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Once false information has been encoded, it can be difficult to diminish its influence. The persistent effect of misinformation on later learning, even after the misinformation has been retracted or corrected, is referred to as the *continued influence effect* (CIE) of misinformation. One possible explanation is that corrections often repeat misinformation and thereby increase its familiarity. Recent work has shown that this increased familiarity is associated with the CIE when corrections are not recollected. The present experiment expands upon those findings by investigating whether a factor known to influence perceived familiarity, cohort agreement, affects participants' ability to detect and recollect corrections of misinformation. Participants first studied true and false statements taken from actual media sources, along with fictional representations of how many people believed each statement to be true. In a second phase, true statements were affirmed, false statements were corrected, and participants reported when they detected corrections. Participants were then tested on the information from the second phase and reported whether each statement had earlier been corrected. The present results replicated previous work showing that memory for was associated with reduced CIE, but cohort agreement was not associated with performance on any of the memory measures. These results provide another demonstration of the powerful association between recollection of corrections and memory for correct statements.

THE EFFECT OF PEERS' BELIEFS ON CHANGE-RECOLLECTION DRIVEN REJECTION OF MISINFORMATION

by

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CHAPTER I

INTRODUCTION

In the age of constant and mostly unlimited access to information, people must distinguish reliable from misleading information. Starting in 2016, misinformation (which the reader may better recognize as "fake news") became so prevalent that social media networks such as Facebook have felt it necessary to give users a way to flag suspicious news articles and other posts for removal for being intentionally false. By the end of 2017, Facebook had already announced reconsidering their method of combatting the spread of false information after simply removing it from circulation on the website did not seem to be helping. The main issue that occurs in this situation is that once the misinformation has been encoded, it continues to be remembered even after it has been retracted or corrected. This persistent effect of misinformation on later learning, even after the misinformation has been retracted or corrected, is referred to as the continued influence effect (CIE) of misinformation (Johnson & Seifert, 1994). This continued influence may also be strengthened by the ability to see other users' support for misinformation articles as shown by them commenting on or sharing the information on their feed. As this spread of misinformation becomes more common on the global stage, finding a reliable method for reducing its influence will only become more important (Connolly et al., 2016). One factor that appears to reduce CIE is a person's ability to

recollect that a correction has occurred (Alexander & Wahlheim, in preparation). When a person receives corrections of misinformation, they may bring to mind the misinformation they learned before. When this occurs, recollection of the correction later is associated with reduction of CIE, while failure to recollect the correction is associated with increases in CIE. However, it is yet to be seen how other naturalistic factors such as cohort agreement affect CIE and the ability to recollect that corrections have occurred. Along these lines, the present study seeks to investigate the effect of cohort agreement and subjects' belief of misinformation on recollection of corrections.

Continued Influence Effect

Once misinformation has been encoded, it can be quite difficult to diminish its influence. Even after multiple retractions of a statement, people continue to rely on the initial information for making decisions and answering questions about the event. This reliance upon outdated or falsified information can have unwanted consequences, as it gives people a faulty base for logical reasoning and decision making (Ecker, Lewandowsky, Swire, & Chang, 2011a).

Consider the example of parents against vaccinations, which is commonly referenced and has been very resistant to retraction and correction (Poland, 2011). After a study falsely implied a causal link between vaccinations and childhood autism, a surge of fear moved parents around the world to refuse to vaccinate their children against common diseases. Although the doctor who conducted the study lost his license to practice medicine and numerous other scientists presented empirical evidence that refuted his claim (which was eventually retracted), the damage was already done. The proliferation

of this misinformation sparked a debate that, alongside other factors, would eventually lead to a spike in the appearance of measles in Europe, from 5,273 cases in 2016 to 21,315 cases in 2017 (WHO Europe Epi-Data 2017).

One proposed approach to countering the effects of misinformation is to avoid referencing the misinformation while correcting it (Swire, Ecker, & Lewandowsky, 2017, Lewandowsky et al., 2009). The theory behind this approach is that when the misinformation is repeated during correction, the familiarity of the misinformation increases. Then, when asked to access information at a later point in time, the misinformation is more readily accessible. Increased familiarity is also recognized as making claims more likely to be believed (Schwarz, Newman, & Leach, 2017; Weaver, Garcia, Schwarz & Miller, 2007).

DiFonzo, Beckstead, Stupak, and Walders (2016) showed this effect of familiarity on beliefs by presenting a sample of college students with false rumors about life on campus. The number of presentations of each rumor was manipulated, ranging from 0 to 9 repetitions. Participants were subsequently asked to rate their belief in each rumor. Given that each of these rumors was false, they will be considered here as akin to misinformation statements. Ratings of belief were found to have a logarithmic relationship to the number of repetitions, in that belief increased with each repetition with diminishing returns. The most important relationship regarding retraction of misinformation, however, is the first repetition which showed the greatest increase in familiarity.

Swire, Ecker, and Lewandowsky (2016) also investigated the relationship between retracted myths and familiarity. In their experiment, participants were presented with a series of true or false claims of ambiguous correctness (for example, that dogs can smell certain types of cancer) and rated their belief in each myth. The experimenters then reaffirmed the true claims and retracted the false claims. Following this feedback, participants were asked to re-rate their belief in each statement either immediately or after a delay of one or three weeks. The researchers manipulated the amount of detail provided by corrections of misinformation as well as the length of the delay between the correction and the participant's second belief rating. Both of these manipulations are believed to affect the recollection of corrections and thereby vary the impact of familiarity. When the recollection rate of corrections is high, the effect of familiarity is reduced compared to when corrections are less likely to be recollected.

The authors found that more explanatory detail during feedback reduced the influence of familiarity on belief ratings across delays. The amount of delay also showed an effect on ratings, in which the change in belief rating after affirmation of a fact stayed consistent after delay but the ratings of belief in retracted myths returned to their original level after delay. For affirmed facts, it does not matter if the participant uses recollection or familiarity to produce their response, as either strategy would produce the same answer. In the case of retracted myths, recollection of the retraction should facilitate accurate rejection of misinformation if it comes to mind. When recollection fails, reliance upon familiarity should increase the probability that misinformation will be

produced as a response. These results implicate a primary role of recollection of the retraction in a person's ability to reject misinformation.

While the research discussed so far has considered the effect of direct references to misinformation, it must also be considered that these references may not be necessary for the participant to bring the misinformation back to mind. Although some research has shown that familiarity-increasing remindings may be controlled by characteristics of the stimuli (Jacoby, 1974; Jacoby & Wahlheim, 2013), not unlike a retraction that includes part of the misinformation being corrected, remindings also frequently happen spontaneously (Hintzman, 2011). If this is the case, then it is possible that retractions of any sort may increase the likelihood that the participant is reminded of previously presented misinformation, thereby boosting the familiarity of the misinformation and facilitating it being falsely accepted as the truth over time if the change is not recollected at time of test. In the literature described above, there is substantial evidence that familiarity plays a key role in CIE.

While some studies have warned against increasing the familiarity of misinformation, it has also been proposed that misinformation will be more effectively rejected when it is better encoded. This perspective posits that memory updating may be facilitated by the information being both well represented and active in memory (van Oostendorp, 1996). From this perspective, information is more susceptible to alteration or retraction when it is active in memory. To investigate this, Ecker, Hogan, and Lewandowsky (2017) created six unique scenarios analogous to events appearing in news media. For each of these scenarios, subjects were asked to read two informational

articles. The first article of each pair introduced the scenario and provided an explanation of what occurred. Within each of these explanations was one piece of critical information that could be retracted in the second article. Four different formats of the second article provided extra information. In one condition, the second article did not retract the critical information. In the other three conditions, the critical item was retracted with either no reference to the critical information, a subtle reference to the information explaining that it was incorrect, or an explicit repetition of the critical information before retracting it.

After reading the articles from each scenario, subjects were asked a series of open-ended questions about each case. Results showed that interference from misinformation was greatest in the no retraction condition and lowest in the explicit retraction condition. This study showed that increasing the detail provided by a retraction can help to reduce CIE. I take the perspective that this occurred because the increased amount of detail increased the likelihood that the correction was recollected. This perspective is supported by Alexander and Wahlheim (unpublished manuscript), who showed that providing a direct retraction of misinformation increased the likelihood of recollecting corrections as compared to corrections provided without retraction. The results of this study will be discussed in greater detail below.

Ecker, Lewandowsky, Swire, and Chang (2011) further examined the interaction between spontaneous remindings and the influence of strengthened encoding on misinformation effects across two experiments. In the first, participants were presented with seventeen messages, each printed on a separate page, that created one overarching narrative in the form of a radio transmission from a police investigator. In each slide

show, misinformation statements first appeared in position 6, and the later retraction first appeared in position 13. Across conditions, the number of statements asserting the misinformation was manipulated to occur once, three times, or not at all. The number of retractions were also manipulated to occur once, three times, or not at all. In all conditions, repeated items were identical (i.e. the participant saw the same message three times). All scripts were of the same length. Participants read the messages aloud at their own pace and were not allowed to look back at previous messages. Then, after a delay, participants were asked to complete a series of open-ended questions.

Critically, two questions were included that targeted awareness of the retraction (*Was any of the information in the story subsequently corrected or altered? And if so, what was it?*). These two questions were always asked last. In line with previous research, this experiment found that when misinformation was only encoded once, its effect was reduced equally by one or three retractions. Although the rate with which retractions were later recalled was discussed, (ranging from .63 to .83) no significant differences were found in between conditions. It was further noted that removing participants who did not acknowledge the change between the misinformation statement and its correction from the dataset did not change the pattern of results. Prior to the studies by Alexander and Wahlheim, this was the closest that any studies had come to directly examining whether recollection that a correction occurred was associated with the magnitude of the CIE.

The role of change recollection regarding retractions of misinformation is only briefly considered in Ecker and colleagues' (2011) experiment but could play a more

critical role in determining the influence of familiarity and whether a retraction of misinformation will be successful. The small effect of change recollection in these previous studies could have occurred because each participant only saw one cycle of explanations or because of other aspects of the design and does not speak to the effects of change recollection directly. However, recollecting that a correction occurred could be important for reducing CIE. Research has already been conducted showing that change recollection is associated with a reduction in proactive interference across multiple types of material.

Memory-for-Change Framework

CIE can be considered a type of proactive interference. Proactive interference refers to when old information disrupts learning of and memory for new information. Work directly investigating when proactive interference is most likely to occur and when it is relieved has shown that recollection of change is important for retrieving items from a target source. Recent work has developed a very specific way of looking at proactive effects of memory that has also been useful for studying CIE. The Memory for Change framework (MFC; Jacoby, Wahlheim, & Kelley, 2015; Wahlheim & Jacoby, 2013) posits that while detecting a change between two sources is sometimes associated with proactive interference, it is also sometimes associated with enhanced recall performance referred to as proactive *facilitation.* Critically, proactive facilitation has been observed when detected changes can be remembered at the time of test.

To demonstrate how prior information can either facilitate or interfere with the learning of new information, Wahlheim and Jacoby directly investigated the role of

change recollection in these proactive effects of memory. In their experiments, participants studied two list of word pairs. These pairs of one cue word and one response word took one of three forms. Repeated pairs remained identical in List 1 and List 2. Control items appeared only in the second list. These items provided a control condition for comparisons because they were not subject to item-specific proactive interference. Finally, changed pairs contained a cue word that appeared in both lists, paired with response words that changed across lists. During the test phase, participants were given cue words and instructed to recall the response words only from the second list. After each response, they were also asked to report whether the item had changed from List 1 to List 2. This last measure is similar to the manipulation check from the Ecker et al. (2011) study above, but queried recollection of change for many items and directly analyzed the effects of recollection on recall of information. The division of item types used in these studies also resembles the materials used in research of CIE. Specifically, repeated items here are similar to reaffirmed facts and changed items are similar to corrections of misinformation in CIE studies.

Wahlheim and Jacoby found that when participants detected change during study and recollected it at test, recall performance on changed responses from List 2 was significantly better than performance recalling control items, exemplifying proactive *facilitation.* However, when participants detected change during study but could *not* recollect the change at test, recall performance was lower for changed items than for control items, showing proactive *interference*. Participants often recalled the original response when detecting the change, resulting in a repetition of the original stimulus. The

account assumes that this repetition then strengthens the accessibility of the original item and binds it to the updated representation that is later accessed more readily when the change is recollected. Such change recollection should facilitate access to both the original and changed items as well as memory for their source. When the change is not recollected, earlier retrieval of the initial item when change is detected makes it a more accessible competitor at test.

The MFC framework described above could be useful for examining CIE, given the previously noted similarity between proactive interference and continued influence. A crucial previous study has shown that this framework was successful in partially explaining how people update their memory to remember contradictions concerning political standpoints in regard to controversial topics. Putnam, Wahlheim, and Jacoby (2014) first applied this account to political materials when they investigated this form of proactive facilitation in its application to political "flip-flopping." In their study, the authors used a similar paradigm, but replaced the word lists with a series of political views of fictional politicians. Participants were presented with these views as the politicians portrayed them during two different debates, between which the politicians' stance changed on certain topics. In the third experiment of the study, participants were asked whether they noticed that the argument changed from the first debate to the second. After reading about both debates, participants were asked to recall the most recently presented position of each politician on individual issues, then were asked to indicate whether the politician had changed stances on the issue. The results showed the same pattern of proactive facilitation when changes were both detected and recollected, as well

as proactive interference when changes were detected but not recollected as in earlier studies (Wahlheim & Jacoby, 2013). The extension of earlier findings to the more naturalistic political positions allowed the authors to show that change detection and recollection could still have an effect when factors such as bipartisanship or other personal biases might be present. This study is of particular relevance to the current research, because of its use of naturalistic materials as study items.

Informational Conformity and Cohort Agreement

An additional factor that people use to help determine how much they believe information and therefore could interact with CIE is the number of people that agree with it (Schwarz, Newman, & Leach, 2016). Humans tend to conform, or change their own views or behavior, to the views of those around them. In classic demonstrations of this phenomenon, Asch (1956) showed that this could be seen in a group testing situation. In his experiments, participants were presented with a picture of a line and were asked to select another line that matched it in length. This was considered a very simple task: when tested individually, participants responded accurately 99% of the time. In the experiment, each participant was tested in a room with a group of confederates. In response to questions, a majority of the confederates verbally endorsed one of the incorrect answers. Even though the selected answer was clearly wrong, participants agreed with the answer of the group 37% of the time. Asch proposed that the conforming action was occurring because of peer pressure from the other group and participants' desire not to deviate from them.

Conforming to a crowd has also been shown to occur even when the participant's peers are not immediately present. Edelson and colleagues (2011) demonstrated that participants will conform to erroneous recollections of a group, even when their initial memory for an item was strong. In an initial session, participants viewed a documentary with a small group. They were then asked to return and complete a memory test three days later and again four days after that. During the second test, participants were also shown the pictures of the participants with whom they had viewed the documentary as well as what they were led to believe were the responses of those participants. Critically, these responses were fabricated to show the group unanimously selecting the wrong answer on some trials. Participants were found to conform to the majority in 68.3% of these trials, despite having answered correctly during the first test.

Crucial to the current study, participants completed one more memory test one week after the conformity manipulation. In this final test, participants were informed that the group members' responses that they saw in the second test were fictional, and yet they maintained false answers on 40% of the critical trials. This study shows that the belief of others can have a lasting effect on memory for information, even when the peers are not in the room to exert pressure. Therefore, participants must be using their peers as a source of evidence to support their decisions. However, one might note that when informed of the fictional nature of information from the second test, that warning could have brought some of those responses to mind and inadvertently increased the accessibility of the false responses. If this is related back to the dual-process work of Jacoby (1991), the percentage of false responses which were maintained would have

arisen because the participants recognized the responses but could not recollect where those responses were coming from.

Given information of ambiguous truth, people regularly look to the views of others to gauge how likely it is to be correct. This is particularly true if the participant believes their partner or cohort is more "powerful" than them (Skagerberg & Wright, 2009) or possess a better memory than the participant (Gabbert et al, 2007), and when the participant desires to maintain an accurate memory (Wright, London, & Waechter, 2010; Wright & Schwartz, 2010). Schwarz et al. (2016) propose that the agreement of a person's peers on a topic makes the information feel more familiar, which is used as an identifier when attempting to recall information if source memory fails. This could explain why the effects of studies of studies like Edelson et al. (2011) are observed even after delay and a retraction of the cohort's responses. If this indeed occurs, one would expect cohort agreement with misinformation to enhance the familiarity of the misinformation in memory and by extension decrease the effectiveness of any later retractions when recollection of the correction does not occur.

Recollecting Corrections of Misinformation

When CIE occurs, misinformation encoded initially supersedes corrections of that misinformation in memory, in a specific type of proactive interference. The MFC framework posits that proactive interference can be reduced by the recollection of change between the two sources of information. A natural addition to the literature was to bring these two together and ask whether recollection of change would also reduce CIE, using naturalistic misinformation. In two experiments, Alexander and Wahlheim (in

preparation) investigated the relationship between change detection/change recollection and the continued influence of misinformation. Inspired by the CIE studies of Ecker, Lewandowsky, and Swire, the study sought to expand upon the existing literature by using a paradigm that more closely resembled that used in the MFC studies. In doing so, they had the opportunity to study the roles of detecting and recollection change in rejecting misinformation, something that had not been previously addressed. In the initial study, participants were presented with two lists of statements. All of the misinformation statements were actual instances of "fake news" taken from online public media sources that had been presented to the public as true. To foreshadow, this naturalistic material set produced effects consistent with the predictions of both CIE and MFC.

In the first list, some items were misinformation statements, and some were accurate statements. Then, in the second list, correct statements were affirmed and misinformation statements were corrected. In addition, control items were added that were not shown in List 1. Following the presentation of each statement, participants were asked whether the statement they just viewed was a correction of a statement presented in the first list. When the participant responded that, yes, the statement was a correction of misinformation in List 1, they were then asked to enter the misinformation they saw earlier. After the completion of List 2, participants were asked a series of questions about the studied statements. After answering each question, participants were asked if they had been presented with a different answer in List 1. Here again, when they responded that the information had changed, they were asked to report the original misinformation.

The results showed that detection and recollection of the correction, as denoted by participants' reports of remembering change as well as their recall of misinformation when queued, between misinformation and the accurate information were associated with participants' ability to recall the accurate information at test. Corrected statements were recalled with significantly greater accuracy than that of control items which were unlikely to have been affected by item-specific interference. Misinformation items were erroneously recalled at test most frequently when participants detected the correction of misinformation during the study phase but forgot that it had occurred by the time of the test. This spike is presumably due to the increased familiarity of the misinformation caused by the retrieval practice that led to change detection, which participants use as a marker in lieu of having access to detailed memory of the item. As noted previously, change detection is associated with either proactive interference or proactive facilitation depending on whether the change is later remembered. In this instance of greater intrusion rates, what most likely occurs is that detecting the correction increased the familiarity of the misinformation. Then, when the participant attempted to recall the correct information at test, they had forgotten that change occurred and reported the more familiar response that came to mind, which was the misinformation.

Now that a substantial link between recollection of corrections and the accessibility of misinformation has been established, testing other factors that affect not only misinformation but belief in information as a whole, such as cohort agreement, will help establish the extensions as well as the limitations of this interpretation of CIE. Understanding the influence of cohort agreement is of particular import, as it is a constant

presence in the everyday experience of most Americans: social media sites provide a constantly accessible source of news information, both accurate and inaccurate. This information is often presented in coincidence with the opinions of viewers' friends and family, as well as a visual representation of how many people "like" or support the shared information. These factors may contribute to an effect that is visible in an empirical setting.

CHAPTER II

GOALS AND HYPOTHESES

The present study explored the interaction between factors affecting the recollection of corrections and reducing CIE. Specifically, this study examined the role of cohort agreement in determining the extent to which a statement is perceived as the truth, as well as when the change between misinformation and its correction is recollected at test. Studies have proposed that a driving factor of CIE is increased familiarity of misinformation following correction, resulting in the misinformation being more likely to be believed to be true. However, research guided by the MFC framework has shown that when people remember that the change has occurred when they are later asked about the information, they are often able to reject the initial information and report its replacement. Another factor that influences people's decisions and belief in information is the degree to which their decision aligns with that of their peers. We do not, as of yet, know how these factors interact with each other. This study will address that gap in knowledge by examining how cohort agreement affects initial beliefs in misinformation, change detection, and their downstream consequences on memory for factual information.

To investigate these effects here, I followed the method of Alexander and Wahlheim (in preparation) in using a modified A-B, A-D paradigm that includes

misinformation statements taken directly from publicly available media sources that were presented as true to viewers within the last five years. Participants studied two lists of statements and were subsequently asked to recall information they read. The first list consisted of some true and some misinformation statements. During this first list, participants were presented with a counter that represented a fictitious proportion of other participants that judged the statement to be true. After viewing this proportion, the participant was also asked to rate whether they believed each statement. The second list included only true statements that were repetitions or corrections of statements from the first presentation, and new items used as control items. During the second list, participants were also asked to report when they detected that a statement was a correction of a statement from List 1, and recall the misinformation when corrections were detected. Finally, they completed a cued recall test in which they were asked to report List 2 information, followed by reporting whether they were presented with misinformation pertaining to the topic in List 1. In the upcoming predictions, I refer to the accurate recall of misinformation during List 2 study as "detecting the correction," and the accurate recall of misinformation during the test as "recollecting the correction."

Based on results from Alexander and Wahlheim (in preparation), I predicted that participants would exhibit higher test performance in terms of questions correctly answered for items where misinformation was presented than for control items. This effect was expected to occur because participants are quite good at detecting corrections. Due to the association of detecting corrections with proactive facilitation when that correction is later recollected, this facilitation is expected to result in better performance

for these items than when correct statements are presented alone. I also predicted that when participants accurately detected and recollected the correction, they would show decreased reliance upon misinformation as exhibited by improved memory for corrected statements over control items, in accordance with findings from studies of the Memory-For-Change framework (Jacoby et al., 2015; Putnam et al., 2014; Wahlheim & Jacoby, 2013). Conversely, when participants detected the correction during study but did not recollect the correction during the test, reliance on misinformation would be boosted as shown by more intrusions of false information while recalling fewer corrected items.

I also predicted that when participants were informed that the majority of their peers believed misinformation items (majority-belief statements), they would rate the misinformation as believed more often than if they were informed that their peers disbelieved (majority-disbelief statements) the statement. This was predicted because information which is supported by peers is more likely to be believed (Festinger, 1954; Skagerberg & Wright, 2009; Gabbert et al, 2007). Furthermore, I predicted that corrected items that were associated with majority-belief would produce more intrusions of misinformation at test than either majority-disbelief statements or control items. This prediction also lead to the inverse prediction that majority-disbelief items would be more frequently rejected, shown by increased recall of correct information at test and decreased false recall of misinformation, over test performance for majority-belief items. Directly connected to this, I further predicted that majority-belief items would increase accurate change detection rates beyond the detection rates of majority-disbelief items, as majority-belief of the misinformation statement should make the correction more surprising to the

participant. This would then make any changes that occur more salient and more likely to be detected than when the cohort rated their belief in a statement as low.

Following these predictions of main effects of cohort agreement and recollection of corrections, I also predicted that the interaction of these two effects would have a polarizing effect on test performance. Specifically, I predicted that corrected statements in the majority-belief condition for which the correction was recollected would produce the highest proportion of accurate recall during the test phase. In addition, I further predicted that corrected statements in the majority-belief condition for which the correction was *not* recollected would produce the highest proportion of misinformation intrusions. These predictions were drawn from the earlier prediction that cohort agreement would increase detection rates for corrections, which should result in greater magnitudes of the downstream effects of that detection. If support from the cohort in misinformation increases the change detection rates, the downstream effects (facilitation or interference, contingent upon recollection of correction) can be expected to occur to a greater degree than the downstream effects of change detection in the majority-disbelief condition.

CHAPTER III

METHOD

Below I describe how sample size was determined, rules for excluding participants, and all manipulations used in the experiment (Nelson, Simmons, & Simonsohn, 2012).

Participants

The participants were 76 undergraduate students from the University of North Carolina at Greensboro recruited via an internal research participation system (Sona Systems Ltd.). A power analysis was conducted using the G*Power 3.1 software for one-way ANOVA analyses with set parameters of α=.05, Power (1-β)= .8, predicted effect size partial $\acute{\eta}^2$= .27 (a large effect size). The analysis recommended a sample size of 36 to observe an effect of this size or larger. This particular set of parameters was selected based upon the effect size found in another experiment studying the downstream effects of change detection (Wahlheim, 2015), which also included a manipulation of List 1 accessibility that affected detection of change in List 2. This study found a significant difference between items for which change was detected and items for which change was not detected with an effect size of Cohen's d = .6. Although the main focus of analyses in this study was construction of generalized linear mixed effects models; I powered the study for use with one-way ANOVA's due to a lack of literature regarding effect sizes or

powering for mixed effects models. Despite the small sample size recommended by G*Power 3.1, an increased sample was selected because it was unclear what magnitude of effect size should be expected in this study, as a manipulation of peer agreement in this context and population had not yet been conducted.

As a stopping rule, exactly 76 participants were to be tested initially, and additional participants would be tested to replace participants if needed. Before data collection began, I determined that participants' data would be excluded from analyses if they failed to follow the instructions or if the computer malfunctioned. Participants to be excluded were to be determined by critically analyzing notes taken by research assistants during data collection, before their data was analyzed. When a participant needed to be excluded for one of the reasons stated above, an extra participant would be recruited to replace the data before analyses began. All participants were able to complete the task, and thus 76 total participants were tested. The average age of participants was 19.21 years (*SD* = 2.56, Range = 18-37 years). Participants received partial course credit in a psychology class as compensation. (For more demographic information regarding the sample, see Table 1.)

Design

The study included one independent variable, which was Statement Type (Corrected [Majority-belief] vs. Corrected [Majority-disbelief] vs. Repeated vs. Control), manipulated within-subjects.

Materials

All of the experimental tasks and the demographics questionnaire were administered on Dell OptiPlex 7040 desktop computers, displayed using Dell E2417H LCD 24" monitors (1920 × 1080 pixel resolution). All programs for this study were designed using the E-Prime 2.0 (demographics questionnaire) and E-Prime 3.0 (experimental tasks) software (Psychology Software Tools, Pittsburgh, PA).

The materials comprised 120 statements (60 misinformation, 60 corrections) that were selected from various news sources (see Appendix A) by the author and trained research assistants. Before any statement was accepted as an addition to the material set, I personally reviewed it for accuracy and viability as test material. Each pair of statements (one misinformation statement and one correction) corresponded to 60 unique issue topics, such as international trade or green energy. Fake news statements included misinformation such as false statistics, debased accusations, and unkept political promises. As a result of the 2016 presidential election in the United States, many of the misinformation statements were collected from video recordings of presidential debates and rallies. To make sure that misinformation statements were coherent in the context of the current paradigm, statements had to be reworded and could not be transcribed directly. However, this allowed for the corrections to differ from the misinformation by changing only the critical detail, such as a category of industry or a statistic, minimizing the chance of any effects being attributed to the surrounding statement as opposed to effects of the manipulation. For example, the misinformation statement "President Obama took fewer vacation days than any other recent president" is corrected by the

statement, “President Clinton took fewer vacation days than any other recent president,” both of which fell under the unique topic label “vacation days.” Though the majority of items only differed by one or two words, no items deviated by more than seven words.

A possible issue that could arise from this type of material set is that participants could be subject to bias based upon the overlap between their political leanings and the political nature of the materials. Multiple strategies were implemented to avoid this. First, many statements were of ambiguous bipartisanship. For statements that included names, such as the aforementioned “vacation days” topic, statements and test questions were designed to not sound as if they were “attacking” one name or another. Finally, statements that dealt with potentially controversial subjects (i.e. investigation of voter fraud in the 2016 presidential election,) were deliberately chosen to make it unclear what political party it would serve (in this example, “In an investigation of the 2016 presidential election, no evidence of voter fraud was found.” did not make clear which party was being investigated). Items were counterbalanced so that studied items appeared as each statement type equally often across participants, resulting in four total conditions.

Procedure

Participants were tested individually with an experimenter present in sessions scheduled for one hour and thirty minutes. Upon arrival to the session participants were seated in front of a computer and provided with informed consent. They were then asked to complete an electronic demographics questionnaire. This questionnaire was not used for analyses but contains questions that may inform later studies. These questions

included topics such as political alignment, political activity, and time spent engaged with social media.

Before the main task began, participants were informed that they would be presented with a list of statements and that they should pay careful attention to each, as they would be tested on the information later in the experiment. Participants were instructed that they should read statements silently. They were also informed that they would be judging whether or not they believed each statement was true. The participants were told that data from previous participants' judgements of truth would be shown in the form of a numerical counter, revealed to them while they were asked to make a judgement of their own. Participants read the following cover story as a part of the task instructions:

The experiment in which you about to participate is part of a multi-university study investigating the effects of misinformation. As a part of this collaboration, you will be contributing to a database of responses judging whether information is correct or not. When prompted, select whether you believe the statement to be true; you will see the live counter onscreen update to record your response. Thank you for your contribution.

After reading and being read the experiment instructions, before the study presentation began, a fixation point appeared in the middle of a black screen for 2750 ms so that participants had an opportunity to orient themselves to where messages would appear. Beginning List 1, statements were presented on the computer screen individually for 8000 ms each. After the allotted time had passed, a prompt appeared below the statement text querying the participant's belief of the information. Below the prompt,

two buttons appeared labeled with a “thumbs up” and a “thumbs down” emoticon to represent ‘believe’ responses and ‘do not believe’ responses, respectively. In addition, a numerical counter appeared below each button displaying the number of fictional other participants that believed or disbelieved a statement.

The integer shown on each counter was selected randomly for each trial from a range of proportions of a consistent total sample of 1100. In the Majority-belief conditions, the ‘believe’ response counter showed an integer ranging from 65-75% of the total sample, while the ‘do not believe’ counter displayed the remainder of the total once the randomly selected integer was subtracted. In the Majority-disbelief conditions this proportion was reversed, with the ‘do not believe’ counter selecting an integer from the 65-75% range while the ‘believe’ counter displayed the remainder after subtraction. In repeated item conditions, the integers both fell in the 48-52% range, to remove the influence of cohort agreement without alerting the participants that something was fundamentally different about those items from the other two item types. Although unlikely, the possibility exists that participants could detect a pattern in the materials and know that any statements which presented near fifty-fifty peer-belief were true statements. However, because the focus of the hypotheses was the comparison between Majority-belief statements and Majority-disbelief statements, the global distribution of agreement-levels across statement types was deemed a higher priority than the small risk of noticing a pattern of true statements. All numbers were randomized at the start of each trial.

Participants were given 5000 ms to make their belief decision, and they were able to enter their response at any point during this time. Message text changed from white to yellow font to notify the participant that their answer had been recorded. The slide did not disappear until the full time had elapsed to hold study time constant. Each slide was followed by a blank screen that appeared for 250 ms. During this first list, participants were presented with 45 items (15 correct and 30 misinformation statements). Half of the misinformation statements were accompanied by a majority agreement to believe the information; the other half were accompanied by majority agreement to disbelieve the information; all correct statements were accompanied by a ~50/50 split agreement. All items were accompanied by a belief judgement.

After List 1, participants completed a distractor arithmetic task for ten minutes. In this task, participants were presented with simple addition problems and asked to report whether the solution to the problem was an even number or an odd number. Participants responded using the "1" key to respond "even" and the "2" key to respond "odd." Each problem stayed onscreen for 6000 ms before disappearing. When participants entered a response within the given time, the font of the text onscreen turned yellow to notify them that the response had been received. To make sure participants focused on the task at hand, they were warned that responding to less than 85% of the problems could result in them being removed from the experiment. Note, however, that no participants were dropped from analyses for this reason. This distractor task separated the two study lists for the purpose of bringing change detection rates down from ceiling to make variation in detection rates more readily observable. This task was deemed necessary following the

previous experiment conducted by Alexander and Wahlheim (in preparation), which found very high detection rates during study of List 2 (M = .83).

After completing the distractor task, participants were informed that some of the statements that they saw during the first phase were false and that they would be corrected for a second presentation. They were further informed of two other statement types: repeated items that were correct when they were viewed during the first list (the 15 correct statements from the first list), as well as a set of new items (15 control statements that only appeared in List 2). The control statements were used to evaluate proactive effects of memory, as they should not be subject to any item-specific interference (or facilitation). Note that all statements presented in this section of the study were accurate statements. Participants were again told to pay attention to each item for a later test. After the participant finished the instructions, a fixation point appeared for 2750 ms. Statements appeared onscreen individually for 8000 ms each. After each statement, participants were asked whether the statement just viewed corrected a statement they viewed in the first presentation. Participants responded with either 1 (Yes) or 2 (No) using the corresponding key on a keyboard. This slide stayed onscreen until the participant entered a response. When participants responded that, yes, the information did conflict with what they remembered seeing, they were then prompted to type in the misinformation they saw during List 1 to an answer box provided and submitted their response with the enter key. During this phase, the participant was presented with a total of 60 items. This 60-item set consisted of 15 correct statements from each statement type.

The presentation order of all information appearing in the first and second lists was random.

After List 2, participants took a cued recall test in which they were asked to report information seen during the second presentation of statements (see Appendix A for recall questions). Before the test began, participants were instructed to answer each question with information from the corrected statements that they saw during List 2. At test, participants were presented with 60 questions relating to the information viewed previously. Each question appeared individually and stayed onscreen until the participant input an answer. Participants submitted responses by typing their answer into an answer box provided. Participants were then asked whether they remembered seeing misinformation regarding the question. They responded to this question by pressing either 1 (Yes) or 2 (No) on the keyboard. If participants responded "yes," they were asked to report the earlier misinformation. Answers were again typed into a provided answer box and submitted by pressing Enter. Participants were instructed to answer all questions to the best of their ability, but they could pass by leaving the box blank and pressing Enter. Question order was randomized for each subject and did not match the order in which statements were presented in either List 1 or List 2.

Debriefing

Since misinformation was presented to participants, it was deemed necessary to hold a formal debriefing following the end of the experiment. The prevailing approach for explaining CIE predicts that the increased familiarity of misinformation following the presentation of its retraction will cause the misinformation to persist in memory when the

retraction is ineffective. Therefore, we must expect that in some cases a participant may continue to believe that the misinformation seen during the first portion of the experiment is actually the truth. Although this poses no risk to be harmful to the participant or others in the long run, it could be uncomfortable for the participant and should be addressed. To help alleviate this risk, participants were individually debriefed after each session, reminding them that not all of the information that they saw during the experiment was true and that if there was any topic they were curious about, they were encouraged to do background research on their own. Participants were also informed during the debriefing that the database to which they were told they contributed judgments was fictional. The final debriefing script (see Appendix B) was approved by the UNCG internal review board.

CHAPTER IV

RESULTS

The dependent measures included the following: subject-belief decisions for each List 1 statement, overt detection of corrections during List 2, recall of List 1 misinformation when corrections were detected during List 2, cued recall responses including recall of correct statements from List 2, overt recollection of corrections during test phase, and recall of misinformation from List 1 when corrections were recollected at test.

All given responses to test questions and misinformation prompts following change detection judgments were coded for accuracy by me and a trained research assistant. I trained the assistant by providing a written set of guidelines and required him to re-code a subset of data from a previously conducted study. After we both separately coded the responses, the two sets of coded responses were compared on average of agreement (items coded identically / total items) to ensure standardization of coding between coders. This initial percentage of agreement was 94.15%. We resolved disagreements through discussion.

All analyses were conducted using *R* software (R Core Team, 2018). This software was utilized to conduct logistic mixed effects models for various comparisons. These models included experimental factors as fixed effects, and subjects and items as

random effects. Including subjects and items as random effects was crucial to analyses because of the potential for an artifact of participants' bias regarding some topics. The level of significance was set at $\alpha < .05$ for all analyses.

Subject-Belief Ratings

To examine the effect of cohort agreement on whether participants believed a statement to be true, I compared subject-belief probabilities across statement types using a 3 (Statement Type) model. As prior research has shown that warning participants that they will encounter misinformation alleviates some of its effects by drawing their attention to it (Loftus, 2005), I expected that accurate statements would be more frequently believed than misinformation statements from either agreement condition. The model indicated a significant effect of Statement Type ($\chi^2(2) = 129.00$, $p < .01$). Post hoc tests indicated that the proportion of believed statements did not differ between repeated statements ($M = .55$, *95 % CI* = [.52, .57]) and corrections in the majority belief condition ($M = .55$, *CI* = [.52, .58]), $z = .16$, $p = .99$. However, the proportions of believed statements were significantly greater for both of those statement types than for corrections in the majority-disbelief condition ($M = .34$, *CI* = [.32, .37]), $z = 9.86$, $p < .01$.

Additionally, I predicted that misinformation statements would be significantly more likely to be subject-believed in the majority-belief condition than in the majority-disbelief condition. This was expected because participants are likely to use the responses of their cohort to make a decision if they are not sure of the information's veracity on their own (Sherif, 1936). Pairwise comparisons indicated a significant difference in

proportions between majority-belief (M = .55, CI = [.52, .58]) and majority-disbelief items (M = .34, CI = [.32, .37]), z = 10.01, $p < .01$. The combination of these two findings support the notion that participants use the beliefs of others to make decisions about their own beliefs. However, it cannot be discerned whether these differences reflected an effect on the participants' actual belief in the misinformation, or whether they reflected a reaction to demand characteristics.

Detection and Recollection of Corrections

To examine the effect of cohort agreement and subject-belief on rates of detecting and recollecting corrections, I compared proportions of misinformation accurately recalled across statement types and subject-belief responses using two 2 (statement type) by 2 (subject-belief) models. One model examined detection of corrections during the List 2 study phase, and a second model examined recollection of corrections during the Test phase. In both cases, recall of misinformation followed the participant's classification of a statement as corrected via button-press. While classification could be subject to response biases in which a participant might disproportionately favor one classification, accurate recall of List 1 misinformation is not. (For rates of correction classification and misinformation recall during List 2 and at Test, see Table 2.) For measures of signal strength (d' collapsed across majority-belief and majority-disbelief hit rates) and participants' selection strategy (c collapsed across repeated and control false alarm rates) see Table 3.

The model that examined misinformation recall during the Test phase included only items for which the correction was detected during List 2, as no a priori predictions

were made about changes which were not detected but spontaneously remembered during test. Statements of this type are also rare in paired-associate learning (e.g., Wahlheim & Jacoby, 2013). In this study, participants falsely reported no correction occurring during List 2 but accurately reported the correction having occurred at Test 4.6% of the time. However, when asked to report the List 1 misinformation under these conditions, no participant accurately did so.

I predicted that analysis of detection rates would indicate significant main effects of Subject-belief and Statement-type. Corrections of subject-believed statements were predicted to be detected more frequently than corrections to subject-disbelieved statements. In the predicted main effect of Statement type, it would be expected that corrections will be better detected more frequently for majority-belief statements than majority-disbelief statements. I predicted these two effects because in the case of majority-belief and subject-believed statements, the List 2 correction should come as a surprise if the List 1 misinformation was sufficiently encoded. The interaction between the Statement Type and Subject-belief was also predicted to be significant. However, the model (as can be seen in Table 2) did not indicate significant main effects of Statement Type ($\chi^2(1) = .02$, $p = .89$), Subject-belief ($\chi^2(1) = .25$, $p = .62$), or the interaction of the two ($\chi^2(1) = .35$, $p = .56$).

Statement Type and Subject-belief were expected to affect recollection of corrections at Test only to the extent which they affected detection rates. The model did not indicate significant main effects of Statement Type ($\chi^2(1) = .00$, $p = .98$) or Subject-belief ($\chi^2(1) = .00$, $p = .99$). The model did indicate a significant interaction between

Statement Type and Subject-belief ($\chi^2(1) = 4.42$, $p = .04$), showing that in majority-belief conditions participants were more likely to recollect change if they had not believed the misinformation, and that in majority-disbelief conditions they were more likely to recollect change if they had believed the misinformation. However, post hoc tests indicated that proportions of corrections recollected did not differ between conditions (smallest $p = .11$).

Cued Recall

To examine how cohort agreement, subject-belief, and the presence of misinformation affect memory for correct statements, I compared response probabilities for List 2 recall (Figure 1) and List 1 intrusions (Figure 2) across statement type using separate models. The 4 (Statement Type) model of correct recall of List 2 items was predicted to indicate that repeated items would be remembered best, changed items would be intermediate, and control items would be remembered worst, showing a significant main effect of statement type. This outcome was predicted based upon previous Memory-For-Change work, which has shown performance for changed items as higher than control items due to the facilitation associated with detecting and recollecting corrections (Alexander & Wahlheim, in preparation). In agreement with this prediction, the model indicated a significant main effect of statement type ($\chi^2(3) = 339.60$, $p < .01$). Items in the control condition were found to have the lowest recall rate compared to the other statement types ($M = .41$, $CI = [.38, .44]$) (largest $p < .01$). Repeated statements were most frequently recalled ($M = .74$, $CI = [.71, .76]$) (largest $p < .01$). Majority-belief

(*M* = .49, *CI* = [.46,.52]) and majority-disbelief (*M* = .52, *CI* = [.49, .55]) statements fell between these but were not different from one another (z = 1.50, *p = .42*).

I also predicted that subject-believed statements would be better remembered than subject-disbelieved statements for both majority-belief and majority-disbelief statements. To investigate this, I compared the proportions of accurate recall in a 2 (Statement Type) by 2 (Subject-belief) model.

If corrections of subject-believed statements are more frequently detected than corrections of subject-disbelieved statements, then the downstream facilitative effects of detecting corrections should drive up test performance for these statements to the extent that the correction is recollected. However, the model did not indicate a main effect of Subject-belief (χ^2 (1) = .10, *p = .76*). Post hoc tests indicated no difference between subject-believed items (*M* = .58, *CI* = [.56, .60]) and subject-disbelieved items (*M* = .59, *CI* = [.56, .61]), z = .15, *p = .88*.

It was also expected that the model would indicate an interaction between Statement Type and Subject-belief in which subject-believed, Majority-belief statements would show the highest test performance. This would be most likely to occur following the prediction that subject-believed, Majority-belief items would produce the greatest proportion of detected corrections, and the consequence of the downstream facilitative effects of detecting the correction. The model supported this prediction, indicating a Statement Type by Subject-belief interaction (χ^2(2) = 8.23, p = .02). Post hoc tests indicated that within repeated statements, subject-believed statements (*M* = .76, *CI* = [.73,

.79]) were better recalled than subject-disbelieved statements (*M* = .70, *CI* = [.66, .74]) z = 2.11, *p = .04*.

I predicted that the 4 (Statement Type) model of misinformation intrusions would indicate that corrected items produced the most intrusions and that repeated and control statements would not produce significantly different intrusions from each other. Finding significant proportions of intrusions from repeated or control items was unlikely because the participants were not presented with the intrusion response under these conditions. However, it is possible that these responses would occasionally be produced from pre-existing knowledge. This prediction was supported by the model which indicated a significant main effect of statement type ($\chi^2(3) = 213.59$, $p < .01$). Post-hoc tests indicated that although corrected statements produced the most misinformation intrusions as predicted, there was no significant difference between intrusions produced in the majority-belief and majority-disbelief conditions (z = .11, *p = .99*).

I also predicted that subject-believed statements would produce fewer overall intrusions than subject-disbelieved statements. This comes as a necessary, inverse result of the facilitative effects of correction detection on recall probability. To examine this, proportions of misinformation intrusions were compared using a 3 (Statement Type [Majority-belief vs. Majority-disbelief vs. Repeated]) by 2 (Subject-belief) model. This prediction was supported by the model, which indicated a main effect of Subject-belief ($\chi^2(1) = 12.82$, $p < .01$). However, post hoc tests did not indicate a significant difference in intrusion rates between subject-believed statements (*M* = .14, *CI* = [.13, .16]) versus subject-disbelieved statements (*M* = .12, *CI* = [.10, .13]), z = 1.31, *p = .19*.

I also predicted an interaction of Statement Type and Subject belief, in which subject-believed, majority-belief statements would produce the fewest intrusions. This was predicted as an inverse of the same interaction's effect on accurate recall. The model indicated a significant interaction ($\chi^2(2) = 9.80$, $p = .01$). Contrary to the prediction however, post hoc tests indicated that in the majority-belief condition, subject-believed statements ($M = .22$, $CI = [.19, .25]$) produced significantly more intrusions than subject-disbelieved items ($M = .14$, $CI = [.11, .17]$), $z = 4.03$, $p = .01$. This was also true of the majority-disbelief condition, in which subject-believed items ($M = .22$, $CI = [.18, .26]$) produced significantly more intrusions than subject-disbelieved statements ($M = .16$, $CI = [.14, .19]$), $z = 2.19$, $p = .03$.

Conditional Cued Recall

To investigate associations among detection and recollection of corrections and recall performance, responses to corrected statements were further separated by combinations of these two measures. Doing so resulted in the following four labels: "Detected," "Detected + Recollected," "Detected + Not Recollected," and "Not Detected." Response probabilities for List 2 recall and List 1 intrusions were computed for each of these categories. As only "Detected" items should create the boosted familiarity for misinformation that is the focus of CIE, and MFC most closely examines the downstream effects of detection, "Detected + Recollected" and "Detected + Not Recollected" items will be the primary focus of analyses, and will be compared against "Not Detected" items.

The proportions of accurate recall and misinformation intrusion rates were compared for Majority-belief and Majority-disbelief statements using separate 2 (Statement type) by 3 (Detection/Recollection ["Detected + Recollected" vs. "Detected + Not Recollected" vs. "Not Detected"]) by 2 (Subject-belief) models. I predicted that "Detected + Recollected" items would be the best remembered and "Detected + Not Recollected" items would be the worst remembered. The model supported this prediction, indicating a main effect of detecting and recollecting corrections ($\chi^2(2) = 227.22$, $p < .01$). Post hoc tests indicated that "Detected + Recollected" items ($M = .83$, $CI = [.81, .86]$) were better remembered than either "Detected + Not Recollected" ($M = .27$, $CI = [.22, .31]$) ($z = 13.30$, $p < .01$) or "Not Detected" items ($M = .49$, $CI = [.48, .51]$) $z = 13.61$, $p < .01$. "Detected + Not Recollected" items were the worst remembered, showing a lower rate of recall than items for which the change was not detected at all ($z = 3.00$, $p < .02$).

Following the expectancy that both cohort agreement and subject-belief would increase the detection of corrections, I predicted a three-way interaction of Statement Type, Recollection, and Subject-belief. Specifically, I predicted that within majority-belief, subject-believed items, "Detected + Recollected" items would be the best remembered and that "Detected + Not Recollected" items would be the worst remembered. However, the model did not indicate an interaction ($\chi^2(2) = 1.88$, $p = .39$). The model did indicate an interaction of Recollection and Subject-belief ($\chi^2(2) = 12.30$, $p < .01$). Post hoc tests indicated that within "Detected + Not Recollected" items, corrections of subject-disbelieved statements were better remembered ($M = .36$, $CI =$

[.29, .43]) than corrections of subject-believed statements (*M* = .17, *CI* = [.12, .23]), z = 3.02, *p* < *.01*.

In regard to misinformation intrusions, I predicted that the model would indicate a three-way interaction of Statement Type, Recollection, and Subject-belief. Specifically, I predicted that within majority-belief, subject-believed items, "Detected + Recollected" items would produce the fewest intrusions and that "Detected + Recollected" items would produce the most intrusions. I made this prediction because majority-belief and subject-belief were both expected to increase the detection of corrections as well as the downstream effects of detection. The model did not support this prediction, indicating no effect of the three-way interaction ($\chi^2(2) = .53$, *p* = *.77*).

The model did indicate a main effect of Subject-belief ($\chi^2(1) = 14.78$, *p* < *.01*). Post hoc tests indicated that subject-believed statements (*M* = .14, *CI* = [.13,.16]) produced more intrusions than subject-disbelieved statements (*M* = .12, *CI* = [.10,.13]), z = 4.85, *p* < *.01*.

The model also indicated a main effect of Recollection ($\chi^2(2) = 159.14$, *p* < *.01*). Post hoc tests indicated that "Detected + Not Recollected" items (*M* = .56, *CI* = [.50, .62]) produced more intrusions than "Not Detected" items (*M* = .10, *CI* = [.09, .11]), (z = 8.67, *p* < *.01*) and that "Not Detected" items produced more intrusions than "Detected + Recollected" items (*M* = .07, *CI* = [.05, .09]), z = 6.96, *p* < *.01*.

Finally, the model indicated an interaction between Subject-belief and Recollection ($\chi^2(2) = 13.32$, *p* = *.01*). Post hoc tests indicated that within "Detected + Not Recollected" statements, subject-believed statements (*M* = .73, *CI* = [.65, .81]) produced

more intrusions than subject-disbelieved statements (*M* = .39, *CI* = [.31, .48]) z = 4.92, *p* < *.01*. The difference between subject-believed and subject-disbelieved statements was not significant for "Detected + Recollected" items (z = 1.64, *p* = *.10*) or "Not Detected" items (z = 1.54, *p* = *.12*).

While the interaction between recollection of corrections and Statement Type (majority-belief vs. majority disbelief) was not significant, it is of note that (see figure 1 for accurate recall and figure 2 for intrusion rates) when corrections were detected but not recollected, the majority-belief condition was associated with numerically lower recall than the majority-disbelief condition (.21 vs. .30) as well as greater rates of intrusions (.26 vs. .25). This may imply that if the participants' ability to recollect corrections were reduced, such as by a delay between study and test, the effect of cohort agreement could become significant. However, since this was not the case in the current analysis, this interpretation should be approached cautiously.

CHAPTER V

DISCUSSION

In this experiment, I examined the effect of cohort agreement, subject-belief of information, and detection/recollection of corrections on later recall of correct information. To accomplish this, I presented participants with a mixed list of accurate and misinformation statements, then corrected misinformation by presenting a new list of all accurate statements, and finally tested them on the information that they had read. This experiment attempted to manipulate the likelihood of subjects believing each statement by presenting them with a number of people that either believed or did not believe the information. The experiment collected subject-belief judgments about information, detection rates of corrections, recall performance via cued-recall test, and recollection of corrections during the test phase. Recollection of corrections significantly reduced CIE, as shown by increased recall of corrections and reduced misinformation intrusions, but did not eliminate it. Although the cohort agreement manipulation did not produce significant differences in test performance, the fact that the results were numerically in the direction of the predicted effects alludes to the notion that the effect could be drawn out by a different manipulation, as will be further discussed below.

The primary focus of this study was to investigate the role of cohort agreement and subject-belief of information in later detection and recollection of corrections to

misinformation. The experiment replicated previous study of the role of change detection and recollection in showing that recollecting corrections at test resulted in proactive facilitation rather than proactive interference as seen in CIE. Facilitation was shown by increased rates of accurate recall and fewer intrusions of misinformation at test. It further replicated findings from Alexander and Wahlheim (in preparation), showing that when corrections were detected during the study phase but were not remembered during the test phase, participants exhibited proactive interference of misinformation as shown by decreased recall of accurate information and increased rates of misinformation intrusions. These findings are consistent with predictions of the MFC framework, which predicts reduction of proactive interference buildup to be driven by recollection of change. The findings are also consistent with previous CIE work, in that recollection reduced CIE but did not eliminate it.

Despite the successful replication of previous work, the additional manipulation of cohort agreement did not affect recollection of corrections or recall performance. During the first study phase, participants were significantly more likely to respond that they believed a statement when the fictional cohort also believed it to be true than when the cohort believed the statement to be false. This finding is consistent with research showing that individuals will use the beliefs of others to inform judgements (Sherif, 1936). However, cohort belief was not found to produce differences in rates of detection or recollection of corrections to misinformation. Neither was it found to produce significant differences in either correct recall or misinformation intrusions. The subjects' judgements of belief additionally did not produce differences in rates of detection,

recollection of corrections. or recall of accurate information. Misinformation statements that were believed by the subject initially, however, did produce higher rates of misinformation intrusions than statements that were not believed by the subject.

Although subject-believed statements initially showed higher rates of accurate recall than statements that were not subject-believed, this effect was no longer significant after conditionalizing recall on the detection and recollection of misinformation. As discussed above, there was a significant effect of detecting and recollecting corrections on both accurate recall as well as misinformation intrusions. An interaction was shown in items for which change was detected during the study phase but not recollected at test, in that initial disbelief of the misinformation resulted in fewer intrusions of that information than when it was believed. This may point to a difference in how participants approach correcting misinformation. One plausible explanation is that when participants actively question the veracity of a statement, they are better able to reject the misinformation from memory when it is corrected, as opposed to when they initially perceived the misinformation as being accurate. This would fit with the work of Ecker, Lewandowsky, and Tang (2010) that showed that being warned of upcoming misinformation helped reduce the processing errors involved with CIE.

The absence of effect from the cohort agreement manipulation could be interpreted in multiple ways. One argument would be to take at face value that while cohort agreement affects participants' judgments of belief, it does not have an effect on familiarity of the information or any downstream effects on the ability to detect and recollect change. The other approach, and the approach that I am taking in this report, is

to argue that the format of the manipulation did not have a strong enough impact on the participants to produce the expected results. Previous research examining cohort effects typically involve interaction with other participants or confederates, which may make the effects of cohort beliefs more salient and believable (Edelson et at., 2011; Sherif, 1936). Given that this study never had participants interact with others and relied upon numerical representations of a cohort, it is possible that the effects of the cohort decision were diminished. I recommend that another experiment be conducted in this line of research which uses live confederates to manipulate cohort agreement. Doing so would better model other studies of cohort effects and has the potential to draw out effects that may be present but not observed in the current study.

Another possible interpretation is that participants were not as affected by the cohort belief manipulation due to preexisting knowledge or emotions about real-world information. Despite best intentions to remove bipartisanship or moral assertions from the study material, the inherently political nature of real-world misinformation items makes it possible that the participants already have preexisting notions about certain topics. As previous research has shown that cohort effects are especially present when information is ambiguous (Skagerberg & Wright, 2009, Gabbert et al., 2007), these preexisting notions may overshadow any influence by the cohort. For example, if a participant has strong preexisting opinions about gun control, the beliefs of the cohort may be irrelevant to the participant regarding any statement around this topic.

Even though the cohort agreement manipulation did not produce the predicted effects, this experiment contributes to the literature by replicating of results from prior

research. Specifically, it conceptually replicated the effects of change recollection shown by studies within the MFC framework (Jacoby, Wahlheim, & Kelley, 2015; Wahlheim & Jacoby, 2013) as well as replicated findings of studies using more naturalistic materials such as the shifting political stances used by Putnam, Wahlheim, and Jacoby (2014). While the predictions of the MFC framework are reliably reproduced across experiments, the use of real-world fake news items is a relatively new addition to the literature and benefits from the replication of predicted effects. The effects of detecting and recollecting change help clarify when CIE is most likely to occur and when it can be avoided. Therefore, more research should be conducted to explore the effects of factors known to affect the familiarity of information such as cohort agreement and the downstream effect on detection and recollection or corrections.

This study also presented multiple strengths in its design. The use of real-world fake news items as stimuli provides a constantly expanding source of naturalistic materials. The paradigm used in this experiment allows for the presentation of these items in a way analogous to a participant's experience scanning a website and scrolling by news article titles. These items are taken from sources applicable to the national public, and thus are not geographically locked to use in one location within the United States. These materials can be shared between researchers and between labs to maintain consistency of material sets for replication and expansion for as long as the information within continues to be relevant to the public.

The line of research combining CIE and the MFC framework is an important addition to the scientific literature in part due to its application to educating the public

about the effects of misinformation. As a whole, the research provides perspective on when misinformation will have the most deleterious effect and how it can be avoided. This study showed this in replication of correcting recollections' reducing CIE. To follow, knowledge of when recollection is most likely to occur may inform new practices intent on reducing the spread of misinformation.

In summary, recollection of corrections continues to present itself as a critical factor in reducing CIE. Therefore, understanding what factors contribute to the probability of recollecting corrections will continue to be an important line of research due to its potential real-world applications. Although the role of cohort belief as examined in this study did not produce significant effects on recall performance or misinformation intrusions, I do not think that setting aside cohort agreement as a manipulation would be the right decision moving forward. It is possible that the manipulation did not influence participants as much as I anticipated, but that a stronger manipulation would draw out effects that are present but unobserved here. Taking this stance, I recommend follow-up studies make the manipulation of cohort agreement through the use of live confederates.

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APPENDIX A

TABLES

Table 1

Demographics Information

Question	Response	%
Sex	Female	0.70
	Male	0.30
Bipartisanship	Democratic	0.47
	Republican	0.12
	Independent	0.24
	Other	0.05
	Declined Response	0.12
Actively Votes	Yes	0.57
	No	0.39
	Declined Response	0.04
Ethnicity	African American	0.38
	Asian or Pacific Islander	0.04
	Caucasian	0.39
	Hispanic or Latino	0.10
	Other	0.08
Handedness	Right	0.93
	Left	0.07

Table 2

Correction Detection and Recollection Rates

	Subject Belief			
	Subject-believed		Subject-disbelieved	
Statement Type	Classified prop	Misinformation Recall	Classified prop	Misinformation Recall
Correction Detection (List 2)				
Repeated	.10 [.06,.12]	.01 [.00,.01]	.12 [.09,.15]	.00 [.00,.01]
Control	.14 [.12,.16]*	.00 [.00,.01]*	.14 [.12,.16]*	.00 [.00,.01]*
Majority-belief	.71 [.67,.75]	.51 [.47,.55]	.76 [.72,.80]	.55 [.50,.59]
Majority-disbelief	.79 [.74,.82]	.54 [.49,.59]	.72 [.69,.75]	.51 [.48,.55]
Correction Recollection (Test)				
Repeated	.12 [.10,.15]	.01 [.00,.02]	.15 [.12,.18]	.02 [.01,.03]
Control	.09 [.08,.11]*	.01 [.00,.02]*	.09 [.08,.11]*	.01 [.00,.02]*
Majority-belief	.53 [.50,.58]	.38 [.35,.42]	.64 [.60,.69]	.48 [.43,.52]
Majority-disbelief	.61 [.56,.66]	.43 [.38,.48]	.58 [.55,.62]	.42 [.38,.46]

*Because control items do not receive Subject-belief ratings, the averages in these cells are the average of all control statements.

*Bootstrap 95% confidence intervals appear in brackets.

Table 3

Signal Detection Theory Measures

Phase	d'	*c*
Detection (List 2)	1.67 [1.45,1.89]	.06 [.04,.07]
Recollection (Test)	1.67 [1.45,1.88]	.06 [.04,.07]

*Bootstrap 95% confidence intervals appear in brackets.

APPENDIX B

EXPERIMENTAL MATERIAL SET

Topic	Misinformation	Correction	Test Q
Disease-I	12 veterans were killed by disease in Illinois after uncontrollable flooding led to a	12 veterans were killed by disease in Illinois after the governor hesitated to respond to a	What led to the deaths of 12 veterans in Illinois by disease?
Gun Cont	10 states in the US prohibit a state-wide gun registry.	7 states in the US prohibit a state-wide gun registry.	How many states in the US prohibit a state-wide gun registry?
Educatior	As high as 50 percent of new teachers in Texas are without college degrees.	A maximum of 1.5 percent of new teachers in Texas are without college degrees.	About what percentage of new teachers in Texas are without a college degree?
NASA	A second moon distantly orbits the Earth, according to Nasa scientists.	A small asteroid distantly orbits the Earth, according to Nasa scientists.	According to NASA, what is distantly orbiting the Earth?
Military_	As of 2018, members of the U.S. military had not received a raise in 10 years.	As of 2018, members of the U.S. military had received a raise every year since 1983.	With what frequency have members of the US military received pay raises in recent years?
Coffee	As of the year 2000, coffee is the second most traded commodity in the world.	As of the year 2000, coffee is the fifteenth most traded commodity in the world.	What rank does coffee hold in most traded commidities as of the year 2000?
Black Ho	Black homeownership hit its highest level in the history of the US in 2017.	Black homeownership hit its highest level in the history of the US in 2004.	In what year did black homeownership reach its highest level?
Cali-State	California has passed a law that will fine homeowners $10,000 dollars a day for c	California has passed a law that will fine cities $10,000 dollars a day for overusing wat	Who will be fined by the state of California for overusing water?
Trump- w	California representatives have asked for the building of a border wall.	California representatives have sued to stop the building of a border wall.	How did Californians react to the idea of a border wall?
Tariffs	Canada places a 270% tariff on all American dairy products.	Canada places a 270% tariff on American dairy products above a surplus quota.	What American dairy products does the Canadian government place a high tariff on?
Carbon F	Wind energy's carbon footprint is larger than coal energy's.	Coal energy's carbon footprint is almost ninety times larger than wind energy's.	What energy source mentioned leaves the largest carbon footprint?
DeltaAirl	Delta Airlines now gives discounts to members of Planned Parenthood, but not the	Delta Airlines does not give discounts to members of Planned Parenthood or the NRA.	To members of what major organizations does Delta Airlines give discounts?
Politics-C	Republican Mitt Romney claims that Donald Trump "has serious emotional problie	Democrat Bernie Sanders claims that Donald Trump "has serious emotional problems, a	Who claimed that Donald Trump "has serious emotional problems?"
Sanctuary	Donald Trump has promised to arrest the leaders of "Sanctuary Cities" in the Unit	Donald Trump has promised to withdraw federal funding from "Sanctuary Cities" in the	What has Donald Trump promised to do in response to "Sanctuary Cities?"
Flu_Hydr	Staying well hydrated is your best protection against the flu.	Getting the vaccine is your best protection against the flu.	What is the best protection against the flu?
Global_W	Global warming will cause more snow in Antarctica, outweighing the rate its ice i	Global warming will cause more snow in Antarctica, but will not outweigh the rate its ic	How does the increase in Antarctica's snow caused by global warming relate to the rate ice is melting?
Hurricane	Hurricane Harvey left more than twelve million residents of Texas homeless.	Hurricane Harvey left more than one million residents of Texas homeless.	How many residents of Texas were left homeless by Hurricane Harvey?
Illegal_In	Illegal crossings at the Mexican border has decreased by 40% since 2016.	Illegal crossings at the Mexican border has decreased by 25% since 2016.	By what percentage has the number of illegal border crossings changed since 2016?
Trump-In	Illegal traffic apprehensions increased by 78% from November 2016 to July 2017	Illegal traffic apprehensions dropped by 61% from November 2016 to July 2017.	By what percentage did illegal traffic apprehensions change from November 2016 to July 2017?
Clinton-N	In 1994, President Clinton gave North Korea $3 billion in aid.	In 1994, President Clinton gave North Korea $1.4 billion in aid.	How much money did the Clinton administration give to North Korea in aid?
UN_Reso	In 2016 the UN passed 24 resolutions, twenty of which singled out Israel.	In 2016 the UN passed 329 resolutions, twenty of which singled out Israel.	How many resolutions did the UN pass in 2016?
Mass sho	In 2017, 270 shootings occurred that killed more than four people.	In 2017, 19 shootings occurred that killed more than four people.	How many shootings occurred in 2017 that resulted in 4 or more deaths?
Immigrati	In 2018, a young immigrant boy was placed in a small animal cage after he was se	In 2018, a young immigrant boy was placed in a small animal cage as part of a protest ag	Under what circumstances was a young boy placed in a small animal cage in 2018?
Economy	In Japan, American cars are tested by having a bowling ball dropped on them.	In Japan, American cars are tested by simulating hitting a pedestrian.	How are American cars tested in Japan?
Liberian_	In Liberia, less than 38% of young women are able to read at age 18.	In Liberia, around 60% of young women are able to read at age 18.	In Liberia, what percentage of young women are able to read?
Popular_	In the 2016 presidential election, Donald Trump won the popular vote by over two	In the 2016 presidential election, Hillary Clinton won the popular vote by over two mill	Who won the popular vote in the 2016 presidential election?
Tennesee	In the early 2000's, Tennesee's unemployment rate almost doubled due to bad lead	In the early 2000's, Tennesee's unemployment rate almost doubled due to the great recess	What caused a spike in Tennesee's unemployment rate in the early 2000's?
Gun_Con	In the US, 25% of firearms are sold without background checks.	In the US, 13% of firearms are sold without background checks.	About what percentage of firearms are sold without background checks in the US?
Green En	In US energy, there are currently more jobs in the solar industry than there are in a	In US energy, there are currently more jobs in the oil industry than there are in any other	What energy based industry currently provides the most jobs in the US?
2020_Bic	Joe Biden claimed in an interview that he is definitely going to run for president in	Joe Biden claimed in an interview that he is unlikely to run for president in 2020.	What did Joe Biden claim about his candidacy for election in 2020?
News sou	More than half of Americans report getting their news from Facebook.	Less than half of Americans report getting their news from Facebook.	What proportion of Americans report getting their news from Facebook?
Missouri_	Missouri's unemployment rates dropped to their lowest levels in history under Pre	Missouri's unemployment rates dropped to their lowest levels in history under President	Under what president did Missouri's unemployment rates reach their lowest levels?
Kenya_M	More Kenyans die from malaria every year than any other condition.	More Kenyans die from auto-immune disease every year than any other condition.	What is the leading cause of death for Kenyans?
Africa_R	Music makes up the third largest export revenue source of Africa.	Music makes up 0.1% of the export revenue of Africa.	What proportion of Africa's export revenue is supplied by music?
Voter_Fr	Substantial evidence of voter fraud was uncovered in relation to the 2016 election	No proof of voter fraud in the 2016 presidential election has been found.	What were the results of investigation of voter fraud In the 2016 presidential election?
Flu_Age	Only older people need a flu vaccine.	People of all ages should get a flu vaccine.	What age range of people should receive a flu vaccine?
GunContr	Police may confiscate a citizen's firearm at any time.	Police must acquire a warrant to confiscate a citizen's firearm.	Under what conditions may a police officer confiscate a citizen's firearm?
Pope_Gu	Pope Francis claims that gun owners claiming to be Christian are untrustworthy.	Pope Francis claims that gun manufacturers claiming to be Christian are untrustworthy.	Who did Pope Francis refer to as "untrustworthy?"
Abortion-	Pop-star Justin Bieber's views on abortion were "pro-choice" until just recently.	Pop-star Justin Bieber's views on abortion have been steadily "pro-life" in recent years.	What have Justin Bieber's views on abortion been in recent years?
Pres_Vac	President Obama took fewer vacation days than any other recent president.	President Clinton took fewer vacation days than any other recent president.	Which recent president took the fewest vacation days?
Trump-Le	President Trump signed more legislation than any other president in his first year i	President Trump signed less legislation than any president since World War II in his firs	How much legislation did President Trump sign in his first year, in relation to other presidents?
Alabama	Prior to 2017, the Alabama senate seat had been held by a republican for 30 years.	Prior to 2017, the Alabama senate seat had been held by a republican for 21 years.	For how many years had the Alabama senate seat been held by a republican, prior to 2017?
Car Head	Removable headrests in cars are designed to break out a window if needed.	Removable headrests in cars are designed to prevent whiplash if needed.	For what purpose are removable headrests in cars designed?
Rep_Con	Republicans last controlled the white house, house of representatives, and the sena	Republicans last controlled the white house, house of representatives, and the senate in 2	When was the last year that republicans controlled the white house, house of representatives, and the senate?
Voter Tur	The 2016 presidential election had the lowest voter turnout in since 1996.	The 2016 presidential election had a higher voter turnout than the previous, in 2012.	In what year was the last presidential election which featured lower voter turnout than that of 2016?
NC-Educ	The 2018 NC Education budget left most schools without supplies, though it favor	The 2018 NC Education budget provided all schools with supplies, though it favors one	How does the 2018 NC education budget affect schools' access to supplies?
Race/Pro	The first athletes to use their sport for protest were NFL players.	The first athletes to use their sport for protest were US Olympians.	What type of athletes were the first to use their sport for protest in the US?
Economy	The gross domestic product (GDP) growth rate has not been below zero since 194	The gross domestic product (GDP) growth rate has been below zero in 42 instances sinc	About how many times has the gross domestic product growth rate dropped below zero since 1946?
Tax_Allo	The majority of American taxes are spent on military programs and the "War on Te	The majority of American taxes are spent on social programs such as Medicare.	What type of program does the majority of tax-payers' money go towards?
Murder_y	The murder rate in the US reached its all-time high in 2017.	The murder rate in the US reached its all-time high in 1980.	In what year did the murder rate in the US peak?
US_Unem	The official unemployment rate in the US is around 36%.	The official unemployment rate in the US is around 8%.	What is the estimated unemployment rate in the US?
President	The price of gas has dropped 40% under the Trump administration.	The price of gas dropped 40% under the Obama administration.	Under what presidential administration did the price of gas drop by 40%?
Gas_2018	The price of gasoline rose 25% in the first half of 2018.	The price of gasoline rose 15% in the first half of 2018.	How did the price of gas change in the first half of 2018?
Vaccines_	The scientific community agrees that vaccines cause autism.	The scientific community agrees that vaccines do not cause autism.	What is the scientific community's stance on vaccines and autism?
Trump-Bu	The Trump administration is cutting the CDC budget by about 80 percent.	The Trump administration is cutting the CDC budget by about 20 percent.	About what percentage of the CDC budget is being cut by the Trump administration?
Energy_In	The United States produces more energy than it consumes, making it energy indepe	The United States consumes more energy than it produces, making it energy dependent.	How much energy does the US consume, in relation to how much it produces?
Chess	The United States has no competitve chess players at the rank of Grandmaster, far	The United States has ninety competitive chess players at the rank of Grandmaster, fewe	How many competitive chess players in the US have attained the rank of Grandmaster?
Residing_	There are approximately 32 million illegal immigrants residing in the USA.	There are approximately 11 million illegal immigrants residing in the USA.	About how many illegal immigrants currently reside in the USA?
Race_Sta	Two young African American men arrested in a Startbucks settled lawsuits for $2	Two young African American men arrested in a Startbucks settled lawsuits for $2.	How much money did two young African American's settle for in a case against Starbucks coffee?
Teen Dru	US teens report finding it easier to acquire marijuana than alcohol.	US teens report finding it easier to acquire alcohol than marijuana.	What substance do US teens report as being easiest to acquire?

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APPENDIX C

DEBRIEFING SCRIPT

“Earlier in this study you were asked to report whether or not you believed statements to be true, under the assumption that these responses were being added to a database of responses across multiple universities. This database is fictional, and the counters that you were presented with do not reflect the actual beliefs of students at this university or at any other university. This manipulation was introduced as a way of studying the effects of peer’s beliefs on individual judgements, and should not be taken as a measurement of how trustworthy information is or how many other people believe it to be true.

Furthermore, while you were shown only information that is true to the best of our knowledge in the second list of statements, some of the information in the first list was selected from false statements made by popular media sources. Knowing this, do not take any information for granted, and research information on your own before making decisions about whether to believe it. By doing so, you can ensure that you are improving your own knowledge as well as helping to stop the spread of misinformation.

Thank you for your participation in this study, and if you have any questions, please do not hesitate to ask your experimenter or contact the primary investigator and their faculty advisor.”

APPENDIX D

FIGURES

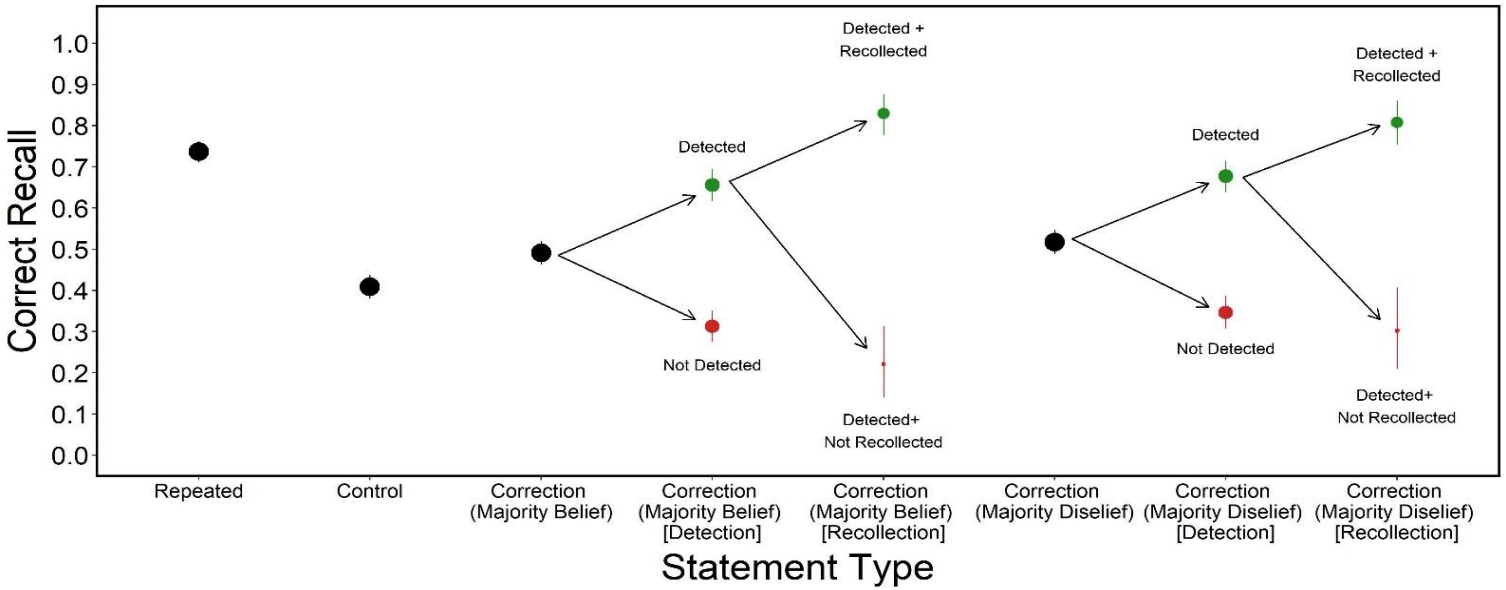

Figure 1. Conditionalized Recall Rates of List 2 Information.

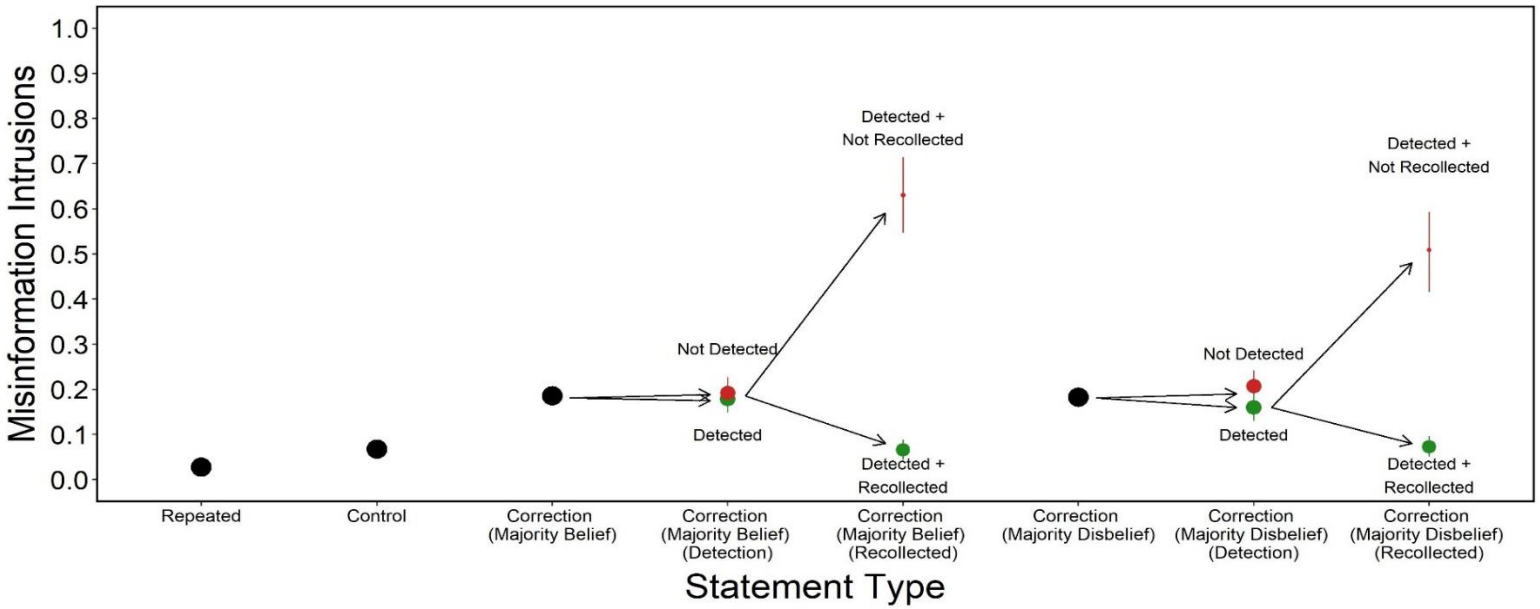

Figure 2. Conditionalized Intrusion Rates of List 1 Misinformation.