suspect because he was out of town when the theft occurred. After reading the news report, participants answer a questionnaire consisting of open-ended prompts, factual questions, inference questions, and rating scales. If the correction is effective, when later queried about the news story, participants should not report the misinformation or provide responses thematically consistent with the misinformation. To use the previous example, if the correction that the son was out of town is effective, then readers should neither endorse the son as the likely thief, nor provide responses thematically consistent with the son having committed the theft (e.g., responses consistent with an inside job). To the contrary, research shows that they sometimes do.

1.1. Factors that Contribute to the Effectiveness of Corrections

Research has provided evidence that several factors may contribute to the effectiveness of corrections (see Lewandowsky et al., 2012, for a recent discussion). For instance, for a correction to be effective, readers must revise, or update, their initial, mistaken understanding of what transpired. In order for such knowledge revision to occur, however, readers must first detect the
inconsistency between the correction and their understanding of the news story (e.g., recognize
that if the son was out of town then he could not have stolen the jewelry) and accept the
correction as true (Kendeou & O’Brien, 2014; Rich, Van Loon, Dunlosky, & Zaragoza, in
revision; Wilson & Brekke, 1994). In other words, participants must first be aware that the
mistaken information and its correction cannot both be true, before they will amend their
mistaken understanding. Consistent with the importance of detecting the inconsistency between
the misinformation and the correction, studies have found that misinformation implied by a news
story (e.g., through innuendo) is more difficult to correct than misinformation explicitly provided
Presumably, readers can more easily detect the inconsistency between the correction and the
misinformation in the explicit case, thus increasing the likelihood that they will use the
correction to revise their understanding of the news story.

Of course, merely detecting the inconsistency is not sufficient for knowledge revision.
Readers will not be motivated to revise (or update) their initial understanding of the news story
unless they also accept the correction as truth. Consistent with this idea, studies have found that
corrections are more effective when a high-credibility source provides the correction relative to a
low-credibility source (Guillory & Geraci, 2013). In addition, readers resist corrections more
often when the corrections challenge readers’ firmly held beliefs and world views (e.g., political
ideology, prejudices; Ecker et al., 2013; Nyhan & Reifler, 2010; Nyhan, Reifler, & Ubel, 2012),
than when the corrections do not, presumably because they reject corrections that challenge their
core beliefs. Hence, manipulations that encourage readers to detect the inconsistency between the
correction and the misinformation, as well as those that encourage participants to accept the
correction as truth, both serve to increase the effectiveness of corrections (see Lewandowsky et al., 2012 for a review).

Even if readers successfully revise their understanding of the event by incorporating the correction, the misinformation remains linked to the event as well, so some readers continue to rely on the misinformation. Counteracting the reasons readers continue to rely on the misinformation can improve the effectiveness of the correction. For example, readers may continue to use the misinformation in part because the correction leaves a causal gap in readers’ understanding of the story. In studies of continued influence, as in real-world news reports, the mistaken information in the news story typically provides a plausible, causal explanation for a consequential, central outcome (e.g., a crime, accident, natural disaster, or other negative outcome). In many cases, however, corrections simply inform readers that the presumed cause of the outcome is mistaken and does not inform readers about the true cause of the outcome.

Consider the earlier story describing a police investigation into a jewelry theft (the negative outcome). The initial misinformation that the owner’s son is a suspect explains the theft, but the correction that the son was out of town does not explain the theft; it does not identify the actual thief. As a consequence, such corrections leave a causal gap in the news story, insofar as the reader no longer has an explanation for the negative outcome. Given that readers are highly motivated to achieve a causally coherent understanding of events (Trabasso, 2005; Trabasso, Secco, & van den Broek, 1984), they may later fall back on the misinformation because it fills the causal gap. Consistent with this hypothesis, several studies have shown that corrections paired with an alternative to the misinformation that can fill the causal gap (e.g., police have identified another suspect) can greatly reduce, and sometimes eliminate, belief in the retracted misinformation (Ecker et al., 2010; Johnson & Seifert, 1994; Rich & Zaragoza, 2016; van
Oostendorp & Bonebakker, 1999, Wilkes & Reynolds, 1999). Hence, providing an explanation for the outcome in the news story along with the correction can greatly increase the effectiveness of that correction (though such alternative explanations may not always be available in the real world).

Readers may also continue using the misinformation despite the correction if the readers fail to monitor the validity of the misinformation (such as searching memory for potentially inconsistent information). When questioned about the news story, the misinformation likely comes to mind relatively automatically, because it provides a plausible account of the outcome. Monitoring this information, in contrast, requires readers to engage in more effortful and strategic processing, which often requires readers to be motivated to engage in such processing. Such monitoring processes are a common component of frameworks and models of memory (Ayers & Reder, 1998; Gallo, 2010; Johnson, Hashtroudi, & Lindsay, 1993; Moscovitch & Melo, 1997; Schacter, Norman, & Koutstaal, 1998; to name a few), and refer to those strategic processes involved in assessing the source, relevance, and validity of retrieved information.

Consistent with the role of monitoring, warning readers before they read the news story improves the effectiveness of corrections. In particular, Ecker and colleagues (2010) provided participants with either (1) a general warning that the media sometimes does not check facts before publishing a news story or (2) a specific warning that people tend to rely on outdated information that has been corrected or retracted, and gave them specific examples (e.g., jurors continue to use information that has been deemed inadmissible). Both warnings reduced reliance on the misinformation, though the specific warning was in some cases more effective. Such warnings likely increase the effectiveness of the correction both because the warnings enhance readers’ awareness that misinformation has been corrected, and because the warnings encourage readers
to engage in more effortful strategic monitoring processes when later questioned about the news story.

1.2. Current Study

At present, research conducted with the continued influence paradigm has resulted in a wealth of knowledge about the correction of mistaken information in news stories. Studies have consistently found that corrections reduce reliance on misinformation, but do not eliminate it. This phenomenon is highly reliable and has been replicated across both a wide variety of news stories (e.g., a warehouse fire, a missing person, a terrorist attack, a bus accident, a house theft) and a range of different types of misinformation (Ecker et al., 2010; Ecker, Lewandowsky, & Apai, 2011; Johnson & Seifert, 1994; Wilkes & Leatherbarrow, 1988). In addition, research with the continued influence paradigm has led to important advances in our understanding of the mechanisms that underlie people’s tendency to rely on discredited misinformation (see Lewandowsky et al., 2012, for a review).

However, one limitation of the extant literature is that the paradigm does not mimic the real-world scenarios it seeks to investigate in some potentially important ways. Specifically, all of the published research on this topic involves studies where the entire experiment takes place in a single experimental session. That is, in all of the studies published to date, readers receive the correction in the very same news story where they encounter the misinformation. In contrast, the correction of mistaken information provided by the media often occurs days, weeks, and even months later, when new information discovered during additional investigation contradicts or invalidates the initial (now mistaken) information. Hence, whether such delayed corrections are more or less effective than the immediate corrections used in previous studies remains unknown.
In addition, though highly relevant to assessing the effectiveness of correction, the existing literature has not addressed the durability of the revised beliefs that results from corrections. To date, all studies involving corrections of mistaken news stories have assessed the effectiveness of the correction almost immediately after readers received the correction, during the same experimental session. As the foregoing review shows, when assessed immediately, corrections can greatly reduce reliance on the misinformation. However, a truly effective correction should also lead to *enduring* revisions in the readers’ beliefs. To assess whether corrections result in durable revised beliefs, it is necessary to assess potential belief in retracted misinformation over the passage of time.

To illustrate some of the differences between the existing literature and real-world situations, consider a major historical event from our lifetime: the Iraq war. In March of 2003, the United States (U.S) declared war with Iraq based on the belief that that Iraq possessed active WMDs. Before the war, in February 2003, a Gallup poll of U.S. citizens revealed that 93% of responders believed that Iraq likely had active WMDs (Newport, 2003). But, by the end of the war in May 2003, U.S. forces had found no evidence of active WMDs. The complete absence of any evidence that Iraq had active WMDs should have eliminated the belief that Iraq had WMDs. However, data collected shortly after the war revealed that 34% of Americans thought WMDs had actually been found in Iraq (Lewandowsky, Stritzke, Oberauer, & Morales, 2005; data collected between May and December 2003). Though the correction greatly reduced the belief that Iraq had WMDs (59% decrease following the correction), over a third of people continued to believe that WMDs *had* been found when they *had not* been found. Note that this correction occurred at least 2 to 3 months (but likely much longer) after people had already formed the
belief that Iraq possessed WMDs. Perhaps the correction was not entirely effective because it came long after the misinformation.

Furthermore, although the evidence that Iraq did not possess active WMDs greatly reduced people’s beliefs, the belief that Iraq had active WMDs prior to the war has increased over time. Though immediately after the war 34% of Americans believed WMDs had been found in Iraq, a poll from January 2015 reported that 42% of U.S. citizens believed WMDs had been found in Iraq (Cassino, 2015). Though a seemingly small change, this belief that Iraq had WMDs changes people’s narratives and perceptions about the war. The return of this belief over time may have critical implications for how U.S. citizens view Iraq, the current conflicts in the middle-east, and the prospect of future conflict over WMDs. Hence, though ideally corrections should lead to durable revised beliefs, it appears that, at least in some situations, readers’ may start to fall back on their original mistaken beliefs over time.

In summary, two issues that have not been addressed in the existing literature to date are (1) whether delaying a correction reduces the effectiveness of the correction and (2) whether the revised beliefs that result from corrections are durable. The goal of the present study was to address this gap in the literature.

1.3. Delaying the Correction

The first goal of the current study was to investigate whether delaying the presentation of a correction reduces the effectiveness of this correction. Why might delaying a correction reduce its effectiveness? Consider the impact that delaying the correction has on integration of the misinformation with the rest of the news story. While reading the news story, readers construct a representation of the text which they update while reading (Graesser, Singer, & Trabasso, 1994; McNamara & Magliano, 2009; Trabasso, 2005; van den Broek, Rapp, & Kendeou, 2005; Zwaan
& Radvansky, 1998). When readers encode the original news story without ever encountering a correction, they should build a causally coherent representation around the mistaken notion that the son committed the theft (the misinformation). If the correction is given immediately after the misinformation, the readers likely have little additional time to elaborate further on the son’s role in the theft. If, instead, the correction is given a few days after the misinformation, readers have the opportunity to further augment this representation with their own self-generated reflections and elaborations regarding the son’s role in the theft. In doing so, the reader may draw connections with other details in the story consistent with this causal interpretation (e.g., inferring that the son may be committing the other thefts in the neighborhood when working his odd jobs). Because these readers have additional opportunity to elaborate on their representations, when they encounter a correction at a later time they may have more difficulty revising their initial beliefs about the cause of the theft than readers who encounter an immediate correction (cf., Anderson, Lepper, & Ross, 1980).

Second, the proximity of the correction to the misinformation may influence the likelihood that people detect the inconsistency between correction and the misinformation. If so, delayed corrections may be less effective than immediate corrections. As outlined previously, awareness of the inconsistency between the original misinformation and the correction is a necessary precondition for updating one’s belief (Kendeou & O’Brien, 2014; Rapp & Kendeou, 2007, 2009; Rapp, Hinze, Kohlhepp, & Ryskin, 2014; Wilson & Brekke, 1994). A recent study by Mullet and Marsh (2016) using different materials found evidence consistent with the prediction that delaying a correction could lead to greater difficulty detecting inconsistencies. They found that delayed feedback for incorrect responses on a memory test led to poorer accurate performance on a later test than immediate feedback. When participants received an
explicit cue to detect the inconsistency between the feedback and the incorrect response, however, this effect of delaying the feedback was eliminated, suggesting that delaying the feedback reduced effectiveness because the delay hindered detection of the inconsistency. To summarize, a delayed correction may be less effective than an immediate correction both because (1) the additional time allows readers opportunity to elaborate on the misinformation, resulting in greater integration of the misinformation with their representations of the news story and (2) separating the correction from the misinformation may make the inconsistency between the misinformation and the correction more difficult to detect.

To evaluate whether delaying the correction reduces the effectiveness of the correction, in the present study, I modified the continued influence paradigm (the critical phases of this modified paradigm are outlined in Table 1). In this modified version, participants read an initial Table 1

*Critical Phases across Days of Experiment 1 for Each Timing Group.*

<table>
<thead>
<tr>
<th>Correction Timing</th>
<th>Day 1</th>
<th>Day 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed-</td>
<td>Misinformation</td>
<td>Correction</td>
</tr>
<tr>
<td>Correction</td>
<td>Pre-Correction Test</td>
<td>Same-Day Post-Correction Test</td>
</tr>
<tr>
<td>Immediate-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No-Correction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Delayed-Correction</th>
<th>Misinformation Pre-Correction Test</th>
<th>Correction Same-Day Post-Correction Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate-Correction</td>
<td>Misinformation Pre-Correction Test</td>
<td>Correction Same-Day Post-Correction Test</td>
</tr>
<tr>
<td>No-Correction</td>
<td>Misinformation Initial Test Follow-Up Report</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Same-Day Post-Follow-Up Test</td>
<td>2-Day Post-Follow-Up Test</td>
</tr>
</tbody>
</table>
news report which contained a critical piece of misinformation but did not receive a follow-up news report containing a correction until 2 days later (Day 3 of the experiment; see the delayed-correction group in Table 1). To evaluate the effectiveness of the correction, I measured participants’ belief in the misinformation both before and after the correction. Specifically, participants completed a questionnaire designed to assess belief in the misinformation after reading the initial news story containing the misinformation (pre-correction test) and then completed a similar questionnaire shortly after receiving the correction (same-day post-correction test). This method provides a way to directly assess how much each participant’s belief in the misinformation changes after receiving the correction. For comparison, I included an additional group of participants who received the misinformation and its correction on the same day (see the immediate-correction group in Table 1). To assess the effects of delaying the correction, change in belief due to the correction (i.e., pre-correction test vs. same-day post-correction test) in the delayed-correction group was compared to this change in belief in the immediate-correction group.

1.4. Durability of the Revised Beliefs

The second goal of the current study was to investigate the durability of the revised beliefs that result from a correction of mistaken information in news reports. Given that a correction rarely eliminates belief in retracted misinformation even when the correction is most salient (i.e., immediately after the correction), these revised beliefs are unlikely to become stronger over time. However, whether these revised beliefs are durable or transient is difficult to predict. On the one hand, some recent research on revising misconceptions has shown that corrected mistaken knowledge stays mostly consistent over a one-month delay (Kendeou, Walsh, Smith, & O’Brien, 2014, Experiment 4), suggesting that revised beliefs may be durable. On the
other hand, other research has found that corrected general knowledge errors return after a one-week delay (Butler, Fazio, & Marsh, 2011) suggesting revised beliefs may be transient.

To evaluate whether these revised beliefs are durable, I measured participants’ belief in the misinformation both immediately after the correction and 2 days after the correction. Specifically, participants in the immediate-correction group returned on Day 3 (2 days after completing the same-day post-correction test on Day 1) and completed the post-correction test a second time (see Table 1). To assess the durability of the revised beliefs, I compared participants’ responses on the same-day post-correction test to their responses on the 2-day post-correction test. Experiment 1 also included a separate group that received the same misinformation, but never received the correction (see the no-correction group in Table 1). The inclusion of this group permits an assessment of whether belief in uncorrected misinformation fluctuates over time. If belief in retracted misinformation returns over time, the immediate-correction group should evidence a greater increase in misinformation reliance over time (as assessed by performance on post-correction tests immediately vs. 2 days later) than the no-correction group (see Table 1).

To summarize, the current study was designed to answer two questions:

1) Does delaying a correction reduce the effectiveness of that correction?

2) Are the revised beliefs that result from a correction durable?
II. Experiment 1

2.1. Introduction

To evaluate these questions, participants read the same news story described earlier that details a police investigation into a jewelry theft from a private home while the owners were on vacation. Two measures were used to assess the belief in the corrected misinformation: (1) an inference question measure that assessed whether participants continued to reason and draw inferences on the basis of the corrected misinformation and (2) a belief rating measure that directly assessed participants’ belief in the corrected misinformation (i.e., that the son was involved in the jewelry theft). As both prior studies and the current findings show that these measures are related (Rich & Zaragoza, 2016), I analyzed the measures together using multivariate analyses of variance (MANOVAs).

An additional novel change in the current study was use of a within-participants design to assess how much corrections reduce belief in the misinformation. Prior studies have exclusively used between-subjects designs where some participants receive a news story containing a correction and others receive a news story containing no correction. In these studies, the effectiveness of the correction is assessed by comparing belief in the misinformation for these two sets of participants. In the current study, all participants read an initial news story that contained the misinformation, completed questions about their belief in the misinformation, then read the correction, and then completed the questions about their belief in the misinformation a
second time. The effectiveness of the correction was assessed by comparing belief in the misinformation before and after participants read the correction.

2.2. Methods

Participants. A total of 168 undergraduates at a large Midwestern university (ages 18-34, \( M = 19.78 \); 106 women) completed the experiment and were awarded credit for a course requirement. All participants were fluent in English. An additional 7 participants completed the study but were excluded for participating in a previous studies using the same materials.

Design. Participants were randomly assigned to one of 3 groups: immediate-correction, delayed-correction, and no-correction. Both the effectiveness of the correction and the durability of revised beliefs were assessed within participants. The effectiveness of the correction was assessed by comparing belief in the misinformation on the pre-correction test and the same-day post-correction test. The durability of the revised beliefs was assessed by comparing belief in the retracted misinformation on the immediate and 2-day post-correction tests. Based on an a priori
power analysis (G*Power 3; Faul, Erdfelder, Lang, & Buchner, 2007) using an expected medium effect size ($f = .25, \alpha = .05, 1-\beta = .80$) for the tests of simple main effects ($df = 1, k = 2, \# \text{ of measurements} = 2$) I aimed to collect a total of 168 participants. Specifically, I aimed to collect 64 participants in the critical immediate-correction and delayed correction groups, and an additional 40 participants in the no correction group. I continued collecting through the end of the semester, ending with a total of 62 immediate-correction participants, 65 delayed-correction participants, and 41 no-correction participants.

**Materials and procedure.** The experiment occurred on two different days (Day 1 and Day 3) with procedure on these days varying by group (see Table 1). Participants completed both days of the study in the same laboratory and completed all phases of the study on computers.

**Phase 1: Initial news report.** All participants read an initial news report describing a police investigation into a jewelry theft from a private home while the owners were on vacation (adapted from Johnson & Seifert, 1994, Experiment 3b; Rich & Zaragoza, 2016). The initial news report described details relating to the initial investigation of the theft without providing a definitive explanation for the theft (see Appendix A). This news report consisted of 9 messages, each 1 to 4 sentences long. Most critically, all participants read a message that presented the son as a suspect (the misinformation). This misinformation message, presented as message 5, stated that the police suspect the son and provided three pieces of evidence implicating him:

*Police suspect that the Harter’s son, Evan, may have taken the box from the house. The Harter’s report that they had asked their son to check in on the house periodically during their absence. The son also did other odd jobs for many of the neighbors to pay off his recent gambling debts.*
Consistent with prior studies, participants read each message at their own pace, one message at-a-time with no opportunity to return to previous messages, but were only given a maximum of 3 minutes and 30 seconds to read the entire story.¹

**Phase 2: Pre-Correction Story Questionnaire.** After reading the initial news story participants completed a modified version of a written questionnaire used by Johnson and Seifert (1994, Experiment 3b). This questionnaire (the pre-correction test; see Table 1) assessed participants’ memory for the news story and beliefs about who perpetrated the crime (see Appendix C). It consisted of a series of 19 questions including 1 question about the cause of the crime, 7 factual questions about events and details reported in the news story, 9 inference questions, and one direct question about belief in the son’s involvement with an accompanying question asking for a justification for this belief. The inference questions and direct question about belief in the son’s involvement served as the two primary measures of belief in the misinformation.

*Inference questions.* The inference questions asked about information not explicitly mentioned in the news story, such as “What steps should the police take next,” “How might the thief have gotten into the house,” and “What might be responsible for the other thefts in the neighborhood recently?” These questions have traditionally been used in prior studies to assess belief in the misinformation.

*Direct measure of belief in son’s involvement.* This question was designed to directly assess about belief in the retracted misinformation. Participants responded to the question, “How much do you believe that Evan Harter was involved in the theft of the jewelry?” using a scale from 1

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¹ Reading times were recorded for each message in both the initial news report and follow-up news report. Across all 3 experiments reading times (deviation scores from average milliseconds per word) for both critical messages (the misinformation message and the correction message) were not associated with any of the dependent variables, did not interact with the effect of the correction, and did not change the results of the reported analyses.
(Highly Unlikely) to 6 (Highly Likely). This was followed by a question asking participants why they gave this response, which was used to assess what reasons participants give for their beliefs.

Participants completed each question at their own pace, one-at-a-time, without the option to return to previous questions. Based on prior studies involving pencil and paper administration of the questionnaire (involving over 1000 participants), participants in the current study were given 10 minutes to complete this questionnaire, which in these prior studies was ample time for participants to complete the questionnaire. Unexpectedly, in the current study, 22 participants failed to complete the direct measure of belief in the misinformation within the time limit, and had to be excluded from analyses.

**Phase 3: Filler task.** After completing the questionnaire, participants were given 10 minutes to complete two individual differences measures: the short form of the Need for Cognition scale (Cacioppo, Petty, & Kao, 1984) and the Need for Closure Scale (Kruglanski, Webster, & Klem, 1994; Webster & Kruglanski, 1994). These measures have been used in numerous previous studies as a filler task. In prior studies I have not find any relationship between these measures and belief in the retracted misinformation, so I did not analyze these measures in the present study.

After completing the filler task, participants in the immediate-correction and no-correction groups immediately proceeded to the follow-up news story. Participants in the delayed-correction group instead completed Day 1 of the study at this time and returned 2 days later (on Day 3) to complete the rest of the experiment.

**Phase 4: Follow-Up News Story.** Participants next read a follow-up news report that reviewed some of the details of the initial news report while providing new information (see Appendix B). This news report consisted of 8 messages, each 1 to 4 sentences long. As with the
initial news report, participants read each message at their own pace, one message at-a-time with no opportunity to return to previous messages, but were only given a maximum of 3 minutes and 30 seconds to read the entire story. Most critically, participants in the immediate-correction and delayed-correction groups read a message that corrected the misinformation by stating the son was out of town (the correction message):

*Police have now confirmed that Evan had been called away on business and had not been in town to look after the house during the Harters’ vacation.*

Participants in the no-correction group read the same follow-up news report with this correction message omitted.

**Phase 5: Filler task.** After participants read the follow-up news story, participants completed a second filler task. For this task, participants completed 3 blocks of a 2-back task (based on Kane, Conway, Miura, & Colflesh, 2007). In each block, participants were shown a sequence of 10 letters, one-letter-at-a-time, with some repeating letters. Each letter was displayed for 500ms followed by a blank screen for 2000ms. Participants were instructed to respond during the entire 2500ms whether the letter shown currently matched the letter shown two previous in the sequence. For instance, in the sequence of letters R-R-K-M-K, the participant should respond that the second K matched the letter shown two previous in the sequence, but for all other letters should respond that there was no match. If a match was present, participants were to respond by pressing the “P” key on the keyboard. If no match was present, participants were to respond by pressing the “Q” key. After extensive instruction on how to complete a 2-back task, including a demonstration and a practice block of 10 items, participants completed 3 total blocks. Each block contained 10 matches and 20 foils and took 1 minute and 15 seconds to complete. In total, the
task took between 5 and 10 minutes depending on how much time the participant spent reviewing the instructive material.  

**Phase 6: Post-Correction Story Questionnaire.** After the second filler task, participants completed a second story questionnaire (the same-day post-correction test, see Table 1). By comparing belief in the misinformation on the pre-correction story questionnaire to belief in the (now retracted) misinformation on the second questionnaire, I assessed how much the correction reduced belief in the retracted misinformation. This second questionnaire was identical to the first questionnaire except participants answered 7 additional questions about details reported in the follow-up news story (see Appendix C questions 2, 5, and 22-26). Specifically, participants answered two additional factual questions, 2 manipulation check questions, and 3 additional questions.

*Manipulation check questions.* Two questions assessed participants’ memory for the correction ("What did the story report about where Evan Harter was during the Harter’s vacation?" and “What facts about the case did the police change their minds about, based on information they discovered later?”). This measure was used to exclude participants who failed to remember the correction from the analyses.

*Additional questions.* Three additional questions were included at the end of the questionnaire. The first asked participants about their belief that the son was out of town and was included as a potential measure of interest in future analyses but was not central to the current study. Finally, the prompt about whether the story was familiar in any way was used to exclude

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2 Across Experiments 1 and 2, performance on the 2-back task (hits minus false alarms) was not associated with any of the dependent variables, the effect of the correction, and did not change the reported results. Therefore, the results of this task will not be discussed further.
participants from previous studies using these materials (as mentioned in the Participants section).

Participants completed each question at their own pace, one-at-a-time, without the option to return to previous questions. Based on prior studies, participants in the current study were given 15 minutes to complete this questionnaire. All participants completed this questionnaire within the time limit.

To assess the durability of belief in the retracted misinformation, participants in the no-correction and immediate-correction groups returned 2 days later (on Day 3) to complete the post-correction story questionnaire a second time (the 2-day post-correction test; see Table 1). I did not assess durability of belief in the retracted misinformation in the delayed-correction group.

**Scoring of dependent measures.** Responses on the story questionnaires were coded based on the purpose of the measure. The two key dependent measures of belief in the retracted misinformation were the inference questions and the direct question about belief in the son’s involvement. All other measures are secondary or used to exclude participants from analysis.

**Inference questions.** The inference question measure provides an indirect means of assessing continued reliance on the misinformation, by assessing the extent to which, when probed, participants generate inferences thematically consistent with the misinformation. Consistent with prior studies (Johnson & Seifert, 1994; Rich & Zaragoza, 2016), the inference questions were coded for responses consistent with an “inside job” theme, on the assumption that a belief that the theft was an inside job (rather than an outside job) is consistent with belief in the son’s guilt. Responses consistent with an “inside job” included direct references to the son’s involvement, having access to the Harter’s home, an intimate knowledge of the Harter’s home,
etc. One trained rater, blind to group, coded each response with a score of “1” if an “inside job” inference was provided and a score of “0” if not. A second rater coded 10% of the responses to verify reliability with disagreements resolved by discussion. Overall, raters agreed on 94% of items. For each participant, the total number of inside job inferences (0-9) were entered into the analyses.

**Direct question about belief in the son’s involvement.** No scoring was needed for the direct question about belief in the retracted misinformation. For each participant, the raw rating was used in analyses.

**Cause question.** The cause question was used to assess whether participants would freely and openly state that the son stole the jewelry. Consistent with previous studies, however, participants rarely openly stated that the son stole the jewelry in all three experiments reported here (2% of the time across all questionnaires), and so this measure will not be discussed further.

**Factual questions.** The factual questions were used to assess memory for the story and coded based on the accuracy of the response.

**Manipulation check questions.** The two manipulation check questions were used to assess memory for the correction. Both questions were coded for responses indicating that the son was out of town or on business. This measure was used to exclude participants who failed to remember the correction from the analyses. Only participants who failed to remember the correction on both questions were excluded.

### 2.3 Results and Discussion

Analysis of the factual questions verified that, as expected, there were no group differences in memory for the general facts of the news story on either the pre-correction, $F(2, 130) = 1.66, p = .19$, same-day post-correction, $F(2, 130) = 1.12, p = .33$, or 2-day post-
correction, \( F(1, 86) = 0.38, p = .54 \), questionnaires. Because the goal of the current study was to investigate the effectiveness of corrections in revising mistaken beliefs, I excluded from the main analyses all participants who failed to remember the correction at the time of the belief assessment. Inspection of performance on the manipulation check questions revealed that, when assessed immediately after the correction, the percentage of participants who failed to report the correction was low, and did not vary by group, \( M's = 3.9\% \) and \( 9.2\% \) for the immediate and delayed correction groups respectively, \( \chi^2(1) = 1.88, p = .17, \phi = .12 \). Interestingly, no participants who remembered the correction on the same-day post-correction test failed to recall the correction when re-tested on the 2-day post-correction test (likely due to the benefits of retrieval practice provided by the same-day post-correction test, see Roediger & Butler, 2011). Hence, all participants who were excluded from the analyses failed to report the correction on the same-day post-correction test. After removing these participants, 138 remained: no-correction \((n = 36)\), immediate-correction \((n = 54)\), and delayed-correction \((n = 48)\).

Analyses confirmed that ratings on the direct measure and performance on the inference question measure (Figure 1) were positively correlated on the pre-correction test, \( r = 0.41, p < .001 \), the same-day post-correction test, \( r = 0.70, p < .001 \), and the 2-day post-correction test, \( r = 0.65, p < .001 \). Hence, I analyzed both measures together using MANOVAs. For completeness, all univariate analyses for all 3 experiments are reported in Appendix D.

Finally, as expected, a one-way between-subjects MANOVA on pre-correction beliefs in the no-correction, immediate-correction, and delayed-correction groups was not reliable, \( V = 0.04, F(4, 270) = 1.27, p = .28, \eta_p^2 = .04 \). This finding verifies that prior to the correction, participants in all three groups evidenced equivalent belief in the misinformation.

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3 The pattern of results for Experiments 1, 2 and 3 were the same even when including participants who did not remember the correction.
**Effect of delaying the correction.** The correction effect was assessed by comparing belief in the misinformation before the correction (pre-correction questionnaire) to belief after the correction (same-day post-correction test). To evaluate whether a delayed correction was less effective, the correction effect for participants in the delayed-correction group was compared to the correction effect for participants in the immediate-correction group. In sum, both measures of belief in the mistaken information were analyzed with a 2 (Correction Effect: pre-correction vs. same-day post-correction) x 2 (Correction Timing: immediate-correction vs. delayed-correction) mixed-design MANOVA. As shown in Figure 1, the correction was highly effective, $V = 0.75, F(2, 99) = 148.87, p < .001, \eta^2_p = .75$, as belief in the misinformation post-correction was significantly lower than pre-correction. Contrary to our predictions, however, a delayed correction was neither more nor less effective than an immediate correction, as indicated by the absence of a significant interaction, $V = 0.04, F(2, 99) = 2.12, p = .13, \eta^2_p = .04$. Instead, as revealed by follow-up comparisons, the correction was highly effective in both the immediate-correction group, $V = 0.67, F(2, 99) = 98.75, p < .001, \eta^2_p = .67$, and the delayed-correction group, $V = 0.53, F(2, 99) = 54.83, p < .001, \eta^2_p = .53$. Overall, the correction, whether provided immediately or after a delay, greatly reduced belief in retracted misinformation. No other main effects were reliable.

**Durability/transience of revised beliefs.** The durability of the revised beliefs was assessed by comparing belief in the retracted misinformation immediately after the correction (same-day post-correction test) to belief 2 days later (2-day post-correction test). To determine whether participants believe the misinformation more over time regardless of whether they receive a correction, the above comparison was made for both groups of participants that completed multiple post-correction assessments of their belief in the retracted misinformation (i.e., the no-correction group and the immediate-correction group). To evaluate the durability of
Figure 1. Mean number of “inside job” inferences (above) and mean rating of son’s involvement (below) as a function of group (No-Correction, Immediate-Correction and Delayed-Correction) and the timing of the assessment of belief in misinformation (pre-correction, same-day post-correction and 2-day post-correction) for Experiment 1. Bars represent 95% confidence intervals.
beliefs in retracted misinformation, both measures were analyzed with a 2 (Test Timing: same-day post-correction vs. 2-day post-correction) x 2 (Correction: no-correction vs. immediate-correction) mixed-design MANOVA. As shown in Figure 1, the main effects of Correction, $V = 0.44, F(2, 87) = 34.53, p < .001, \eta_p^2 = .44$, and Test Timing, $V = 0.30, F(2, 87) = 18.18, p < .001, \eta_p^2 = .30$, were qualified by a significant interaction, $V = 0.08, F(2, 87) = 3.59, p = .03, \eta_p^2 = .08$.

Specifically, although belief in the misinformation increased over the 2 days following a correction, this belief increased more for participants in the immediate-correction group, $V = 0.31, F(2, 87) = 19.36, p < .001, \eta_p^2 = .31$, than participants in the no-correction group, $V = 0.11, F(2, 87) = 5.24, p = .01, \eta_p^2 = .11$. These results provide evidence that the revised beliefs that result from correction are transient.

Consistent with the within-participants comparison reported above (pre-correction versus same-day post-correction) the between-subjects comparison of the immediate-correction and no-correction groups provides converging evidence that the correction was initially highly effective. Specifically, immediately after receiving the correction participants in the immediate-correction group had lower ratings of belief in the misinformation than participants in the no-correction group, $V = 0.43, F(2, 87) = 33.25, p < .001, \eta_p^2 = .43$. Although the magnitude of this correction effect diminished over the 2 day delay, the effects of the correction remained on the 2-day post-correction test. Participants who had received the correction exhibited lower ratings of belief in the retracted misinformation than participants who had not received a correction, $V = 0.39, F(2, 87) = 27.41, p < .001, \eta_p^2 = .39$. In summary, the results showed that the revised beliefs that resulted from a correction were somewhat transient; in two days, belief in the retracted misinformation started to return, but had not returned to pre-correction levels.
Note, again, that this analysis only includes participants who could remember and report the correction when directly asked. Hence, the increased belief in the retracted misinformation over time cannot be attributed to participants forgetting the correction over time.
III. Experiment 2

3.1. Introduction

In Experiment 1, adding a 2 day interval between the misinformation and the correction did not increase or decrease the effectiveness of the correction (relative to providing the correction almost immediately after exposure to the misinformation). However, in Experiment 1 the comparison between the effectiveness of the immediate and delayed corrections was based on participants’ belief in the retracted misinformation immediately after the correction. On these immediate assessments the correction may be highly salient to participants, thus maximizing the effectiveness of correction. Experiment 2 sought to assess whether a delayed correction might be less effective than an immediate correction in situations where the correction is less salient. Accordingly, in Experiment 2, I again manipulated the timing of the correction relative to the misinformation (immediately after the misinformation or two days after the misinformation), but assessed participants’ beliefs in the retracted misinformation after a two-day delay, when the correction should be less salient.

The second goal of Experiment 2 was to assess whether belief in retracted misinformation would continue to increase over intervals of time longer than the 2-day interval investigated in Experiment 1. To evaluate this possibility, participants in the immediate-correction group completed the story questionnaire both 2 days after the correction and again 4 days after the correction. Given the limited fluctuation of beliefs in the no-correction group in Experiment 1, this group was not included in Experiment 2.
3.2. Methods

**Participants.** A total of 140 undergraduates (ages 18-71, \( M = 20.49 \); 108 women) completed the experiment and were awarded credit for a course requirement. All participants were fluent in English. An additional 12 participants completed the study but were excluded for participating in a previous studies using the same materials.

**Design.** Participants were randomly assigned to either the immediate-correction group or the delayed-correction group. Both the effectiveness of the correction and the durability of revised beliefs were assessed within participants (see Table 2). The effectiveness of the correction was assessed by comparing belief in the misinformation on the pre-correction test and the 2-day post-correction test. The durability of the revised beliefs was assessed by comparing belief in the retracted misinformation on the 2-day and 4-day post-correction tests. Based on an a priori power analysis (G*Power 3; Faul, Erdfelder, Lang, & Buchner, 2007) using an expected medium effect size (\( f = .25, \alpha = .05, 1-\beta = .80 \)) for the tests of simple main effects (\( df = 1, k = 2, \) # of measurements = 2) I aimed to collect 64 participants in each group for a total of 128 participants. I continued collecting through the end of the semester, ending with a total of 68 immediate-correction participants and 72 delayed-correction participants.

**Materials and procedure.** The materials and procedure were identical to Experiment 1 with the exception that in both the immediate-correction and delayed-correction groups the initial assessment of belief in the retracted misinformation did not occur until 2 days after the correction (see Table 2). Given that the initial assessment did not occur until 2 days post-correction, the repeated assessment of belief in the retracted misinformation did not occur until 2 days after the initial assessment (the 4-day post correction test). This shifting of the initial post-
correction assessment by two days resulted in participants having to come back to the lab an additional day, on Day 5 (see Table 2).

Table 2

*Critical Phases across Days of Experiment 2 for Each Timing Group.*

<table>
<thead>
<tr>
<th>Correction Timing</th>
<th>Day 1</th>
<th>Day 3</th>
<th>Day 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Delayed-Correction</strong></td>
<td>Misinformation</td>
<td>Correction</td>
<td>2-Day Post-Correction Test</td>
</tr>
<tr>
<td><strong>Pre-Correction Test</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Immediate-Correction</strong></td>
<td>Misinformation</td>
<td>Correction</td>
<td>2-Day Post-Correction Test</td>
</tr>
<tr>
<td><strong>Pre-Correction Test</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Correction</strong></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Scoring of dependent measures.**

*Inference questions.* As in Experiment 1, one trained rater, blind to group, coded each response with a score of “1” if an “inside job” inference is provided and a score of “0” if not. A second rater coded 10% of the responses to verify reliability with disagreements resolved by discussion. Raters agreed on 90% of items.

**3.3. Results and Discussion**

As in Experiment 1, analysis of the factual questions verified that, as expected, there were no group differences in memory for the general facts of the news story on either the pre-correction, \( t(132) = 0.36, p = .72 \) or 2-day post-correction, \( t(132) = 0.01, p > .99 \), questionnaires. I excluded all participants who failed to report the correction from the analyses. Inspection of performance on the manipulation check questions revealed that the percentage of participants who failed to report the correction was low, and did not vary by group, \( M's = 7.9\% \) and \( 5.6\% \) for the immediate and delayed correction groups respectively, \( \chi^2(1) = 0.28, p = .60, \varphi = .05 \). As in Experiment 1, no participants who remembered the correction on the 2-day post-correction test failed to recall the correction when re-tested on the 4-day post-correction test. Hence, all
participants who were excluded from the analyses failed to report the correction on the 2-day post-correction test. An additional 6 participants failed to complete at least 1 of the story questionnaires within the time limit, and were excluded from analyses. After removing these participants, 126 remained: immediate-correction (n = 59) and delayed-correction (n = 67).

Analyses confirmed that ratings on the direct measure and performance on the inference question measure (Figure 2) were positively correlated at all three time points: the pre-correction test, $r = 0.32, p < .001$, the 2-day post-correction test, $r = 0.55, p < .001$, and the 4-day post-correction test, $r = 0.71, p < .001$. Hence, I analyzed both measures together using MANOVAs. To foreshadow, the results replicated those of Experiment 1.

**Effect of delaying a correction.** To analyze the effect of delaying the correction, both measures were analyzed with a 2 (Correction Effect: pre-correction vs. 2-day post-correction) x 2 (Correction Timing: immediate-correction vs. delayed-correction) mixed-design MANOVA. As expected, the correction was highly effective, $V = 0.53, F(2, 123) = 69.10, p < .001, \eta^2_p = .53$, as belief in the misinformation post-correction was significantly lower than pre-correction (see Figure 2). However, the timing of the correction once again had no effect, as indicated by the absence of a significant interaction, $V = 0.02, F(2, 123) = 1.41, p = .25, \eta^2_p = .02$. Instead, the correction was highly effective in both the immediate-correction, $V = 0.31, F(2, 131) = 27.91, p < .001, \eta^2_p = .31$, and delayed-correction groups, $V = 0.42, F(2, 131) = 43.59, p < .001, \eta^2_p = .42$. No other main effects were reliable.

**Transience of revised beliefs.** A one-way, within-subjects MANOVA comparing belief in retracted misinformation on the 2-day and 4-day post-correction tests for participants in the immediate-correction group was significant, $V = 0.25, F(2, 57) = 9.37, p < .001, \eta^2_p = .25$,.
Figure 2. Mean number of “inside job” inferences (above) and mean rating of son’s involvement (below) as a function of (Immediate-Correction and Delayed-Correction) and the timing of the assessment (pre-correction, 2-day post-correction and 4-day post-correction) for Experiment 2. Bars represent 95% confidence intervals.
replicating the finding that belief in retracted misinformation increases over time. However, as in Experiment 1, belief in retracted misinformation did not return to pre-correction levels: belief in the retracted misinformation 4 days after the correction was lower than prior to the correction, $V = 0.40, F(2, 57) = 18.80, p < .001, \eta^2_p = .40$. In summary, the results of Experiment 1 replicated the finding that belief in retracted misinformation returned over time, but there were also enduring benefits of the correction.

In summary, the results of Experiment 2 replicate and extend those of Experiment 1 to situations where the assessment of belief in retracted misinformation occurs days after the correction. In spite of this delayed assessment, the results were identical. First, there was no evidence that delaying the correction had any influence on the effectiveness of the correction. Second, revised beliefs that result from correction were not durable; belief in the retracted misinformation increased over a period of just two days. Experiment 3 assessed whether some corrections might effect more durable change than others.
IV. Experiment 3

4.1. Introduction

Experiments 1 and 2 found that belief in retracted misinformation increased in the two days immediately following a correction (Experiment 1), and continued to increase further after an additional two days (Experiment 2). These findings raise a critical question: why are these revised beliefs transient? One possibility stems from the problem that corrections often leave a causal gap in the news story. In many news stories, the critical pieces of misinformation often serve to explain the cause of the event that is the subject of the news report. For example, in the current study, the news story describes a house theft, and the misinformation concerns the prime suspect in the theft, the owner’s son. When a correction retracts these critical pieces of misinformation, the story contains a causal gap. In other words, if the son did not steal the jewelry, who did? Over time, readers may fall back on the retracted misinformation because, although they can remember the correction, the story contains a causal gap that the misinformation fills.

Prior studies have documented that one of the most effective corrections is one where the correction is accompanied by an alternative explanation for the outcome (Ecker et al., 2010; Johnson & Seifert, 1994; Rich & Zaragoza, 2016; van Oostendorp & Bonebakker, 1999). For example, combining the correction that the son was out of town with an alternative explanation that police have identified another suspect in the case (e.g., an ex-convict whose girlfriend cleans the victims’ home) greatly increases the effectiveness of the correction. Hence, if the revised beliefs are transient because people fall back on the misinformation to fill the causal gap in the story, providing an alternative explanation should reduce the transience of the revised beliefs.
The goal of Experiment 3 was to evaluate whether providing an alternative explanation reduces the transience of the revised beliefs that result from a correction. To address this goal, participants read the initial news story with the misinformation, completed the pre-correction measures of their belief in the retracted misinformation, and then received an immediate correction. Half of participants received just the correction (i.e., the son was out of town) and half received both the correction and alternative explanation (i.e., another suspect has been identified by police). To assess the durability of the revised beliefs, following the correction, participants completed measures of their belief in the retracted misinformation immediately after the correction, 2 days after the correction, and 4 days after the correction. If readers fall back on the misinformation because they have no other explanation, then the revised beliefs should be more transient for participants who receive the correction alone than participants who receive both the correction and an alternative explanation.

4.2. Methods

Participants. A total of 103 undergraduates (ages 18-26, \( M = 20.09 \); 77 women) completed the experiment and were awarded credit for a course requirement. All participants were fluent in English. An additional 9 participants completed the study but were excluded for participating in a previous studies using the same materials.

Design. Participants were randomly assigned to either the correction-only group or the correction-alternative group. The effectiveness of the correction was assessed within participants by assessing belief in the misinformation pre-correction and immediately post-correction. The durability of revised beliefs was also assessed within participants by comparing belief in the retracted misinformation immediately, 2 days and 4 days after the correction. Based on an a priori power analysis (G*Power 3; Faul, Erdfelder, Lang, & Buchner, 2007) using a medium to
large effect size \((f = .30, \alpha = .05, 1-\beta = .80)\) for the interaction \((df = 1, k = 2, \# \text{ of measurements} = 2)\) I aimed to collect 45 participants in each group for a total of 90 participants. The slightly larger effect size in this study was based on splitting the difference between a medium effect size \((f = .25)\) and the large effect sizes for the increase in belief in the retracted misinformation over time \((\text{Experiment 1 } f = .67; \text{ Experiment 2 } f = .58)\). I continued collecting through the end of the semester, ending with a total of 56 correction-only participants and 47 correction-alternative participants.

**Materials and procedure.** Experiment 3 occurred on three different days (Day 1, Day 3, and Day 5), and the procedure was identical for both groups except for a slight modification to the follow-up news report. For participants in the correction-alternative group, the follow-up news story was modified, such that the following alternative explanation for the outcome (based on Johnson & Seifert, 1994) came immediately after the correction that the son was out of town:

> They have identified a suspect, ex-convict Dan Fowler. Fowler recently sold expensive jewelry to a pawn shop, and his girlfriend, Sarah, works for a cleaning service that regularly cleans the Harter’s home (see Appendix B).

For participants in the correction-only group the follow-up news story was identical to Experiments 1 and 2.

In addition, the procedure was a modified version of the procedure use in the immediate-correction group. Specifically, after reading the follow-up news report containing the correction, participants completed a same-day post-correction story questionnaire, returned two days later (on Day 3) to complete a 2-day post-correction story questionnaire, and returned again two days

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4 As with the other messages, reading times were recorded for the alternative explanation message. Reading times on the alternative explanation message were not associated with any of the dependent variables, did not interact with the effect of the correction, and did not change the results of the reported analyses.
later (on Day 5) to complete a 4-day post-correction story questionnaire. This allows for a replication of both the increase in belief in the retracted misinformation over 2 days (Experiment 1) and 4 days (Experiment 2) in a single experiment.

In addition, participants did not complete the 2-back task as a filler task on Day 1 following the follow-up news story. I have unpublished data indicating the presence of these brief filler tasks have limited impact on belief in the retracted misinformation, so I removed the 2-back task to reduce the amount of time the experiment required on Day 1.

**Inference question scoring.** As participants in the correction-alternative group had two plausible explanations consistent with the “inside job” theme, these inferences needed to be coded separately. Hence, in Experiment 3 inferences questions were coded for direct references to the son, direct references to the ex-convict and his girlfriend, and ambiguous “inside job” inferences. Responses with direct references to both suspects were counted for both, and responses containing both a direct reference and an ambiguous inference were counted as a direct reference. A second rater coded 10% of the responses to verify reliability with disagreements resolved by discussion. Overall, raters agreed on 94% of items. For each participant, the total number of direct references to the son (0-10), direct references to the ex-convict and his girlfriend (0-10), and ambiguous “inside job” inferences (0-10) were calculated separately.

An initial analysis revealed that these ambiguous “inside job” inferences correlated positively with the direct measure of belief in the son’s involvement and with direct references on the 2-day and 4-day post-correction tests ($r_s$ between .24 and .34, $ps < .10$; same-day post-correction $r_s > 0.14$, $ps > .19$). Furthermore, these ambiguous inferences negatively correlated with direct references to the ex-convict on the 2-day and 4-day post-correction tests (both $r_s > - .35$, $ps < .02$; same-day post-correction $r = -0.19$, $p = .20$). Hence, consistent with Experiments 1
and 2, the ambiguous “inside job” inferences were included in the total inferences consistent with the misinformation, but were *not* included in the total inferences consistent with the alternative.

### 4.3. Results and Discussion

As in the prior experiments, analysis of the factual questions verified that, as expected, there were no group differences in memory for the general facts of the news story on either the pre-correction, $t(100) = 0.85, p = .40$, same-day post-correction, $t(100) = 0.51, p = .61$, 2-day post-correction, $t(100) = 0.76, p = .45$, or 4-day post-correction, $t(100) = 0.29, p = .77$, questionnaires. In addition, I excluded all participants who failed to report the correction from the analyses. Inspection of performance on the manipulation check questions revealed that the percentage of participants who failed to report the correction was low, and did not vary by group, $M’s = 3.6\%$ and $2.2\%$ for the correction-only and correction-alternative groups respectively, $X^2(1) = 0.17, p = .68, \phi = .04$. As in Experiments 1 and 2, no participants who remembered the correction on the same-day post-correction test failed to recall the correction when re-tested on either the 2-day or 4-day post-correction test. Hence, all participants who were excluded from the analyses failed to report the correction on the same-day post-correction test. One additional participant failed to complete at least 1 of the story questionnaires within the time limit, and was excluded from analyses. After removing these participants, 99 remained: correction-only ($n = 54$) and correction-alternative ($n = 45$).

**Belief in the retracted misinformation.** As expected, analyses confirmed that ratings on the direct measure and the number of inferences generated implicating the son (Figure 2) were positively correlated on the pre-correction test, $r = 0.41, p < .001$, the same-day post-correction
Effect of alternative explanation on correction effect. To assess whether a correction accompanied by an alternative explanation was more effective than a correction alone, both measures were analyzed with a 2 (Correction Effect: pre-correction vs. same-day post-correction) x 2 (Correction Type: correction-only vs. correction-alternative) mixed-design MANOVA. As predicted, although the correction was highly effective, $V = 0.76, F(2, 96) = 147.67, p < .001, \eta_2^p = .76$, Correction Type moderated the effectiveness of the correction, $V = 0.10, F(2, 96) = 5.57, p = .005, \eta_2^p = .10$. Specifically, the correction was more effective in the correction-alternative group, $V = 0.66, F(2, 96) = 95.00, p < .001, \eta_2^p = .66$, than in the correction-only group, $V = 0.53, F(2, 96) = 54.57, p < .001, \eta_2^p = .53$. No other main effects were reliable.

The same pattern of effects was observed when assessing the correction effect 2 days (pre-correction vs. 2-day post-correction) and 4 days (pre-correction vs. 4-day post-correction) after the correction. The correction effect was highly reliably at both 2 days, $V = 0.53, F(2, 96) = 53.70, p < .001, \eta_2^p = .53$, and 4 days after the correction, $V = 0.52, F(2, 96) = 52.94, p < .001, \eta_2^p = .52$. Furthermore, at both time points the correction was more effective in the correction-alternative group than the correction-only group, as indicated by an interaction with Correction Type both 2 days, $V = 0.11, F(2, 96) = 5.93, p = .004, \eta_2^p = .11$, and 4 days after the correction, $V = 0.10, F(2, 96) = 5.44, p = .006, \eta_2^p = .10$, as. Overall, these findings support prior research finding that a correction accompanied by an alternative explanation reduces beliefs more than a correction alone.

Transience of revised beliefs. To address the primary prediction that the alternative explanation would increase the durability of the revised beliefs, I first analyzed the overall changes in belief in the retracted misinformation over time with a 3 (Test Timing: same-day post-
Figure 3. Mean number of “inside job” inferences (above) and mean rating of son’s involvement (below) as a function of (Correction-Only and Correction-Alternative) and the timing of the assessment of belief in misinformation (pre-correction, same-day post-correction, 2-day post-correction, and 4-day post-correction) for Experiment 3. Bars represent 95% confidence intervals.
correction. 2-day post-correction, 4-day post-correction) x 2 (Correction Type: correction-only vs. correction-alternative) mixed-design MANOVA. As shown in Figure 3, the finding that belief in the retracted misinformation increased over time, main effect of Test Timing, $V = 0.37, F(4, 388) = 21.99, p < .001, \eta^2_p = .19$, was qualified by a significant interaction with Correction Type, $V = 0.06, F(4, 388) = 3.21, p = .01, \eta^2_p = .03$.

To determine the locus of the change over time and the interaction, I analyzed the change in belief in the misinformation over each of the two delay intervals separately. I first analyzed whether belief in the retracted misinformation changes over the initial 2-day delay with a 2 (Test Timing: same-day post-correction vs. 2-day post-correction) x 2 (Correction Type: correction-only vs. correction-alternative) mixed-design MANOVA. As shown in Figure 3, belief in the retracted misinformation increased over the two days following a correction, replicating Experiment 1, $V = 0.41, F(2, 96) = 32.90, p < .001, \eta^2_p = .41$. However, contrary to the primary prediction, the alternative explanation did not moderate this change in belief over time, $V = 0.054, F(2, 967) = 2.281.93, p = .115, \eta^2_p = .054$. As in prior studies, although belief in retracted misinformation increased over time, these beliefs did not return to pre-correction levels.

Specifically, belief in the retracted misinformation 2 days after the correction was lower than belief prior to the correction in both the correction-alternative group, $V = 0.48, F(2, 96) = 43.11, p < .001, \eta^2_p = .48$, and the correction-only group, $V = 0.22, F(2, 96) = 13.38, p < .001, \eta^2_p = .22$. Hence, although belief in the retracted misinformation increased over time, the effects of the correction were not reversed completely. Finally, although belief in the retracted misinformation was numerically lower in the correction-alternative group relative to the correction-only group (see Figure 3), the main effect of Correction Type was not reliable, $V = 0.04, F(2, 96) = 1.80, p = .17, \eta^2_p = .04$. Thus the predicted superiority of the correction-alternative was not observed.
I next analyzed whether the alternative explanation moderated changes in belief in retracted misinformation over the subsequent two days with a 2 (Test Timing: 2-day post-correction vs. 4-day post-correction) x 2 (Correction Type: correction-only vs. correction-alternative) mixed-design MANOVA. In contrast to the above findings, belief in the retracted misinformation did not change over this time frame, as neither the main effect of Test Timing, $V = 0.04, F(2, 96) = 2.20, p = .12, \eta^2_p = .04$, nor the interaction with Correction Type was reliable, $V = 0.03, F(2, 96) = 1.55, p = .22, \eta^2_p = .03$. Consistent with this finding, 4 days post-correction, belief in retracted misinformation remained lower than pre-correction levels in both the correction-alternative group, $V = 0.46, F(2, 96) = 40.21, p < .001, \eta^2_p = .46$, and the correction-only group, $V = 0.25, F(2, 96) = 15.97, p < .001, \eta^2_p = .25$. Thus indicating that the correction has some lasting benefits. Finally, the alternative explanation was more effective than the correction alone, as belief in the retracted misinformation was significantly lower for participants in the correction-alternative group than participants in the correction-only group, $V = 0.07, F(2, 96) = 3.71, p = .03, \eta^2_p = .07$.

In summary, collectively, the results showed that, for both the correction-alternative and correction-only groups, belief in corrected misinformation started to return over the first 2 days post-correction, but stabilized over the subsequent 2 days. In addition, the correction accompanied by an alternative was more effective at reducing belief in misinformation than the correction alone.

**Belief in the alternative explanation.** Given that belief in retracted misinformation increases over time, I assessed whether belief in the alternative explanation may decrease over time. To test this prediction, the number of responses to the inference questions that referenced the ex-convict committing the crime were analyzed using a one-way repeated-measures ANOVA with the independent variable of Test Timing (same-day post-correction, 2-day post-correction, & 4-day post-correction). Overall, responses consistent with the alternative changed over time, $F(2, 90)$
Specifically, belief in the alternative significantly decreased from the same-day post-correction test, $M = 3.89$, to the 2-day post-correction test, $M = 3.24$; $F(1, 45) = 9.96, p = .003, \eta_p^2 = .18$, mirroring the increase in belief in the retracted misinformation over this period. Also consistent with the analyses of belief in the retracted misinformation, belief in the alternative did not significantly change from the 2-day post-correction test to the 4-day post-correction test, $M = 3.22$; $F(1, 45) = 0.43, p = .84, \eta_p^2 = .001$. These results suggest that, over time, participants may forget the alternative explanation.

**Summary.** Taken together, the foregoing results found evidence that belief in retracted misinformation increased over the two days following the correction, but remained constant over the two days (2-days post-correction to 4-days post-correction) following this brief period of transience. Importantly, the present results also provide further evidence that a correction accompanied by an alternative explanation is more effective than a correction alone, with this advantage of the alternative explanation observed up to four days post-correction. However, participants in the correction-alternative group were not immune to falling back on the corrected misinformation over time. Even when the correction was accompanied by an alternative explanation, belief in the retracted misinformation increased over the two days following the correction, perhaps because participants forgot the alternative explanation over this time frame. Hence, the hypothesis that a correction accompanied by an alternative explanation would increase the durability of revised beliefs was only partially supported.
V. General Discussion

5.1. Effects of Delaying Corrections

Prior studies have consistently found that when readers encounter mistaken information in a news report, a later retraction of this misinformation greatly reduces, but does not eliminate, belief in the retracted, mistaken information. Additional research has identified numerous factors that can increase the effectiveness of corrections (i.e., detecting the inconsistency, credibility, strategic monitoring, and eliminating causal gaps). However, two issues have thus far remained unaddressed in this domain of research: (1) whether delaying a correction reduces the effectiveness of that correction and (2) the durability of the revised beliefs that result from a correction. The current study aimed to address these issues.

Regarding the first issue, the present results failed to find evidence that delayed corrections are less effective than immediate corrections. As shown in Figures 1 and 2, regardless of whether the correction was provided immediately or after a 2-day delay, the correction greatly reduced belief in the retracted misinformation. However, unexpectedly, the correction in the current study was extremely effective and virtually eliminated reliance on misinformation (see Figures 1 and 2). Indeed, the correction effects obtained in the present study were much larger than those that have been obtained in prior studies that employed the same news stories, but where the correction was manipulated between participants (Johnson & Seifert, 1994; Rich & Zaragoza, 2016). Therefore, the effectiveness of the correction in the current study likely stems from having measured the correction effect within participants, which required assessing participants’ belief in the
misinformation both before and after they received the correction. As can be seen in Figures 1 and 2, prior to the correction, participants endorsed high levels of belief in the misinformation that the son was responsible for the theft. Readers may process follow-up news reports and correction differently when they explicitly reflect on, and endorse beliefs about, mistaken information, perhaps by increasing their sensitivity the inconsistency between their initial beliefs and the follow-up news report. In addition, to the extent that these inconsistencies surprise readers, such surprise may lead readers to devote more attentional resources to the correction, thus rendering the correction highly effective (see the hypercorrection effect; Butterfield & Metcalfe, 2001, 2006; Fazio & Marsh, 2009, 2010). If initially committing to the misinformation significantly enhances the effectiveness of the correction, the current finding that delaying a correction had no effect may not generalize to situations where participants do not explicitly commit to their belief in the misinformation prior to the correction.

In addition, the current findings may not generalize to situations where participants’ belief in the misinformation becomes more entrenched over the delay between the misinformation and the correction. In the current study, the fictitious news story was likely not of great personal significance or consequence to participants. In contrast, in those situations where a news story describes an event of greater significance to the reader, a delay between the mistaken information and its correction may give participants greater opportunity to reflect upon and elaborate on the misinformation. These processes could result in a stronger, more entrenched belief in the initially provided misinformation, making that belief more difficult to correct. Consider, for example, the early media reports suggesting that Iraq possessed WMDs. During 2002 and early 2003 (prior to the war), whether Iraq possessed WMDs was highly consequential to the average American citizen: if Iraq had WMDs then armed conflict could be imminent. Even when not watching the
news, people likely reflected on whether Iraq had WMDs, perhaps engaging in conversation with other people about the issue. In these situations, the longer it takes for a correction to be released, the more opportunities people have to engage in elaboration on the mistaken information. Prior studies suggest that such elaboration decreases the likelihood that a correction successfully revises an initial belief (Anderson et al., 1980). In the current study participants who received a delayed correction may have had little motivation to engage in such elaboration because the event was not consequential to their lives. Given the potential role of motivation in such elaborative processes, the current finding that delayed and immediate corrections reduce mistaken beliefs to a similar extent may not extend to situations where the misinformation is highly consequential to the reader.

5.2. Durability of Revised Beliefs

Regarding the second issue addressed in the current study, the present results provide clear and novel evidence of transience in the revised beliefs that result from a correction. As shown in Figures 1 and 3, belief in the retracted misinformation increased over the two days following a correction. Over a period of two days, between 30 and 45% of belief in the retracted misinformation returned, despite the fact that participants had overtly committed to their initial beliefs on the questionnaire immediately following the correction (see the anchoring heuristic, Tversky & Kahneman, 1974).

Why were these revised beliefs transient? One possible explanation stems from the causal role of the misinformation in the story (Lewandowsky et al., 2012; Johnson & Seifert, 1994). Immediately after receiving the correction readers may revise their representation of the story to decrease or eliminate the role of the misinformation. This revision leaves a causal gap in the story, because the reader no longer has a concrete explanation for the outcome reported in the story. Given that people are motivated to achieve a causal understanding of the events they experience.
(Trabasso, 2005; Trabasso et al., 1984), they may fall back on the misinformation because it provides the only available explanation for the outcome reported in the story. However, the results of Experiment 3 provide evidence that the causal gap hypothesis cannot solely explain the transience of revised beliefs. In Experiment 3, even participants who received an alternative explanation, which should have filled the causal gap, evidenced transience in their beliefs in the retracted misinformation. If readers fell back on the misinformation over time because the misinformation provided the only explanation for the news story, then providing an alternative explanation should have reduced the need for readers to do so.

However, in the current study, the alternative explanation did not eliminate the misinformation as a possible cause of the outcome. Instead, the alternative explanation used in the current study stated that the police had identified another highly plausible suspect. The fact that police had identified a likely suspect, even when combined with the correction that the son had an alibi, does not rule out that the possibility that the son committed the theft. Perhaps the son worked with the ex-convict to steal the jewels, or the son was trying to frame the ex-convict, or the son hired a friend to commit the crime and the new suspect was a coincidence. In other words, the current study did not present the alternative explanation as the proven, definitive, causal explanation for the events in the story (e.g., the police arrested the ex-convict, who confessed after the police found the jewelry in his home). Therefore, some participants may have maintained both the misinformation and the alternative explanation as two potential explanations for the outcome. Given that, as indicated in Experiment 3, some participants may have forgotten the alternative over time, participants may have fallen back on the misinformation over time because they forgot the alternative. Based on this foregoing issue, the transience observed in the current study might be eliminated in situations where the alternative explanation provides the definitive cause of the
events in the story (e.g., proof that the ex-convict stole the jewelry). This possibility remains a question for future research.

The transience of revised beliefs could also be explained by an increase in strategic monitoring failures over time. Strategic monitoring failures refer to instances where, after retrieving a memory, people fail to monitor the source, relevance, or validity of that memory (Ayers & Reder, 1998; Gallo, 2010; Johnson et al., 1993). In the case of mistaken information, strategic monitoring failures occur when people retrieve the misinformation, but fail to either retrieve or use information which invalidates the misinformation (i.e., the correction). Importantly, the present findings rule out the possibility that participants failed to encode, or completely forgot, the correction because the reported analyses only included participants who could remember and report the correction.

However, just because participants can remember the correction does not mean that they spontaneously do when answering questions about the misinformation. Indeed, in the current study belief in the retracted misinformation increased over time (despite participants remembering the correction) indicating that, over time, participants failed to adequately use the correction when responding to the questionnaire about the news story. In other words, participants made more strategic monitoring errors over time. This likely occurred because, over time, memory for the association between the misinformation and the correction decayed more rapidly than the memory for either piece of information alone. By this account, although readers could retrieve the correction when directly asked about it, they did not spontaneously retrieve the correction when the misinformation came to mind because the association between the misinformation and correction weakened over time. Although the results of the current study are consistent with this possibility, they do not provide any direct evidence that people forget the association between the correction
and misinformation over time. Nevertheless, research in other domains have evidenced similar phenomena. For example, studies of the well-known “sleeper effect” have documented that people initially persuaded by an argument that is later discredited tend to fall back on the discredited argument over time (see Kumkale & Albarracín, 2004 for a review). This sleeper effect has similarly been attributed to a dissociation of the argument and the discrediting information. Hence, future studies of the correction of mistaken information in news reports should attempt to investigate more directly whether the association between the misinformation and the correction decays more rapidly over time than each individual piece of information.

Although the current study provides clear evidence that belief in the retracted misinformation returns over the 2 days immediately following a correction, whether these beliefs continue to increase over longer periods of time remains unclear. In Experiment 2 (see Figure 2), belief in the retracted misinformation continued to increase over 2 additional days, but Experiment 3 (see Figure 3) did not replicate this effect in either group. The unreliability of this effect could be explained if the function that describes the return of belief in retracted misinformation is logarithmic rather than linear (i.e., beliefs increase rapidly shortly after the correction but more gradually over longer periods of time). If, as proposed above, belief in retracted misinformation returns because readers forget the association between the misinformation and its correction, then this belief should return at a logarithmic rate as a wide body of research has established that forgetting occurs at a logarithmic rate (i.e., the forgetting curve; Averell & Heathcote, 2011; Ebbinghaus, 1964). If belief in retracted misinformation returns at a logarithmic rate, then, after the initial 2 days, reliably detecting increases in belief over time may require longer subsequent delays than the additional 2-day delay used in the current study. Given the inconsistencies in the current
study, future studies should further investigate whether belief in retracted misinformation continues to increase over longer delays and at what rate this belief returns over time.

5.3. Creating Effective Corrections

A critical implication of these findings is that the effectiveness of corrections should be measured both by their ability to reduce belief in retracted misinformation immediately and their ability to lead to enduring changes in beliefs. Consider, in particular, the benefits of providing an alternative explanation. Many prior studies have consistently demonstrated that a correction paired with an alternative explanation reduces beliefs substantially more than a correction alone (Ecker et al., 2010; Johnson & Seifert, 1994; Rich & Zaragoza, 2016; van Oostendorp & Bonebakker, 1999). However, in the current study, though a correction paired with an alternative lowered belief in the retracted misinformation more than a correction alone, belief in the retracted misinformation started to return over time, regardless of whether an alternative was provided. This suggests that although alternative explanations reduce belief in the retracted misinformation, they may not help prevent these revised beliefs from changing over time. Given that alternative explanations, one of the most consistently effective ways to improve corrections, only appear to benefit the magnitude of the correction effect, further research should continue to explore techniques which can increase both the magnitude of the correction effect and the endurance of the revised beliefs. The remainder of this section focuses on using a combination of prior literature and the current findings to offer suggestions for the creation of more effective corrections.

Given that readers continue to rely on retracted misinformation both immediately after receiving the correction and even more so over time, readers presumably consider the misinformation plausible. Readers may consider the misinformation plausible, even despite the correction, because they assume that others only report quality (i.e., true), relevant information
This suggests that in order to reduce belief in the retracted misinformation, a correction can be supplemented not only by providing information that supports the correction, but also by providing information that directly discounts the quality and relevance of the misinformation (e.g., explaining why the details of the misinformation were incorrect). Consistent with this prediction, prior research suggests that explaining that the misinformation was of poor quality (e.g., the son does not have gambling debts and the police never considered him a suspect) or by explaining why the misinformation is no longer relevant (e.g., the information about the son concerned a trip the Harters took last year, he had actually joined them on this vacation) can reduce belief in the retracted misinformation (Seifert, 2002). In addition to improving the magnitude of the correction, such discounting information might reduce reliance on the misinformation over time.

Finally, as belief in the misinformation may return over time because people forget the association between the misinformation and the correction, interventions designed to help prevent forgetting should benefit memory for the correction and the association between the correction and the misinformation. One intuitive technique commonly used in real-world scenarios is repeating the correction over time (Delaney, Verkoeijen, & Spirgel, 2010; Ebbinghaus, 1964; Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006). Of note, prior research on the correction of misinformation in news reports found evidence that repeating a correction only reduced belief in the misinformation when the misinformation had also been repeated (Ecker, Lewandowsky, Swire, & Chang, 2011). Though these results suggest that repeating the correction does not always revise beliefs more than a single correction, as this study only assessed these beliefs immediately after the correction, whether repeating the correction enhanced the durability of these revised beliefs remains unknown. In fact, research on the long-term retention of information has consistently
demonstrated that although repeated, spaced presentations maximize long-term retention of the to-be-remembered material, they provide limited immediate benefits to memory (Cepeda et al., 2006; Cepeda, Vul, Rohrer, Wixted, & Pashler, 2008). Similarly, if belief in the retracted misinformation returns over time due to forgetting of the association between the misinformation and the correction, then spaced reminders of the correction may, over time, boost the durability of the revised beliefs that result from the correction. Though such spaced repetitions may not increase how much corrections initially reduce belief in the mistaken information, they may prove a critical tool in maintaining these revised beliefs.

5.4. Implications and Conclusions

The overall transience of the revised beliefs that result from a correction suggests that effecting long lasting change in mistaken beliefs may be difficult. When combined with the prior studies demonstrating that corrections rarely, if ever, eliminate belief in the retracted misinformation (Ecker, Lewandowsky, Swire & Chang, 2011; Johnson & Seifert, 1994; Rich & Zaragoza, 2016), the current study raises further concerns about the effectiveness of simple corrections by indicating that any reductions effected by the correction may be temporary. For instance, even though a vast majority of people corrected their belief that Iraq possessed active WMDs in the face of contradictory evidence, this belief has slowly returned over the past 12 years. This has occurred despite repeated reports of evidence contradicting the notion that Iraq had active WMDs (see the Duelfer Report released in 2004 and recent reports indicating that those WMDs found in Iraq were likely unknown to the Iraq government). Consider further the evidence in the current study that belief in the retracted misinformation increased over time even when participants received both a correction and alternative explanation. Overall, even when a correction is highly effective, the revised beliefs may be transient.
These revised beliefs about inaccurate and mistaken information are likely even more transient when the mistaken information continues to permeate public discourse. Consider the mistaken belief that vaccines cause autism. A Gallup poll of U.S. citizens from March of 2015 found that, since 2001, the percentage of Americans who have heard about the “disadvantages” of vaccines has increased from 39% to 73% (Newport, 2015). Even though only 6% of the responders currently believe vaccines caused autism, an additional 52% were unsure whether vaccines did or did not cause autism. Despite scientific evidence suggesting no relationship between vaccines and autism (see Taylor, Swerdfeger, & Eslick, 2014 for a recent meta-analysis), the idea that vaccines cause autism continually re-enters public discourse. That repeating the misinformation over time could further counteract the benefits of the correction seems likely given prior studies have demonstrated that repeating the misinformation multiple times prior to correction reduces the correction’s effectiveness (Ecker, Lewandowsky, Swire, & Chang, 2011). Even repeating the misinformation specifically to refute that misinformation with contradictory information can increase belief in that misinformation (Schwarz, Sanna, Skurnik, & Yoon, 2007; but see also Tippet, 2010). Repeating the misinformation makes that misinformation more accessible in memory, and could increase the likelihood that readers later retrieve the misinformation without retrieving the relevant contradictory information (Lewandowsky et al., 2012). Hence, if people continue to encounter the misinformation throughout their lives, then the revised beliefs that result from a correction may be shorter lived, even if the misinformation is repeatedly associated with the correction (Schwarz et al., 2007).

Additionally, the transience observed in the current study likely extends beyond situations where participants encounter mistaken information in news reports to situations where incorrect knowledge needs to be corrected. For example, recent research investigating the correction of high
confidence general knowledge errors (Butler et al., 2011) and the correction of psychology misconceptions in a classroom (Butler, Umanath, Dolan, Thomas, & Marsh, 2015, June) have found similar patterns of transience for revised knowledge. Indeed, the transience of revised knowledge and revised beliefs may be closely tied. Presumably people base their beliefs about an event in part on the details they can remember about that event. If participants remember the misinformation and the correction, presumably they will report beliefs consistent with the correction. But, if participants do not remember the correction, presumably they will report beliefs consistent with the misinformation. Hence, the mechanisms underlying the transience of revised beliefs may directly relate to those underlying the transience of revised knowledge.

Overall, the present study highlights the potential trade-off between the immediacy and accuracy of news reports. In order to provide information to the public as quickly as possible, news organizations must sometimes release reports before all the facts are known. Further investigation sometimes reveals falsehoods and inaccuracies in these initial reports. To counteract any influence of such mistaken information, news organizations release retractions and corrections. However, the current study found evidence that even when such corrections produce substantial, immediate change, the revised beliefs that result from that correction were transient. That is, belief in the retracted misinformation increased substantially over the days following the correction. Hence, though prior research has demonstrated that such corrections do not eliminate belief in the mistaken information, the current results suggest that the presence of mistaken information in news reports could have additional repercussions: over time, belief in that retracted mistaken information starts to return. Most critically, these results suggest that the effectiveness of a correction should be measured both by its ability to reduce belief in mistaken information as well as the extent to which it leads to enduring changes in mistaken beliefs. Given the trade-off between immediacy and
accuracy, and the near necessity of immediate news, future studies should continue to work
towards developing corrections that can lead to large, lasting changes in erroneous beliefs.
APPENDICES

A. INITIAL NEWS REPORT

<table>
<thead>
<tr>
<th>Message 1</th>
<th>At 3:00 p.m., May 2nd, police responded to a call made from a home on Acorn Street in the middle-class, residential neighborhood of Sunny Hollow.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message 2</td>
<td>The homeowner, June Harter, reported that her jewelry box was missing. The box’s contents included gold chains, gold and silver earrings, rings, and pendants with precious stones.</td>
</tr>
<tr>
<td>Message 3</td>
<td>She discovered that the box was missing when she and her husband returned from a vacation and she wanted to put a new necklace she had bought in the jewelry box. The box had been stored in a locked drawer in her bedroom dresser.</td>
</tr>
<tr>
<td>Message 4</td>
<td>Mrs. Harter swears that she had checked the box before leaving on vacation and that everything was in order. A tall tree arches near the bedroom window, but police have found no evidence of tampering with the window.</td>
</tr>
<tr>
<td>Message 5</td>
<td><strong>Misinformation Message:</strong> Police suspect that the Harters’ son, Evan, may have taken the box from the house. The Harters report that they had asked their son to check in on the house periodically during their absence. The son also did other odd jobs for many of the neighbors to pay off his recent gambling debts.</td>
</tr>
<tr>
<td>Message 6</td>
<td>Sunny Hollow has been hit with a number of thefts recently, but there are no arrests or leads in these cases so far.</td>
</tr>
<tr>
<td>Message 7</td>
<td>The Harters’ next-door neighbor reported that she noticed a light on in the Harters’ house after her dog suddenly began barking late Saturday evening, April 28th. An unfamiliar dark-colored car had been parked in a nearby alley.</td>
</tr>
<tr>
<td>Message 8</td>
<td>However, a search for footprints and tire tracks has turned up inconclusive due to a recent rainstorm. In the course of the investigation, an officer also noted a broken latch on a basement window.</td>
</tr>
<tr>
<td>Message 9</td>
<td>Police are still attempting to determine whether other valuables are missing from the home.</td>
</tr>
</tbody>
</table>
### B. FOLLOW-UP NEWS REPORT

| Message 1 | The investigation into the theft of jewelry from the Harter’s home and the rash of thefts in the neighborhood of Sunny Hollow has been ongoing. |
| Message 2 | Police have confirmed that Mr. and Mrs. Harter left for their Caribbean vacation on Sunday, April 22\textsuperscript{nd}, and returned 10 days later on Wednesday, May 2\textsuperscript{nd}. Mrs. Harter noticed the missing jewelry box shortly after returning from the trip. |
| Message 3 | As reported previously the Harters’ neighbor noticed some suspicious activity on the evening of Saturday, April 28\textsuperscript{th}. Police have been unable to confirm these details. |
| Message 4 | Police have determined that only the jewelry appears to have been stolen. The television and home computer had not been disturbed. |
| Message 5 | The Harters reported that they had contacted their insurance company about the loss. The last appraisal showed the box’s content to be worth several thousand dollars. |
| Message 6 | **Immediate-Correction & Delayed-Correction groups:** Police have now confirmed that Evan had been called away on business and had not been in town to look after the house during the Harters’ vacation.  
**No-Correction:** No Message |
| Message 6b | **Experiment 3 Correction-Alternative:** They have identified a suspect, ex-convict Dan Fowler. Fowler recently sold expensive jewelry to a pawn shop, and his girlfriend, Sarah, works for a cleaning service that regularly cleans the Harter’s home. |
| Message 7 | In addition, Mrs. Harter is considering offering a reward for the return of several of the pieces of jewelry because they have great sentimental value for her. She says that there would be no questions asked. |
| Message 8 | Detectives will look for similarities between this case and the other thefts reported in the neighborhood recently. If you have any information which may aid in the investigation, please contact the police department. |
C. STORY QUESTIONNAIRE

Causal Question

1. What caused the box to be missing from the Harters’ home?

Factual Questions

2. How much did an appraisal show the box’s contents to be worth? (Post-Correction only)
3. Where was the Harters’ home located?
4. Where was the jewelry box normally kept?
5. Why did Mrs. Harter consider offering a reward? (Post-Correction only)
6. What did the Harters’ next-door neighbor notice?
7. What kinds of jewelry did the box contain?
8. When did Mrs. Harter discover that the jewelry box was missing?
9. What did the police notice about the bedroom window?
10. When did the neighbor’s dog suddenly start barking?

Inference Questions

11. Why might the neighbor’s dog have been barking?
12. Whose car might the neighbor have noticed parked in the alley?
13. Why might the son feel bad about the incident?
14. What could the Harters have done to better avoid this problem?
15. What steps should the police take next?
16. How might the thief have gotten into the house?
17. How do you think the thief got into the locked drawer to steal the jewelry box?
18. What might be responsible for the other thefts in the neighborhood recently?
19. Who, if anyone, should be questioned more thoroughly by the police?
Direct Measure of Belief in the Son’s Involvement

20. How much do you believe that Evan Harter was involved in the theft of the jewelry?

1  2  3  4  5  6
Highly Moderately Somewhat Somewhat Moderately Highly
Unlikely Unlikely Unlikely Likely Likely Likely

21. Why do you believe this?

Manipulation Check Questions (Post-Correction only)

22. What did the story report about where Evan Harter was during the Harters’ vacation?

23. What facts about the case did the police change their minds about, based on information they discovered later?

Direct Measure of Belief in the Correction (Post-Correction only)

24. How much do you believe that Evan Harter was out of town on business while his parents were on vacation?

1  2  3  4  5  6
Highly Moderately Somewhat Somewhat Moderately Highly
Unlikely Unlikely Unlikely Likely Likely Likely

25. Why do you believe this?

26. Was the story you read familiar to you in any way? If so, why/how is it familiar? (Post-Correction only)
D. UNIVARIATE INFERENTIAL STATISTICS

Table 3

Inferential Statistics for Univariate Analyses on the Inference Questions and Ratings of Belief in the Son’s Involvement.

<table>
<thead>
<tr>
<th>Univariate Analyses</th>
<th>Inference Questions</th>
<th></th>
<th></th>
<th>Belief in Son’s Involvement</th>
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<td></td>
<td>F</td>
<td>df</td>
<td>p</td>
<td>η²</td>
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<td><strong>Experiment 1</strong></td>
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<td>.64</td>
<td>227.56</td>
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<td>.22</td>
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<tr>
<td>Correction</td>
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<td>.94</td>
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### Inference Questions

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<th>Univariate Analyses</th>
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REFERENCES


http://dx.doi.org/10.1207/s15327752jpa4803_13


http://dx.doi.org/10.1080/17470218.2010.497927


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