**The effects of memory distrust toward commission and omission on recollection-belief correspondence and memory errors**

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## Contributor Roles Taxonomy

In the table below, we employed CRediT ([Contributor Roles Taxonomy](https://credit.niso.org/)) to identify the contributions and roles played by the contributors in the current research effort.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Yikang Zhang | Henry Otgaar | Robert A. Nash | Chunlin Li |
| Conceptualization | X | X | X | X |
| Data curation | X |  |  |  |
| Formal analysis | X |  |  |  |
| Funding acquisition |  | X |  |  |
| Investigation | X | X | X | X |
| Methodology | X | X | X | X |
| Project administration | X |  |  |  |
| Resources |  |  |  |  |
| Software |  |  |  |  |
| Supervision |  | X | X |  |
| Validation |  |  |  |  |
| Visualization | X |  |  |  |
| Writing-original draft | X | X | X | X |
| Writing-review and editing | X | X | X | X |

# Abstract

Our appraisals and beliefs about our memory functioning shape how we reconstruct and report specific memory episodes. Research has shown that people differ in the extent to which they are sceptical about their memories, which is termed memory distrust. In general, memory distrust has two aspects: distrust over forgetting (i.e., making omission errors) and distrust over falsely recollecting events that did not happen (i.e., making commission errors). Although these two aspects of memory distrust have been studied, how they are associated with memory validation (e.g., the formation of autobiographical belief) and reporting remains unclear. In the present study, we plan to examine the effect of metacognitive appraisals on the memory validation process as well as the commission and omission errors in memory reporting. Specifically, participants will first complete a memory task where they either receive inaccurate feedback regarding making commission errors or making omission errors, or they receive no feedback. Then, they will complete another new recognition task. We expect that compared to the control group with no feedback, participants receiving feedback on their errors will show larger belief-recollection divergence (i.e., smaller correlations between ratings). Further, people who receive feedback indicating a tendency to make commission errors in the first memory task will make more omission errors in the second task and show a shift toward a more conservative response criterion. Conversely, individuals who receive feedback suggesting a tendency to make omission errors will show an increase in commission errors during the second task, demonstrating a shift toward a more liberal response criterion.

*Keywords*: Memory distrust, misinformation, response criterion, commission errors, omission errors

# Introduction

In most instances of remembering, the rememberer trusts that the recollected event truly happened in the past. Such event representations, which encompass both vivid recollection and a firm belief in the event’s occurrence, are referred to as believed memories. However, there are other types of event representations in addition to believed memories. For some events, people can hold strong beliefs about their occurrence without any recollections about them, such as the celebration of your first birthday (believed-but-not-remembered events). More interestingly, in some instances, people can recollect certain events vividly but do not believe the events have happened in the past. The latter phenomenon is known as nonbelieved memories (NBMs, Mazzoni et al., 2010; Otgaar et al., 2014). Cases where the recollection and belief of a memory diverge reveal that autobiographical recollection and belief of an event are two related but distinct constructs (Clark et al., 2012; Mazzoni et al., 2010; Otgaar et al., 2014, Scoboria et al., 2014).

The dissociation between recollection and belief can also be observed in other ways. Scoboria et al. (2014) reported that memory characteristics that predict recollection ratings well (e.g., perceptual, re-experiencing, emotion intensity, event specificity) did not predict belief ratings and vice versa (e.g., plausibility judgment). Furthermore, studies on nonbelieved memory showed that autobiographical beliefs can be altered relatively easily —more so than can recollections—in response to social information contradicting one’s memories (Li et al., 2020; Otgaar et al., 2013, 2017; Scoboria et al., 2018; Wang et al., 2017). On the other hand, in the course of forming false memories, false beliefs can be created more easily relative to false recollections (Mazzoni et al., 2001; Pezdek et al., 1997). People who start to falsely believe a suggested event may then utilize general scripts for similar events, or memory details of other episodes, to develop their recollections (Pezdek et al., 1997).

these recollection-belief ies or believed-not-remembered eventsSpecifically, Blank proposed a theoretical framework of remembering that distinguishes memory, belief, and the communication of memory (e.g., memory reporting) and elaborates on the role of social influence in remembering (2009). First, memory traces are activated through either internal processes (e.g., intentional searches) or external cues (e.g., verbal prompts). The second stage, involves a validation process, in which the validity of the memory is inferred from both the retrieved internal information and from external information (e.g., physical evidence or social feedback) to form a (memory) belief. Finally, the rememberer decides whether or not to communicate and how to communicate the belief to others. see also , Scoboria & Henkel, 2020

Expanding this theoretical framework, recent research brings to the discussion the roles of beliefs and appraisals in the process of memory validation (e.g., Nash et al., 2023; Zhang et al., 2022a, 2022b). More specifically, researchers have argued that memory distrust, defined as the sceptical perception or appraisal of one's own memory functioning, contributes to the formation of false memory and nonbelieved memory (Nash et al., 2023; Zhang et al., 2022b). The term “memory distrust” was first coined by Gudjonsson and MacKeith (1982) to describe a phenomenon in which interviewees in a forensic context develop profound distrust towards their memories due to inappropriate investigation practices. Subsequently, researchers expanded the concept of memory distrust to denote a more general and stable appraisal of one’s memory functioning (Nash et al., 2023; van Bergen et al., 2010). As of now, there exist two validated scales measuring trait memory distrust: the adapted Squire Subjective Memory Questionnaire (SSMQ, Squire et al., 1979; van Bergen et al., 2010) focuses on people’s beliefs about their susceptibility to memory omission errors (i.e., forgetting) whereas the Memory Distrust Scale (MDS, Nash et al., 2022), which measures beliefs about susceptibility to commission errors (i.e., falsely remembering events which never happened).

Zhang et al. (2022a, 2022b) argued that while evaluating one’s recollection against external information, people differ in the extent to which they trust their recollections. Specifically, people with high memory distrust (vs. low memory distrust) would give less credence to their recollections and would in turn lower their memory beliefs. Building on this premise, Zhang et al. (2022a, 2022b) examined the relationship between memory distrust (as measured by the SSMQ) and nonbelieved memories, finding that people with high memory distrust were more likely to report nonbelieved memories than those with low memory distrust. Similarly, using an indirect recall method, in which participants were given cues to recall past events and then rated their recollections and beliefs about those events, Nash et al. (2023) found that people who reported nonbelieved memories, compared with people who did not, scored higher on average on memory distrust (as measured by the MDS). Furthermore, in one study, individuals with high or low memory distrust differed in their chosen strategies for verifying personal memories (Zhang et al., 2023a). In Zhang et al.’s (2023a) research, people with high (vs. low) memory distrust, when confronted with the possibility of erroneous memory, were more likely to use low-cost but less reliable verification strategies (e.g., seeking information from other people), thus exhibiting a greater cheap-and-easy strategy bias (Nash et al., 2017; Wade et al., 2014), and they seemed less likely to rely on their recollections for making belief judgments, even in the absence of external information (Zhang et al. 2024).

A more nuanced picture of the relationship between memory distrust and memory appraisal was revealed through analyses using the Signal Detection Theory (SDT, Green & Swets, 1966). SDT is a framework designed to analyze people’s ability to differentiate between signal and noise (i.e., sensitivity or discriminability) and their thresholds for deciding that a given stimulus is a signal (i.e., response criterion), in decision-making processes such as recognition memory. For example, some people may have a very conservative response criterion and therefore only judge a stimulus as signal when the evidence is strong, resulting in them making few false alarms but also having relatively poor correct recognition of the signal (i.e., hits). Others, in contrast, might respond more liberally, requiring more moderate evidence for judging a stimulus as signal, and therefore making more hits and more false alarms. Zhang et al. (2023c) reported a positive association between participants’ scores on the MDS (but not SSMQ) and the response criterion index *β*, with higher values indicating a more conservative response bias (i.e., a bias toward judging stimuli as new in a recognition task). However, in another study (Zhang et al., 2024), higher memory distrust as indexed by the MDS was negatively associated with *β,* whereas higher memory distrust as indexed by the SSMQ was positively associated with *β* . Put differently, in one study, people who believed themselves susceptible to certain memory errors exhibited response biases that aligned with those subjective beliefs (Zhang et al., 2024); whereas in another study (Zhang et al., 2023c), people who believe themselves susceptible to certain memory errors exhibited response biases that seemed to compensate for that susceptibility.

Two major differences in the design may have caused these inconsistent results, as argued by Zhang et al. (2024). First, in Study 2 of Zhang et al. (2023c), participants were given (correct or incorrect) feedback allegedly from another participant after each judgment. Second, there was a cash incentive for high performers in the memory task of that study. Both features were absent in Zhang et al. (2024). The presence of peer feedback and an incentive to be accurate might prompt participants to use their subjective memory appraisals to calibrate their responses. For example, if a participant thinks that they often make commission errors, they should then have a higher threshold to make an “old” judgment in this task, and in the absence of incentive, this participant may rely heavily on recollection to make this judgment (Blank, 2017), as reflected in the positive associations of memory distrust with recollection and with *β* in Zhang et al. (2024). But in the presence of an incentive, a participant who thinks they often make commission errors might aim to improve their accuracy by adopting a more conservative response criterion. Taken together, accumulating evidence leads us to propose that under specific conditions, people apply their beliefs about their subjective memory functioning to calibrate their evaluations of their recollections.

So far, the limited work on the role of memory distrust in the memory validation process considered only trait memory distrust (e.g., Zhang et al., 2024, 2023c), which complicates the picture as it is associated with the objective functioning of memory. That is, trait memory distrust can be linked to memory performance in experiments through different mechanisms. First, given that trait memory distrust is associated with objective memory functioning, we can expect people who are high (vs. low) on memory distrust to perform worse in memory tasks (i.e., lower sensitivity, Zhang et al., 2024; but see Kuczek et al., 2018 for a different result). Second, in situations where individuals reflect upon their subjective memory functioning and calibrate their memory validation based on it, we would expect memory distrust to have a different impact on memory performance, e.g., response bias. Further, the moderation effect of memory distrust on recollection-belief correspondence is complicated by the fact that memory distrust is associated with both belief and recollection ratings (Zhang et al., 2024).

To single out the potential calibration effects of memory distrust on memory validation, the current study aims to experimentally manipulate participants’ concern over making omission errors or commission errors, and examine the effect of this manipulation on subsequent memory reporting, including recognition, recollection, and belief judgments. We hypothesize that with an incentive to be as accurate as possible, participants who are told that they often make commission errors will adjust their response criterion, and show a shift toward a more conservative response bias. On the other hand, participants who are told that they often make omission errors will show a shift towards a more liberal response bias. The idea that feedback can induce criterion shifts is by no means novel. Research has shown that biased positive feedback on incorrect old classification of new items (i.e., false alarm), or incorrect new classification of old items (i.e., miss), caused participants to shift toward a more lax or conservative response criterion, respectively, without them being aware of the biased nature of the feedback (Han & Dobbins, 2008; 2009). Despite the similarity, the focus of the current study is not to examine the incremental criterion shift based on trial-by-trial positive feedback, but rather, a more general appraisal of one’s memory functioning that is influenced by negative feedback. Furthermore, we expect that the effect of a memory distrust manipulation goes beyond only criterion shift. Compared with participants who receive no feedback, we expect that the association between recollection and belief will become weaker among participants who receive either false feedback about making commission or omission errors.

# Method

All study materials are (or will be) available at the Open Science Framework (OSF) [https://osf.io/8qbkn/?view\_only=a663f2e3619545edafe86b0aee885603]. The present study received ethical approval from the Ethics Review Committee Psychology and Neuroscience (ERCPN) of Maastricht University (reference: ERCPN-OZL\_246\_167\_12\_2021\_S5)

## Design

The proposed study will employ a 3 (Feedback: omission vs. commission vs. no feedback) between-participant design.

## Participants

### Sample Size Justification

**Expected Effect Size of Criterion Shift.** We expected the effect of the memory distrust manipulation on criterion shift to be smaller than the effect of explicit instructions to respond liberally or conservatively (ca conservative = 0.34, ca liberal = -0.50, ca diff = 0.84, Azimian-Faridani & Wilding, 2006) but larger than the effect of implicit biased feedback (Experiment 2: ca conservative = 0.39, ca liberal = 0.02, ca diff = 0.37; Experiment 3: ca conservative = 0.19, ca liberal = 0.05, ca diff = 0.14, Han & Dobbins, 2008). We therefore set a conservative expected effect size as a difference of c = 0.15 between the omission condition and the control condition and between the control and commission condition (in between Experiments 2 and 3 in Han & Dobbins, 2008).

**Smallest Effect Size of Interest of Criterion Shift.** We consider the following data pattern to be the smallest effect size of interest (SESOI) in the current experimental setup: the top 25% of participants who are most receptive to the memory distrust (Omission) manipulation will make one more hit response and one more false alarm response compared to their control counterparts in the current experiment. Similarly, the top 25% of participants who are most receptive to the memory distrust (Commission) manipulation will make one less hit response and one less false alarm response compared to their control counterparts[[1]](#footnote-1). The idea behind one hit and one false alarm comes from the idea that the remembrance of already one (false) detail can have practical value (e.g., misremembrance of the face of a culprit). Using the data from Study 2 of Zhang et al. (2023c) as the control condition and the expected differences between conditions, we created a synthetic dataset and calculated the SDT indices (See Table A1). In the synthetic dataset (See Table A1), the average difference of response criterion c is 0.06 between the Feedback-Omission and control or between control and the feedback commission with a standard deviation of 0.30 (i.e., Cohen’s *d* = 0.06/0.30 = 0.2). With the same standard deviation assumed, our expected effect size would translate a difference of Cohen’s *d* = 0.50.

We performed a priori power analysis for minimal effect testing (see Riesthuis, 2024 for the relationship between NHST and minimal effect testing) using G\*Power 3.1 (Faul et al., 2009) for the pairwise comparisons of response criterion between the (a) control and omission conditions and (b) commission and control conditions. This analysis showed that a sample of 417 (139 in each condition) participants is required to detect the SESOI reliably (*α* = .05 and 1-*β* = .80; see appendix for the power analysis protocol).

**Expected Effect Size of State Memory Distrust.** Given that in Dudek and Polczyk (2023), the difference of memory distrust between the experimental group and control group was close to that of Cohen’s *d* = 1.0, we consider the expected effect size of manipulation on state memory distrust to be Cohen’s *d* = 1.0.

Smallest Effect Size of Interest of State Memory Distrust. Assuming that memory distrust is the underlying mechanism of response criterion change, and that the correlation between state memory distrust and response criterion c is at least r = 0.25[[2]](#footnote-2), this requires that the strength of the manipulation to be no smaller than Cohen’s d = 0.2/ 0.25 = 0.8 for comparisons between memory distrust conditions and the control condition (calibration, Dienes, 2021). That is, state memory distrust toward omission should be 0.8 SD higher in the Feedback-Omission condition than in the control condition. Similarly, the state memory distrust toward commission should be 0.8 SD higher in the Feedback-Commission condition than in control condition. With a group sample size of 152 (456 in total) and a point estimate of Cohen’s d = 1.0, the 90% CI will be [0.80, 1.20] with the lower bound being the SESOI (or, in terms of a raw point-difference on the original response scales, 90% CI [1.60, 2.40]). We therefore set the sample size to N = 456, the larger required sample size from the two analyses. Sensitivity analysis showed that a sample of 456 would allow us to detect a slope of 0.017 (α = .05 and 1-β = .80) in linear regression when examining the association between state memory distrust and response criterion c (See appendices- Sensitivity Analysis protocol).

We will recruit participants using Connect (https://connect.cloudresearch.com/). The only inclusion criteria will be that participants should be aged 16 or above, have normal (corrected) vision, and be fluent English speakers. Participants can only sign up for and complete the experiment using laptops or PCs (i.e., no tablet or mobile answering) and will receive $1.20 for the first session (approximately 10 minutes) and $1.80 for the second session (approximately 18 minutes) one day later. Assuming an attrition rate of 10% from Session 1 to Session 2, we aim to collect 507 valid participant responses during Session 1.

## Materials and Procedure

### Stimuli for the Memory Task

To increase the generalizability of our findings across a wider range of stimuli but also to minimize the potentially unnecessary emotional impact on participants, a total of 80 valenced (valence ≥ 3 and arousal ≤ 5 on 7-point scales) colour images were selected from the open affective standardized image set (OASIS, Kurdi et al., 2017), an open-access stimulus set depicts a broad spectrum of natural or social situations (e.g., pets, people, buildings, or car accidents). We then randomly divided these 80 scenes into two 40-scene blocks that will be used either as old (i.e., appearing in encoding) or new stimuli (i.e., only appearing in tests as fillers). Each block was then subdivided into 2 sub-blocks of 20 scenes that will be tested either during Test 1 or Test 2. Using Kurdi et al. (2017)’s norming data we performed between-subject two-way ANOVAs to ensure that there were no statistically significant difference in the mean level of arousal and valence ratings between different blocks and old vs. new scenes (see Table A2 in the Appendix).

Forty scenes will be presented during encoding (hereafter referred to as old scenes) and another 40 scenes will be used as fillers for the first and second recognition tests. Old scenes and new scenes will be counterbalanced between participants. That is, each scene will be an old scene for half of the participants while being a new scene for the other half of the participants. Designated old scenes and new scenes will be further randomly divided into two blocks (*n* = 20). For the first recognition task, one block of old scenes and one block of new scenes as fillers will be randomly selected and presented to participants, leading to a recognition test containing 40 scenes. In the second recognition task, participants will be presented with the remaining block of old scenes and the remaining block of 20 new scenes. The order of the blocks is thus also counterbalanced.

### Manipulation Check

Two statements measuring state memory distrust will be completed using a 10-point Likert scale (from 1 = Extremely disagree to 10 = Extremely agree). The first statement is “At this moment, if I am asked to retrieve something from memory, I think I likely would remember things that did not happen” (MC-commission). The second is “At this moment, if I am asked to retrieve something from memory, I think I likely would forget things that happened” (MC-omission). Half of the participants will answer the manipulation check before the second test and half of the participants will answer the manipulation checks after the second test. This random assignment is to examine whether the expected effect is influenced by the timing of the manipulation check, which could in principle make the feedback on commission /omission errors more salient. For example, it could be that there is a stronger effect of feedback in the manipulation-check-first conditions than in the memory-test-first conditions.

### Trait Memory Distrust

As stated earlier, previous research showed that aspects of trait memory distrust are differently associated with response bias and memory performance. We therefore also include measures of trait memory distrust in the current study, in an attempt to further examine the associations. The SSMQ (Squire et al., 1979) adapted by van Bergen et al. (2010) has 18 items (e.g., “my ability to pay attention to what goes on around me is” from -4 = *Disastrous* to 4 = *Excellent)* measuring distrust toward making omission errors. The Memory Distrust Scale (MDS) consists of 20 items (e.g., “I am sometimes uncertain whether an event that I recall really happened to me, or whether I saw it on TV or in a movie” from 1 = *Strongly disagree* to 7 = *Strongly agree*) measuring distrust toward commission errors. Both the SSMQ and the MDS have been shown to have good internal consistency (e.g., Cronbach’s *α* =.94 and .95 respectively, Zhang et al., 2023a) and criterion validity (e.g., recognition tests, Zhang et al., 2024, compliance, Zhang et al., 2023c). To ease the comparison of results, after establishing internal consistency of the SSMQ and the MDS in the current sample, we will reverse-code the SSMQ then calculate the mean of all items for the two scales, so that a higher mean score in both scales reflects a higher level of memory distrust.

### Procedure

**Session 1.** After reading the information letter and giving informed consent, participants will first answer demographic questions about their age, gender, and education level, followed by the SSMQ and the MDS in counterbalanced order. Embedded in the two scales, we will include three attention checks asking participants to choose a specific answer for that item (e.g., for this item, please choose “strongly agree”). Then they will view 40 scene images, one at a time and in randomized order. Each scene will be presented for 3 seconds with an inter-stimulus interval of 1 second. At the end of Session 1, participants will be reminded to sign up for and complete Session 2 at the same time the next day. In the current study, we expect to complete session 1 data collection within 3 hours. If, however, there are not enough participants signing up for the study within a 3-hour window, we will close the signup for Session 1 after 3 hours and run another cycle of data collection until the planned sample size is met.

[Session 1 Qualtrics for reviewers: <https://maastrichtuniversity.eu.qualtrics.com/jfe/form/SV_bJcpth68pHDyJdI>]

**Session 2[[3]](#footnote-3).** Twenty-four hours later, Session 2 will be made available online. Participants will then have a 6-hour window to sign up for and complete Session 2, after which the session will be closed. They will first be reminded of the tasks involved in the study and informed that they will receive feedback on their incorrect judgments after each of their decisions. The session begins with a first recognition task, presenting 20 previously seen (old) scenes alongside 20 new scenes, displayed individually in a random sequence without a time constraint. In this task, participants will first indicate whether a scene is old or new (“Did you see this exact scene in yesterday’s session?” Options: *yes* or *no*). Regardless of their recognition judgment, participants will then assess their levels of recollection (“Do you actually remember seeing this exact scene in yesterday’s session?”) and belief in occurrence (“Regardless of whether or not you remember this scene, do you believe that this scene appeared in yesterday’s session?") on an 8-point Likert-like scale (Memory: 1 = *No memory at all*, 8 = *Clear and complete memory;* Belief: 1 = *Definitely did not appear*, 8 = *Definitely did appear*). These questions are adapted from Scoboria et al. (2004) and Li et al., (2020; 2023).

After making recognition, recollection, and belief judgments for each scene, participants will be shown feedback on supposedly incorrect recognitions. In reality, the feedback will contain both true and false feedback, depending on their assigned condition, to increase the credibility of the feedback manipulation. For participants who are in the feedback-commission condition, they will receive false feedback on correctly identified old items and true feedback on incorrectly identified new items. For each correctly recognized old item, there is a 20% probability that participants will receive false feedback that this is actually a new scene. For each incorrectly recognized new item, participants will receive true feedback that this is a new scene. No feedback on non-identified old items (i.e., misses) will be given. For participants who are in the feedback-omission condition, they will receive true feedback on old items and false feedback on new items. For each correctly recognized new item, there is a 20% probability that participants will receive false feedback that this is actually an old scene. For each incorrectly recognized old item, participants will receive correct feedback that this is an old scene. No feedback on incorrectly identified new items (i.e., false alarms) will be given. For participants in the control group, no feedback will be given.

Immediately after the first recognition test, participants in the feedback-commission condition will receive inaccurate summary feedback claiming that they made several mistakes in the test, misidentifying as ‘old’ several scenes that were not seen in Session 1. Participants in the omission error condition will receive inaccurate summary feedback claiming that they have made several mistakes in the test, misidentifying as ‘new’ several scenes that were actually seen in Session 1. Although the majority of participants will make both commission and omission errors, consistent with the manipulation during the first test, in each condition, they will only receive feedback focusing on one type of error. Moreover, irrespective of their actual performance, they will be led to believe that they have made more commission/omission errors than the average participant. Accompanying the feedback, we will add general descriptions of memory distrust (similar to Dudek & Polczyk, 2023) to increase the credibility of the feedback (see Appendices - Feedback Script). They will further be reminded that participants who ranked in the top 10% of scorers in terms of accuracy in the second memory task will receive an additional monetary bonus ($3), and that it is important to take the memory tasks seriously. The feedback page will automatically turn over after 1 minute. For participants in the no-feedback condition, they will be given an instruction stating that this is a 1-minute break between tests and will be reminded of the monetary bonus for top performers, after which the second test will commence. Half of the participants in each condition will complete the manipulation checks before the second test.

Then participants will complete the second recognition task, in which their memory for the remaining block will be tested. All the measures are the same as the first recognition task with no feedback. After the memory tasks, the other half of the participants in each condition will complete the manipulation checks. Finally, all participants will answer six funnelling questions: 1) “To what extent did you take into account your tendency to have memory errors while making recognition judgments in the second memory task?” (1 = *not at all*, to 7 = *very much*); 2) “To what extent did you find the experiment procedures difficult to understand?” (1 = *not difficult at all*, to 7 = *very difficult*); 3) “When completing this study, how seriously did you take answering the questions with care? (You answer will not affect your payment for the experiment)” (1 = *not serious at all*, to 5 = *very serious*); 4) “Have you seen the materials of this experiment before in other studies” (Yes or No); 5) “What do you think is the purpose of the experiment?” (Open-ended); 6) “Did you notice any errors in the experiment or do you have any suggestions to improve the experiment?” (Open-ended).[[4]](#footnote-4)

[Session 2 Qualtrics for reviewers: <https://maastrichtuniversity.eu.qualtrics.com/jfe/form/SV_6VY2oMi7t9Fw58i>]

We will then pay participants, debrief them, and will pay them the bonus where applicable after the data collection is done. We will calculate and rank the accuracy for each participant within their experimental conditions based on the second recognition task only.

# Data Analyses Plan

All data analyses will be carried out in R (version 4.2.2, R Core Team, 2021. All anonymized datasets and coding scripts will be available via the OSF (<https://osf.io/8qbkn/?view_only=a663f2e3619545edafe86b0aee885603>). The Scripts for planned analyses[[5]](#footnote-5) are at <https://osf.io/ypga3?view_only=a663f2e3619545edafe86b0aee885603>.

Response criterion indices *β* and c will be calculated using the *psycho* package (Makowski, 2018), β is calculated based on the likelihood ratio of the two distributions (noise and signal) while c represents the distance between the response criterion and the unbiased point, expressed in units of standard deviations. A higher value of either *β* or c would indicate a greater tendency to recognize stimuli as new instead of old (i.e., a more conservative response criterion). Since *β* is based on a ratio and more likely to violate distribution assumptions than c (Zhang et al., 2024), when the results of the two indices diverge, we will give more weight to c when reaching conclusions.

## Outliers and Exclusions

1. Participants who fail at least one of the attention check questions (i.e., participants who did not respond to the attention checks by selecting the correct or the required answer) will be excluded from all analyses.
2. Participants who report being not serious when completing the experiment (score <3) will be excluded from the analyses.
3. Participants who report having seen the photo materials before in other studies will be excluded from the analyses.
4. Participants who indicate, in the open question regarding the goal of the experiment, that they distrusted the feedback they received will be excluded from the analyses. Two independent coders (Y. Zhang and one research assistant) will code participants’ responses regarding this exclusion criterion.

## Primary Analysis

### Manipulation Check

Two one-way ANOVAs, each with the experimental condition as a between-participant factor will be run for the two manipulation checks (MC-commission and MC-omission) separately. The effect of manipulations will be reported averaging over manipulation check order conditions (also see Table 1).

We expect that participants in the feedback-commission condition will report higher distrust toward falsely remembering, compared to those in the feedback-omission and no-feedback conditions. Further, we expect that participants in the feedback-omission condition will report higher distrust toward forgetting, compared to those in the feedback-commission and no-feedback conditions. Since the manipulation needs to reach a certain level of strength, only if the lower bound of the 90% CI on the effect size is not lower than Cohen’s *d* = 0.80, will we consider the manipulation adequate. Assuming a SD of 2 scale points, this lower bound would translate to a raw score difference of 1.60 points on a 10-point scale.

### The Effect of Feedback on Response Bias

To examine whether the distrust manipulation would cause a shift in response bias, we will first calculate the SDT response criterion indices *β* and c for the second test. Then we will run one-way ANOVAs with the experimental condition (Feedback: commission vs. omission vs. no feedback) as a between-participant factor for *β* and c in the second test respectively. The effects of manipulations will be reported averaging over manipulation check order conditions.

If our hypothesis is supported, we would expect a main effect of the manipulation. Simple effects would reveal that the response criterion is the most conservative in the feedback-commission condition, followed by the control condition. The feedback-omission condition will have the least conservative (most liberal) response criterion.

Further, we will run regression analyses on response criterion in the second test, with state memory distrust toward commission and omission errors being entered in the model separately. We expect that in the current experiment, state memory distrust toward commission errors is associated with a more conservative response criterion while state memory distrust toward omission errors is associated with a more liberal response criterion.

## Exploratory Analysis

### The Effect of Feedback on Recollection-Belief Correspondence

Even though we hypothesized about the effect of memory distrust on recollection-belief correspondence, the precise magnitude of this effect and the appropriate sample size required to test it remain uncertain. Given this uncertainty, we have decided to classify this analysis as exploratory. We will run a linear mixed model with belief score as the dependent variable. For fixed effects, we would include recollection score, Feedback (Commission vs. omission vs. no feedback), and their interaction term. For random effects, we will include random intercepts for participants and the stimuli. If our hypothesis is supported, we would expect a two-way interaction. Simple effects would reveal that the recollection-belief association in the second test is weaker in the two feedback conditions compared with the no-feedback condition.

**Table 1**

***Study Design Table***



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Question** | **Hypothesis** | **Sampling plan** | **Analysis Plan** | **Rationale** | **Interpretation** | **Theory** |
| Is the manipulation of memory distrust toward commission effective? | The manipulation of memory distrust toward the commission is effective. | For the single-tem MC-commission error question, the expected effect size of the manipulation is Cohen’s *d* = 1.00 given previous research (Dudek & Polczyk 2023).  We will recruit 456 participants (139 in each condition) using Connect.  The sample size was determined by the research question examining criterion shift.  With this sample size, the 90% CI of the expected effect size will be Cohen’s *d* [0.80, 1.20], with the lower bound being the minimal effect we wish to establish. In terms of raw score difference on the original response scale, it will be close to [1.60, 2.40]. | One-way ANOVA (Feedback: commission vs. omission vs. no feedback) will be conducted for MC-commission.  Only if the lower bound of the 90% CI on the effect size is not lower than Cohen’s *d* = 0.80 (raw score difference of 1.6 assuming an SD = 2) for the pairwise comparisons between control and distrust-commission, will we consider the manipulation(s) adequate. | Assuming that the correlation between state memory distrust and response criterion c is at least *r* = 0.25, given the minimal effect of memory distrust manipulation on criterion is set to be Cohen’s *d* = 0.20 (see row 3), this requires that the strength of the manipulation to be no smaller than Cohen’s *d* = 0.80. | If the manipulation to increase distrust toward commission errors is successful, we would expect that compared to feedback on omission errors and no feedback conditions, participants in the feedback on commission errors condition will report higher distrust toward falsely remembering. | NA |
| Is the manipulation of memory distrust toward omission effective? | The manipulation of memory distrust toward omission is effective. | For the single-tem MC-commission error question, the expected effect size of the manipulation is Cohen’s *d* = 1.00 given previous research (Dudek & Polczyk 2023).  We will recruit 456 participants (139 in each condition) using Connect.  The sample size was determined by the research question examining criterion shift.  With this sample size, the 90% CI of the expected effect size will be Cohen’s *d* [0.80, 1.20], with the lower bound being the minimal effect we wish to establish. In terms of raw score difference on the original response scale, it will be close to [1.60, 2.40]. | One-way ANOVA (Feedback: commission vs. omission vs. no feedback) will be conducted for MC-omission.  Only if the lower bound of the 90% CI on the effect size is not lower than Cohen’s *d* = 0.80 (raw score difference of 1.6 assuming an SD = 2) for the pairwise comparisons between control and distrust-omission, will we consider the manipulation(s) adequate. | Assuming that the correlation between state memory distrust and response criterion c is at least *r* = 0.25, given the minimal effect of memory distrust manipulation on criterion is set to be Cohen’s *d* = 0.20 (see row 3), this requires that the strength of the manipulation to be no smaller than Cohen’s *d* = 0.80. | If the manipulation to increase distrust toward omission errors is successful, we would expect that compared to feedback on commission errors and no feedback conditions, participants in the feedback on omission errors condition will report higher distrust toward forgetting | NA |
| Will the increase in memory distrust toward commission lead to a more conservative response criterion while the increase of memory distrust toward omission lead to a more liberal response criterion? | The increase in memory distrust toward commission leads to a more conservative response criterion while the increase in memory distrust toward omission leads to a more liberal response criterion. | The difference between the SESOI and the expected effect size is therefore c = 0.09 (Cohen’s *d* = 0.30). Then we performed a priori power analysis for minimal effect testing using GPower 3.1 (Faul et al., 2009) for pairwise comparisons between control and omission as well as between commission and control conditions on criterion, which showed that a sample of 417 (139 in each condition) participants is required to detect such an effect (α = .05 and 1-β = .80). | One-way ANOVA (Feedback: commission vs. omission vs. no feedback) will be conducted for response criterion *β* and c.  Simple effects would reveal that the response criterion is the most conservative in the feedback-commission condition, followed by the control condition. The feedback-omission condition will have the least conservative (most liberal) response criterion. | **Expected Effect Size.** We expected the effect of memory distrust manipulation on criterion shift to be smaller than explicit instructions to respond liberally or conservatively (ca conservative = 0.34, ca liberal = -0.50, ca diff = 0.84, Azimian-Faridani & Wilding, 2006) but larger than implicit biased feedback (Experiment 2: ca conservative = 0.39, ca liberal = 0.02, ca diff = 0.37; Experiment 3: ca conservative = 0.19, ca liberal = 0.05, ca diff = 0.14, Han & Dobbins, 2008). We therefore set a conservative expected effect size (close to Experiment 3 in Han & Dobbins, 2008) as a difference of c = 0.15 between the omission condition and control condition and between control and commission condition.  **Smallest Effect Size of Interest.** Using the data from Study 2 of Zhang et al. (2023c) as the control condition and the expected differences between conditions, we created a synthetic dataset and calculated the SDT indices In the synthetic dataset (See Table A1), the average difference of response criterion c is 0.06 between Feedback-Omission and control or between control and feedback commission with a standard deviation of 0.30 (i.e., Cohen’s *d* = 0.06/0.30 = 0.2). With the same standard deviation, the expected effect size translates a difference of Cohen’s *d* = 0.50. | If our hypothesis is supported, we would expect a main effect of the manipulation. Simple effects would reveal that the response criterion is the most conservative in the commission feedback condition, followed by the control condition. The omission feedback condition will have the least conservative and most liberal response criterion. | If our manipulation is successful yet we do not observe the shift in response criterion, the notion that people calibrate their response criterion based on their memory appraisal will be disconfirmed. The results will have an impact on the frameworks of memory reporting regulation by eyewitnesses. |
| Is state memory distrust toward commission errors associated with a more conservative response criterion while state memory distrust toward omission errors associated with a more liberal response criterion? | State memory distrust toward commission errors is associated with a more conservative response criterion while state memory distrust toward omission errors is associated with a more liberal response criterion. | Sensitivity analysis showed that a sample of 456 would allow us to detect a slope of 0.017 (*α* = .05 and 1-*β* = .80) in linear regression (See appendices- Sensitivity Analysis protocol) | Linear regression with response criterion c (SD = 0.30) as the DV and either state memory distrust toward commission or omission (SD = 2.00) as IV. | We expect that the correlation between state memory distrust and response criterion c is at least *r* = 0.25 (raw slope = 0.0375). | If our hypothesis is supported, we would see that memory distrust toward commission positively predicts β and c while memory distrust toward omission negatively predicts β and c. | Even if we receive support that the manipulation affects response criterion, if state memory distrust is not associated with response criterion as we hypothesized, our hypothesis that state memory distrust influences response criterion will be disconfirmed and the effect of manipulation might be explained by other mechanisms. |

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# Appendices

## Table A1

***Descriptives of the Synthetic Dataset***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Condition | d’ | c | *β* | *n*hit | *n*false alarm |
|  | *M (SD)* | *M (SD)* | *M (SD)* | *M (SD)* | *M (SD)* |
| Commission | 1.93 (0.69) | 0.15 (0.31) | 1.71 (1.37) | 15.73 (2.61) | 2.83 (2.42) |
| Control | 1.87 (0.64) | 0.08 (0.29) | 1.30 (0.64) | 15.94 (2.61) | 3.15 (2.38) |
| Omission | 1.86 (0.69) | 0.03 (0.30) | 1.18 (0.62) | 16.14 (2.64) | 3.49 (2.58) |

## Power Analysis Protocol

**t tests -** Means: Difference between two independent means (two groups)

**Analysis:** A priori: Compute required sample size

**Input:** Tail(s) = One

Effect size d = 0.3

α err prob = 0.05

Power (1-β err prob) = 0.80

Allocation ratio N2/N1 = 1

**Output:** Noncentrality parameter δ = 2.5009998

Critical t = 1.6503932

Df = 276

Sample size group 1 = 139

Sample size group 2 = 139

Total sample size = 278

## Sensitivity Analysis Protocol

**t tests -** Linear bivariate regression: One group, size of slope

**Analysis:** Sensitivity: Compute required effect size

**Input:** Tail(s) = One

Effect direction = Slope > H0

α err prob = 0.05

Power (1-β err prob) = 0.80

Total sample size = 456

Slope H0 = 0

Std dev σ\_x = 2

Std dev σ\_y = 0.3

**Output:** Noncentrality parameter δ = 2.4901878

Critical t = 1.6482168

Df = 454

Slope H1 = 0.0173743

## Table A2

***Analyses on Stimuli Valence and Arousal Ratings***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Model | Effect | *F* statistics | p-value | *η*2 |
| Arousal | Old vs. new | *F* (1, 76) = 1.27 | .263 | =. 016 |
| Block | *F* (1, 76) = 0.04 | .850 | <.001 |
| Old vs. new \* Block | *F* (1, 76) = 0.70 | .407 | =.009 |
| Valence | Old vs. new | *F* (1, 76) = 0.01 | .910 | < .001 |
| Block | *F* (1, 76) = 1.25 | .267 | =.016 |
| Old vs. new \* Block | *F* (1, 76) = 0.17 | .679 | =.002 |

## Feedback Script

### Commission Error Condition

Thank you for completing the first memory test. We have collated your responses and evaluated your performance. In the previous test, while you were pretty good at correctly identifying old photos, in the meantime, you mistakenly recognized several new photos as old, indicating that these new photos were present in the first part of the study while in reality, they were not. Your accuracy at ***correctly identifying*** ***new photos*** is among the lowest **20%** among all participants so far. That is, on average you made more such errors than other participants.

It is possible that you sometimes have difficulty distinguishing events you remember from those you only imagined. You sometimes may also become uncertain whether a recalled event really happened, or whether you saw it on TV or in a movie. Your ability to remember the source of information and the context of events may not be complete.

It's important to note that participants who rank in the **top 10%** in the second memory test will receive a $ 3 bonus and it is important to complete the experiment seriously.

### Omission Error Condition

Thank you for completing the first memory test. We have collated your responses and evaluated your performance. In the previous test, while you were pretty good at correctly identifying new photos, in the meantime, you mistakenly recognized several old photos as new too, indicating that these old photos were not present in the first part of the study while in reality, they were. Your accuracy at ***correctly identifying old photos*** is among the lowest **20%** among all participants so far. That is, on average you made more such errors than other participants.

It is possible that you often experience the Tip-of-the-tongue phenomenon when you know that you remember something but are unable to express it. Sometimes, you may also find it difficult to recall what you were doing after you have taken your mind off it for a few minutes, especially under stress and pressure. In the future, memorizing things and successfully recalling them after a while may become more difficult.

It's important to note that participants who rank in the **top 10%** in the second memory test will receive a $ 3 bonus and it is important to complete the experiment seriously.

### Control Condition

Thank you for completing the first memory test. We have gathered your responses.

This is a 1-minute break before the second memory test commences.

Please keep in mind that people who rank **top 10%** in the second memory test will get a $ 3 bonus and it is important to complete the experiment seriously.

1. In reality, the probabilities will likely not be symmetrical. However, we consider the potential effect of the differences of probabilities on estimates insubstantial given that we set a rather conservative SESOI. [↑](#footnote-ref-1)
2. In Zhang et al., (2023), the trait memory distrust measure and memory task were measured three days apart and their correlation was *r* = .19. In the current study, the association is expected to be stronger given that we will measure state memory distrust right before or after the memory task and plan to increase participants’ motivation to be accurate by raising the performance bonus to $3, 100% of the basic experiment payoff. [↑](#footnote-ref-2)
3. In our previous plan for the design, the memory tests were placed right after encoding and there was no feedback on individual recognition decisions during the first test. Further, we included example scenes of supposedly incorrect recognitions in the summary feedback.

   Pilot testing (<https://osf.io/dh2w6>) to examine the effectiveness of the planned manipulation (*N* = 87, *M* age = 39.4, *SD* age = 13.1) showed that state memory distrust toward commission increased from before the first test to after the first test in the Feedback-Commission condition. However, we did not find an increase in state memory distrust toward omission in the Feedback-Omission condition, suggesting the feedback on omission was not working as expected. Inspecting the funneling questions, we noticed that several participants guessed that the feedback was false and a few misread the feedback. Most importantly, it appears that participants were quite confident in their performance and rightfully so (30 participants had 100% accuracy or only made one mistake). Given these results, we changed the design to the current version to increase the strength of the manipulation and avoid the ceiling effect on participants' memory performance. [↑](#footnote-ref-3)
4. In each data collection cycle, the time window for participating in session 1 is 3 hours. For the second session, we expect a long time (e.g., 6 hours) to complete data collection given the pool will be restricted to participants who have signed up for Session 1. The potential range of gap between Sessions 1 and 2 therefore will be 21 (24-3) hours to 30 (24+6) hours. [↑](#footnote-ref-4)
5. The faux datasets were generated by Qualtrics and were pure noise. [↑](#footnote-ref-5)