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Preference for cheap-and-easy memory verification strategies is strongest among people with high memory distrust

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ABSTRACT
When choosing strategies for verifying one's memory, people are more influenced by the perceived cost of using a strategy than by its likelihood of yielding reliable information (i.e., *cheap-strategy bias*). The current preregistered study investigated whether people with high memory distrust are less likely to exhibit this bias than their low memory distrust counterparts. Participants ($N = 535$) imagined a scenario in which they witnessed an accident and were then led by friends to question their memories about the accident. Participants had to propose five strategies for verifying that particular memory. Following this, they rated each strategy's cost, reliability, and their likelihood of using it, as well as completing two validated measures of trait memory distrust. Contrary to our prediction, compared with participants with low memory distrust, participants with higher memory distrust exhibited a larger cheap-strategy bias. Follow-up analyses suggested that compared with memory-trusters, memory distrusters' strategy choices were more influenced by a strategy's perceived cost, and less influenced by its perceived reliability. Our results suggest that people who are more skeptical about their memories may be more cynical about the worthwhileness of verifying their memory, which could make them especially susceptible to misinformation acceptance and false memory creation.

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Memory serves several important functions in our lives, such as building a self-concept, guiding future behaviours, and maintaining social relationships through sharing personal memories (Bluck, 2003; Bluck et al., 2005). As a highly social species, we experience and explore the world with others and reminisce together about these memories at later moments. However, it is sometimes the case that our own memories about an experience conflict with other people's memories (e.g., Sheen et al., 2001, 2006). For example, when twin siblings were given cues to recall a series of specific memories, they would sometimes both recall the same event – such as getting into a fight in the school playground – as having happened to themselves and not to their sibling, thus disputing "ownership" of the memory (Sheen et al., 2001). In a similar vein, people sometimes report having experienced occasions when their family or friends confronted them that their memories were not correct, and which resulted in them reducing their belief that the event truly occurred (e.g., nonbelieved or refuted memories, Burnell et al., 2022; Mazzoni et al., 2010; Otgaar et al., 2019). When situations like these arise, individuals may need to find ways to verify or validate their memory (Otgaar et al., 2019; Ross, 1997; Wade & Garry, 2005).

In one study, researchers asked participants about the strategies that they use to verify their memories (Wade & Garry, 2005). The researchers discovered that the most commonly reported strategies involved seeking information from other people, and recalling the event using various cognitive techniques (e.g., trying to recall corroborating facts about the event), whereas going back to the location or finding physical evidence were less frequently mentioned. Subsequent work similarly shows that people are often highly motivated to use strategies, such as asking friends or searching for photos for reconstructing forgotten experiences (Nash & Takarangi, 2011). These studies, however, did not systematically examine the underlying factors behind people's choices of verification strategies.

Wade et al. (2014) therefore investigated the roles of cost (e.g., cognitive or physical effort) and reliability (e.g., trustworthiness and accuracy). More specifically, the researchers asked participants to list five strategies they could use to verify a specific childhood memory if they

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had been confronted with contradictory information (i.e., being told "No, that never happened. You're wrong."). Then, they asked participants to rate the cost and reliability of each strategy, as well as the likelihood that they would actually use each strategy. Overall, cost was a negative predictor of the likelihood of using specific strategies, and reliability was a positive predictor. But critically, cost was a stronger predictor of likelihood than was reliability. In other words, whereas people generally wanted to choose strategies that were both cheap-and-easy and reliable, when these two priorities were at odds people preferred cheap-and-easy strategies over reliable strategies.

In follow-up work, Nash et al. (2017) found that this so-called *cheap-strategy bias* replicated across several plausible boundary conditions. Specifically, the researchers obtained the bias when participants considered verifying both distant memories and when verifying recent memories, for both trivial and personally important memories, and even when the consequences of being incorrect would be serious. The authors proposed that the cheap-strategy bias might stem from people generally having confidence in their memories, such that they are unwilling to invest effort or resources into challenging them. This interpretation fits with the finding that the cheap-strategy bias was greater when verifying a recent memory rather than a childhood memory, with the former arguably being more trusted than the latter. On the basis that confidence in one's memory could explain the cheap-strategy bias, Nash et al. (2017) further speculated that one might expect to see an attenuated or even reversed cheap-strategy bias among people who take a more skeptical view of their own memory functioning. According to this reasoning, people who generally are skeptical about their own memories may be especially willing to invest in reliable and costly strategies for verifying their memories, because of the greater perceived likelihood of the memories being inaccurate or false.

The skeptical perception or appraisal of one's own memory functioning is captured well by the concept of memory distrust, first coined by Gudjonsson and MacKeith (1982) in their research on false confessions. They described "memory distrust syndrome" as a phenomenon in which interviewees in a forensic context develop profound distrust towards their memories as a consequence of inappropriate investigation practices, which could be an important causal factor in the development of false confessions. In subsequent research, van Bergen et al. (2010a) extended the concept of memory distrust to describe a more general and stable appraisal of one's memory functioning, and they adapted the Squire Subjective Memory Questionnaire (SSMQ) as a tool for measuring trait memory distrust. The SSMQ consists of 18 items that (inversely) assess people's tendency to believe they are vulnerable to memory omission errors (by rating e.g., "my ability to remember things that have happened more than a year ago"), with higher scores indicating greater trust in their memory functioning and lower scores indicating lesser trust. Research has shown that people who score highly on memory distrust – as measured by lower scores on the SSMQ – tend to be more susceptible to accepting misinformation about a witnessed event (van van Bergen et al., 2010b; although see Kuczek et al., 2021 for a non-replication of this result) and are more likely to report experiencing nonbelieved memories (Zhang et al., 2022a, 2022b). Findings such as these point to the role of memory distrust in shaping people's attributions of and decisions about their recollections, thus indicating its relevance to the memory reconstruction process.

Whereas the SSMQ focuses on people's beliefs about their memory omission errors, people's degree of trust in their own memory depends on beliefs not only about omission errors but also commission errors. That is, some people are more likely than others to consider that their memories might be distorted or entirely false. Because the SSMQ focuses only on beliefs about omission errors and not commission errors, Nash et al. (2022) developed and validated a new measure – the Memory Distrust Scale (MDS) – which focused on the latter type of belief, with participants indicating their agreement with items such as "I often turn to other people to help me decide whether my memories are accurate". The authors showed that the SSMQ and MDS were only moderately correlated ($r = -.46$ to $-.48$), indicating that memory distrust indeed has two distinct aspects (beliefs about one's own memory omission errors, and beliefs about one's own memory commission errors). Whereas Nash et al.'s findings came from a sample of British participants, Zhang et al. (2023) extended their findings to the Chinese context, confirming that distrust toward omission errors and commission errors were only moderately correlated among a Chinese participant sample.

In the present study, we tested the hypothesis that memory distrust as measured by the SSMQ and the MDS moderates the cheap-strategy bias. Specifically, similar to Nash et al. (2017; Study 3), participants in the current study imagined a hypothetical scenario in which they witnessed an accident at a party or festival but then after discussion with friends were led to question their memories of the accident. Participants then listed five strategies for verifying that hypothetical memory and they evaluated the cost, reliability, and their likelihood of using each strategy. In line with Nash et al.'s (2017) speculation, we hypothesised that the cheap-strategy bias would be stronger for people with lower memory distrust, than for people with higher memory distrust.

Method

We preregistered our hypotheses, sample size justification, and data exclusion criteria at the Open Science Framework (OSF) https://osf.io/ne85z. Although we did not elaborate on the exact analytic methods in the preregistration, we uploaded the scripts for planned moderation analyses as well as some exploratory analyses on OSF before starting data collection (https://osf.io/vzxwa). The present study received ethical approval from the Institutional Review Board of Maastricht University (reference: ERCPN-OZL_246_167_12_2021_S4)

Participants

Sample size justification

Using the complete dataset from Study 3 of Nash et al. (2017)[1], we conducted a simulated power analysis using the lme4 (Bates et al., 2014) and mixedpower (Kumle et al., 2021) packages. A sample of 150 participants would have a statistical power of .95 to detect the cheap-strategy bias (critical value = 1.96, number of simulations = 500). However, because the present study aimed to detect a potential moderation effect of memory distrust on the cheap-strategy bias, we composed a synthetic dataset using the Nash et al.'s (2017) dataset. More specifically, we first took Nash et al.'s (2017: Study 3) original data – dataset that showed a clear cheap-strategy bias – which we imagined as the results from a hypothetical group of "low memory distrust" participants. We then created a second, mock dataset in which the same Nash et al. (2017; Study 3) data were modified, such that cost and reliability explained similar amount of variance in the likelihood of using specific strategies, eliminating the cheap-strategy bias; we imagined this second sample as the results from a hypothetical group of "high memory distrust" participants. Then we combined these two datasets and performed simulation power analyses to detect the cheap-strategy-bias by "memory distrust" group (high versus low) interaction. Note that in this synthetic dataset, the overall cheap-strategy bias was not present because of the influence of the "high memory distrust group" mock data. Based on these simulations we planned to recruit at least 600 participants, which would afford a statistical power of .84 to detect the predicted moderation effect. The R code for power analyses can be accessed at https://osf.io/zud3g.

We recruited British participants using the crowdsourcing platform Prolific (https://app.prolific.co/). The only inclusion criteria were that participants should be aged 18 or above and native English speakers. Participants received £2.50 as compensation. A total of 652 respondents completed the study, and in accordance with our preregistration, those who failed at least one attention check question (described below; $n = 107$) and those who suggested fewer than 4 strategies ($n = 10$) were removed from analyses, leaving a total sample of 535 ($n_{female} = 339$, $n_{male} = 195$, $n_{no\ disclosure} = 1$, $M_{age} = 43.0$, $SD_{age} = 14.2$). Due to the unexpectedly large number of participants who failed an attention check question, we conducted an additional sensitivity analysis, which showed that the sample of 535 participants afforded statistical power of .81 to detect the simulated effect. We therefore opted not to undertake a further round of data collection.

Materials and procedure

The study was closely based on the design and materials of Study 3 by Nash et al. (2017). After giving informed consent and answering demographic questions including age and gender, participants were asked to imagine a hypothetical event and to import self-relevant details into that imagination. Specifically, participants imagined that they were at a party or festival with a friend and that they witnessed an incident in which someone was seriously hurt and taken to the hospital. Participants were instructed to imagine specific details that would make this imagined event plausible for themselves, such as people and places, and they were asked to type a detailed description of the event. The purpose of using a fictitious rather than a real memory was to ensure that participants would be envisaging roughly comparable events, which would allow us to better control the consequences of the remembering. Further, in Nash et al. (2017), the cheap-strategy bias was observed both when using real memories (Studies 1 and 2) and imagined scenarios (Study 3), supporting the validity of using a fictitious event. All the participants included in the final sample provided a coherent basic description of an event.

Next, participants imagined that a few weeks later they were talking to the friend with whom they had co-witnessed the incident and that this friend challenged the participant's memory. Participants were told to suppose that they planned to tell their families about the incident during an upcoming dinner; however, because their friend had challenged their memory, they felt they should verify if their memory was correct before sharing it. Participants were advised to assume that they had ample time to do the checking. They were asked to suggest five different strategies that they might use for determining whether their memory of this hypothetical incident was true. After listing these strategies, participants saw their suggestions again and were asked to rate each strategy in terms of its reliability, cost, and their likelihood of actually using it. We told participants that "reliability" should be defined as the likelihood that the information they might gain would be indisputable, trustworthy, and accurate. Likewise, we told them that "cost" is the extent to which the strategy required them to expend money, time, energy, effort, labour, or aggravation. Different from Nash et al. (2017), we assessed reliability (1 = Not reliable at all, 7 = Extremely reliable), cost (1 = Very small cost, 7 = Very high cost), and likelihood (1 = Not at all likely, 7 = Extremely likely) using 7-point scales instead of 5-point scales, as a means to better capture variance in people's judgments. The order in which participants completed reliability/cost ratings and likelihood ratings was counterbalanced, with half of the participants considering reliability and cost first, and the other half considering likelihood first. Moreover, within both of these counterbalancing groups, we also counterbalanced the order of reliability and cost, with half rating reliability before cost, and the other half rating cost before reliability.

The strategy-rating task was followed by an attention check question, wherein participants were asked to recall whom they were told the intended audience of their memory report was, and were required to select from four options presented in random order: (a) the police, (b) your family, (c) the local newspaper, or (d) your work colleagues. For exploratory purposes, we then added an extra task not used in Nash et al.'s (2017) work. Specifically, we asked participants to repeat the strategy-rating task, but this time by considering five specific, general strategy types for verifying their imagined incident: (1) Ask other people such as parents or neighbours; (2) Look for physical evidence such as videos, photos, notes, etc.; (3) Return to the location of the event and search for cues; (4) Mentally reconstruct the settings in which the events occurred, to retrieve as much information as possible; (5) Consider the plausibility of your memory. Participants used the same 7-point rating scales as previous to judge each of these strategy types.

Finally, participants completed two memory distrust measures: the SSMQ (van Bergen et al., 2010a) and the MDS (Nash et al., 2022), with a total of three attention checks embedded (e.g., "This is an attention check item, please choose response option 7"). As introduced earlier, the SSMQ is an 18-item questionnaire answered on a 9-point scale (− 4 = disastrous to 4 = perfect) focusing on people's distrust toward omission memory errors. On the other hand, people's distrust toward commission memory errors was assessed by the 20-item MDS using a 7-point scale (1 = strongly disagree, 7 = strongly agree). The order of the two scales and the order of the items within each scale were randomised. In the current study, both scales showed excellent internal consistency (SSMQ: Cronbach's $\alpha = .94$, McDonald's $\omega = .95$; MDS: Cronbach's $\alpha = .95$, McDonald's $\omega = .96$). It is important to note that whereas a higher score on the MDS indicates higher levels of memory distrust, a higher score on the SSMQ indicates *lower* levels of memory distrust. Therefore, for ease of interpretation and comparison of the results across both memory distrust measures, we first reversed participants' SSMQ scores and then calculated the means of the items for both scales so that a higher score reflects a higher level of trait memory distrust.

Data analyses plan

All data analyses were carried out in R (version 4.1.2; R Core Team, 2021). To examine the cheap-strategy bias and to test the hypothesis that memory distrust moderates this bias, we used generalised linear mixed models (lme4; Bates et al., 2014). All anonymized datasets and coding scripts are available via the OSF (https://osf.io/my3rw/?view_only = 8442a36e2411422fbe209feb9a17f869).

Outliers and exclusions

Participants who failed at least one of the four attention check questions (i.e., participants who did not respond to the attention checks by selecting the correct or the required answer) were excluded from all analyses. For the verification strategy task, if participants listed fewer than four unique strategies, their data were also excluded from analyses.

Results

Replicating the cheap-strategy bias

First, we performed linear mixed models with participants' standardised rating of their likelihood of using a given strategy as the outcome variable, either their standardised cost or reliability rating as the fixed effect, and random slope and random intercept for participants. Then we ran a further linear mixed model including both standardised cost and reliability ratings as fixed effects. The results are presented in Table 1, which shows that strategy cost was negatively related and reliability was positively related to the likelihood of using a specific strategy. Moreover, based on the standardised coefficients in the Cost Only model and the Reliability Only model, it is clear that cost was a stronger predictor than reliability; this pattern is replicated in the third, Cost and Reliability model.

The above results showed that consistent with previous findings (Nash et al., 2017; Wade et al., 2014), cost explained more variance than reliability. However, these results did not answer whether the difference in their predictive power is statistically significant. To pit the two coefficients against each other and test the null hypothesis that reliability and cost are equally strong predictors of Likelihood, following Nash et al. (2017), we constructed new variables, which hereafter we call Dif_beta and Equal_beta. These were calculated as Dif_beta = z [z (Reliability) − z (−Cost)], and Equal_beta = z [z (Reliability) + z (−Cost)], with the former being an indicator of the relative predictive power of reliability to that of cost, and the latter being an indicator of the combined predictive power of both reliability and cost.[2] We performed linear mixed models with these two constructed variables as fixed effects, with random slopes for both constructed variables, and with random intercepts for participants. If Dif_beta is a significant negative predictor in these models when Equal_beta is included as a covariate, this would mean that cost is a stronger predictor than reliability (Nash et al., 2017), thus supporting the presence of a cheap-strategy bias. Our results showed that Dif_beta was indeed significantly below zero ($B = -0.42$, $SE = 0.04$, $p < .001$) while Equal_beta was controlled for ($B = 0.88$, $SE = 0.04$, $p < .001$), thus allowing us to reject the null hypothesis, and indicating that overall people had a cheap-strategy bias when choosing strategies for verifying memories.

Using multilevel correlation to control for the non-independency of observations, we found a weak negative

Table 1. The effects of cost and reliability on the likelihood of using the strategy.

	Cost Only model			Reliability Only model			Cost and Reliability model		
	Fixed effects								
	B	*SE*	*p*	*B*	*SE*	*p*	*B*	*SE*	*p*
Intercept	−.0.03	0.02	.27	−0.01	0.02	0.82	−0.03	0.02	0.27
Cost	**−0.52**	**0.03**	**<.001**				**−0.50**	**0.03**	**<.001**
Reliability				**0.20**	**0.02**	**<.001**	**0.16**	**0.02**	**<.001**
Random effects									
	SD			*SD*			*SD*		
Participant (Intercept)	0.42			0.37			0.40		
Participant (Cost)	0.32						0.33		
Participant (Reliability)				0.28			0.26		
Pseudo-R^2 (fixed effects)	.25			.04			.26		

Note. *p* values calculated using Satterthwaite d.f.

correlation between participants' strategy reliability ratings and cost ratings at the within-participant level ($r = -.08$, $SE = 0.02$, $p < .001$), but no significant correlation at the between-participant level ($r = -.09$, $SE = 0.08$, $p = .22$). These results were also consistent with those of Nash et al. (2017).

Testing the moderation by memory distrust

To test whether memory distrust moderated the cheap-strategy bias, we performed two separate linear mixed models with either the MDS or the SSMQ as the moderator. In these two models, we included Dif_beta, Equal_beta, memory distrust, and the two interaction terms "Dif_beta*-Memory Distrust" and "Equal_beta*Memory Distrust", all as fixed effects. In terms of random effects, we only included a random intercept for participants. The results are presented in Table 2, and we remind the reader that because we reverse-scored the SSMQ, higher scores on both measures signify greater levels of memory distrust in this study. As indicated by the significant "Dif_beta*-Memory Distrust" term in both the MDS and SSMQ models, memory distrust moderated the magnitude of the cheap-strategy bias. However, in contrast with our hypothesis, the sign of the interaction terms was negative, indicating that the cheap-strategy bias was stronger among people high in memory distrust, compared with their low memory distrust counterparts.

Table 2. Memory distrust moderated the cheap-strategy bias.

	SSMQ model			MDS model		
Fixed effects						
	B	*SE*	*p*	*B*	*SE*	*p*
Intercept	−0.00	0.02	.979	−0.02	0.02	1.00
Memory Distrust	−0.05	0.02	.037	0.02	0.02	.500
Dif_beta	**−0.22**	**0.02**	**<.001**	**−0.22**	**0.02**	**<.001**
Equal_beta	0.47	0.02	<.001	0.47	0.02	<.001
Dif_beta*MD	**−0.04**	**0.02**	**.016**	**−0.05**	**0.02**	**.005**
Equal_beta*MD	0.03	0.02	.055	0.01	0.02	.684
Random Effects						
	SD			*SD*		
Subject (Intercept)	0.43			0.43		

Note. *p*-values calculated using Satterthwaite d.f. The SSMQ was reverse-scored such that higher scores equal greater memory distrust, as per the MDS.

In addition, we found that the coefficient of memory distrust in the SSMQ model was significantly negative, indicating that people who received high memory distrust scores on the SSMQ were less likely to verify their memories in general. This effect also received support when we ran a new LMM model with likelihood ratings as the outcome variable and SSMQ scores as the only fixed effect ($B = -0.11$, $SE = 0.04$, $p = .01$). However, we did not find support for a similar overall relationship between memory distrust and strategy use likelihood in the MDS model (see Table 2).

Given that our main analyses revealed the reversed pattern of interaction to the one we hypothesised, we conducted a series of additional exploratory analyses with a view to better understanding the data. The remainder of this Results section serves to outline these additional analyses.

Exploratory analyses

Strategy types. One possible question about the unexpected direction of the interaction effect, is whether people who are high versus low in memory distrust tended to suggest qualitatively different types of verification strategies, and whether any such differences could have contributed to the pattern of moderation. To address this question, the first author coded all the nominated strategies into 9 categories and a second independent coder coded around one-third of the nominated strategies ($n = 722$). The inter-coder reliability was good (Cohen's kappa = .76). Therefore, we used the first author's categorisation for the analyses.

The most frequently mentioned strategy type was to seek others' opinions, either from familiar people such as friends or through social media discussion (33.4%, $n = 890$), or by seeking other credible sources of testimony such as local news, the person involved in the incident, police, or medical staff (21.8%, $n = 580$). Thus, over half of the strategies involved seeking social information of one kind or another. Two other frequently mentioned strategies were to find photos, videos, or messages (15.6%, $n = 416$), and to recall more using various cognitive techniques such as writing, meditation, or mental context reinstatement (17.4%, $n = 462$). Less-popular strategies included revisiting the venue of the incident to jog memory (4.5%, $n = 119$), finding one's own initial accounts of the event to see whether the memory has changed (1.4%, $n = 36$), appraising the comparative reliability of the disputing source by e.g., taking into account their alcohol or drug consumption (1.0%, $n = 26$), and other cognitive strategies such as imagining alternative scenarios or considering the plausibility of the remembered information (1.5%, $n = 39$). A small percentage of strategies were deemed as ambiguous and thus categorised as "Other" (3.5%, $n = 93$).

We selected the top and bottom quartiles of participants in terms of their MDS scores to artificially create two groups of "memory distrusters" and "memory trusters", respectively, and we ran chi-square tests to examine whether these two groups differed in the types of strategies they nominated. Considering all categories together, there was no statistically significant difference in the omnibus test, χ^2 (8) = 11.70, $p = .165$ $V = .05$, 95% CI [.00, .10]. However, the memory trusters nominally proposed more strategies of recall (Low: 140 vs. High: 117) and fewer strategies of seeking evidence (Low: 94 vs. High: 123) than the memory distrusters. In a comparable analysis where memory trusters and distrusters were instead categorised based on the top and bottom quartiles of SSMQ scores, the results were similar, χ^2 (8) = 7.90, $p = .443$, $V = .00$, 95% CI [.00, .08].

We next re-ran the two linear mixed models including Dif_beta, Equal_beta, Memory Distrust (SSMQ or MDS, depending on the model), and the two interaction terms "Dif_beta*Memory Distrust" as well as "Equal_beta*Memory Distrust" as fixed effects, and random intercepts for participants and strategy type (based on the coding described above). Adding random intercepts for the strategy type helped us to address the possibility that differences in the types of strategies suggested between memory trusters and distrusters could have contributed to the moderation of the cheap-strategy bias. In these models, the results were very similar to those from the models that did not control for strategy types, albeit that the key interaction in the SSMQ model was no longer statistically significant (SSMQ model: $B_{\text{Dif\_beta*Memory Distrust}} = -0.03$, $SE = 0.02$, $p = .061$; MDS model: $B_{\text{Dif\_beta*Memory Distrust}} = -0.04$, $SE = 0.02$, $p = .014$). Therefore, we consider that the moderation effect is unlikely to be an artifact of the choice of strategy types.

The separate roles of cost versus reliability. We also wanted to understand whether the unexpected moderation effect was driven by differences in how people with high versus low memory distrust used information about strategy cost and/or about strategy reliability. To address this question, we conducted another two linear mixed models to examine how memory distrust interacted separately with cost and with reliability in predicting the likelihood of using the strategy. These models again utilised the subsets of data consisting of participants scoring only the top 25% (memory distrusters) or bottom 25% (memory trusters) on the MDS, or the SSMQ, respectively. As Table 3 shows, memory distrust interacted both with cost ratings and with reliability ratings to predict strategy likelihood in the MDS grouping model, and interacted only with cost ratings in the SSMQ grouping model (the results of comparable analyses using continuous memory distrust scores were very similar, and can be accessed at https://osf.io/f84sw).

To make these interactions more intuitive to interpret, we plotted simple linear regressions (see Figure 1) using the same subset of data used in the MDS grouping model. As these plots show, memory distrusters' decisions were more influenced by a strategy's cost than were memory trusters' decisions, as indexed by the steeper slope of the regression line for the former group. In contrast, memory trusters' decisions were more influenced by a strategy's reliability than memory distrusters' decisions. In short, the moderating effect of memory distrust on the cheap-strategy bias appears to be driven by different appraisals of the importance of both cost and reliability. As can already be inferred from Table 3 and Figure 1, and supported by our additional analyses, although the cheap-strategy bias was robust among memory distrusters (MDS: $B_{\text{Dif\_beta}} = -0.30$, $SE = 0.04$, $p < .001$; SSMQ: $B_{\text{Dif\_beta}} = -0.24$, $SE = 0.04$, $p < .001$), among memory trusters, it was less so (MDS: $B_{\text{Dif\_beta}} = -0.09$, $SE = 0.05$, $p = .082$; SSMQ: $B_{\text{Dif\_beta}} = -0.18$, $SE = 0.05$, $p = .001$).

Table 3 . Memory distrust moderated the effect of cost and reliability.

	MDS grouping model (N = 273)			SSMQ grouping model (N = 261)		
	B	SE	*p*	B	SE	*p*
Fixed effects						
Intercept	0.01	0.05	.905	0.06	0.05	.267
Distruster (vs. truster)	−0.01	0.07	.857	−0.11	0.07	.104
Cost	−0.35	0.04	<.001	−0.41	0.03	<.001
Reliability	0.27	0.03	<.001	0.23	0.03	<.001
Distruster (vs. truster)*Cost	**−0.18**	**0.05**	**.001**	**−0.14**	**0.05**	**.005**
Distruster (vs. truster)* Reliability	**−0.13**	**0.05**	**.007**	−0.04	0.05	.348
Random effects						
Subject (Intercept)	*SD* 0.470			*SD* 0.447		
Pseudo-R^2 (fixed effects)	.244			.288		

Note. *P* values calculated using Satterthwaite d.f.

Exploratory analyses: associations of memory distrust with cost and reliability judgments

Finally, we wanted to explore (1) how people judged the cost and reliability of broad types of verification strategy irrespective of which specific strategies people suggested or judged themselves likely to use, and (2) whether these judgments of broad strategy types were systematically associated with individual differences in memory distrust. Recall that in the final part of the study, participants were

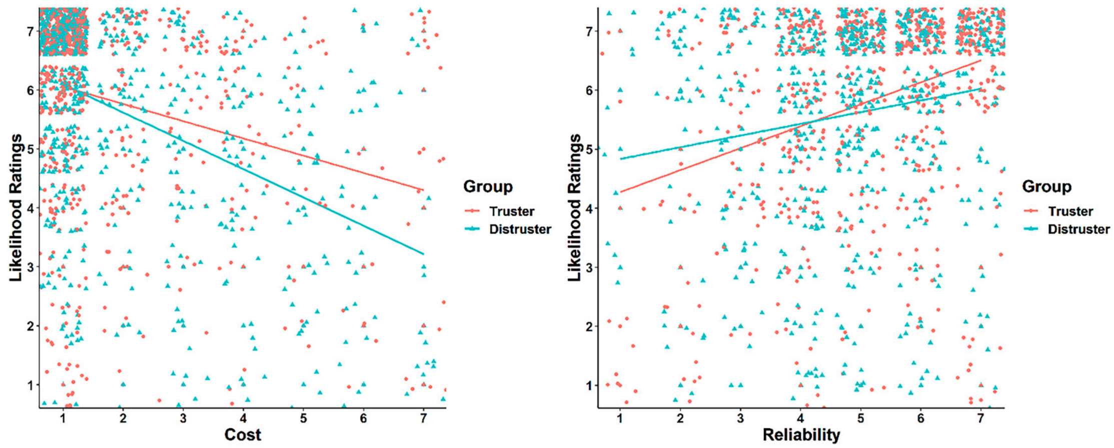

Figure 1 . *The Moderating Effect of Memory Distrust on the Cost-Likelihood and Reliability-Likelihood Relationships.*
Note. The lines were fitted using simple linear regressions without accounting for the non-independence of observations.

asked to individually rate each of five general strategy types: (1) Other people; (2) Physical evidence; (3) Returning to the location; (4) Mental context reinstatement; (5) Considering plausibility. Looking at these data, a one-way within-subject ANOVA showed that participants perceived significant overall differences in cost between these five broad types of strategy, F (3.19, 1710.44) = 572.71, $p < .001$, $\eta_p^2 = .52$, 95% CI [.49, .54]; False Discovery Rate (FDR)-corrected pairwise comparisons indicated that all strategy-types differed significantly ($p < .001$; see Table 4 for details). Likewise, participants perceived significant overall differences in reliability between these five broad types of strategy, F (3.51, 1879.43) = 221.45, $p < .001$, $\eta_p^2 = .29$, 95% CI [.26, .32]; FDR-corrected pairwise comparisons indicated that all pairs differed significantly ($p < .002$; see Table 5 for details) except for Other People – Location ($p = .094$) and Other People – Plausibility ($p = .107$).

To examine whether people with higher versus lower memory distrust rated these general verification strategies differently, we performed correlational analyses. These analyses revealed that participants' MDS scores were weakly and positively related to their ratings of the cost of seeking information from others, looking for physical evidence, and mental context reinstatement (MCR). This result might suggest that people who are more skeptical about their memories tend to perceive the process of verifying as somewhat more burdensome than their memory-trusting counterparts. However, we note that SSMQ scores were not significantly related to cost judgments for any strategy type. Even more interesting, participants' MDS and SSMQ scores were moderately and negatively correlated with their ratings of the reliability of the two cognitive strategies – Mental Context Reinstatement and Plausibility – but not the other strategy types. This result suggests – as seems intuitively appropriate – that people who are more skeptical about their memories tend to believe cognitive verification strategies are less reliable, than do their memory-trusting counterparts.

Discussion

When we have cause to doubt whether one of our memories is accurate and trustworthy, there are many means by which we might gather evidence to inform our decisions (Otgaar et al., 2019; Wade et al., 2014; Wade & Garry, 2005). When choosing how to verify a personal memory, our participants preferred strategies that are cheap-and-easy rather than expensive-and-effortful, and they preferred strategies that are reliable rather than unreliable. We also replicated the cheap-strategy bias in memory verification, insofar that participants' judgments about their likelihood of using a strategy were more affected by whether the strategy was cheap-and-easy than by whether it was reliable (Nash et al., 2017; Wade et al., 2014). Extending prior findings, people's memory distrust moderated the magnitude of this cheap-strategy bias, albeit in the opposite direction to what we had hypothesised. Specifically, whereas we predicted that the cheap-strategy bias would be attenuated or reversed among participants who distrusted their own memories, in fact this bias was even stronger among these people than among their memory-trusting peers. In the following sections, we discuss the results in detail and their theoretical as well as practical implications.

As shown by Wade et al. (2014), Nash et al. (2017) and the current study, people use diverse strategies to verify their memory, among which most involve looking outwards to the world and one's social connections for information. The prominence of social information in verifying memory is consistent with the finding that receiving negative social feedback (e.g., being told by family or friends that one's memory is wrong) is one of the most powerful precursors to create nonbelieved memories, whereby people maintain vivid recollections of events yet disbelieve that those events really happened (e.g., Li et al., 2020; Otgaar et al., 2016; Scoboria et al., 2018). The heavy reliance on social information in verifying our

Table 4. Correlations between cost ratings and memory distrust.

Variable	*M*	*SD*	1	2	3	4	5	6
1. SSMQ	−1.43	1.13						
2. MDS	2.79	1.06	.54** [.48, .60]					
3. Cost (Other People)	2.14	1.43	.00 [−.08, .09]	.15** [.06, .23]				
4. Cost (Physical)	3.02	1.80	−.01 [−.09, .07]	.10* [.01, .18]	.51** [.44, .57]			
5. Cost (Location)	4.82	1.86	.00 [−.08, .09]	−.01 [−.10, .07]	.30** [.22, .38]	.33** [.25, .40]		
6. Cost (MCR)	1.89	1.45	−.01 [−.10, .07]	.12** [.03, .20]	.56** [.50, .62]	.40** [.33, .47]	.25** [.16, .32]	
7. Cost (Plausibility)	1.66	1.25	−.04 [−.12, .05]	.08 [−.01, .16]	.52** [.45, .58]	.35** [.27, .42]	.15** [.06, .23]	.57** [.52, .63]

Note. MCR = Mental Context Reinstatement. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. * indicates $p < .05$. ** indicates $p < .01$.

memories and "deciding the reality" might be crucial in creating a shared past and forming collective memories (Rajaram, 2022).

The current study replicated the cheap-strategy bias in memory verification, which fits with broader research in human psychology and cognitive science that characterizes humans as "cognitive misers" who prefer heuristics that simplify complex decision-making and reduce cognitive effort (Kool et al., 2010; Stanovich, 2018, 2021). However, in this respect and contrary to our prediction, we discovered that people with high memory distrust were the greater "cognitive misers", insofar that they unexpectedly expressed a stronger cheap-strategy bias than did people low in memory distrust. Breaking down this results in further exploratory analyses, as compared with memory-trusters, memory-distrusters' choices of strategies were more influenced by the perceived cost of a strategy (i.e., they were more deterred by a strategy being high-cost), but less influenced by the perceived reliability of a strategy.

Why might memory distrusters be more, rather than less, likely to show a cheap-strategy bias? Some of our other exploratory findings offer insights to inform potential explanations. For example, in our analysis of how participants judged the cost and reliability of five general types of strategy, people with high memory distrust tended to rate some strategy-types as more costly than did their low-memory distrust counterparts, yet these patterns were only observed when assessing memory distrust with MDS scores, and not with SSMQ scores. Moreover, consistent with the conceptualization of memory distrust (Gudjonsson & MacKeith, 1982; Nash et al., 2022; van Bergen et al., 2010a), people with high memory distrust rated different cognitive strategy-types as less reliable than did their low-memory distrust counterparts. Furthermore, when assessing memory distrust with SSMQ scores (but not with MDS scores), people with high memory distrust reported being less likely overall to use verification strategies. Together, these observations – albeit sometimes inconsistent between memory distrust measures – hint at a perception of general skepticism among memory-distrusters not only toward their own memories, but also more generally toward the whole enterprise of validating past events. That is to say, one interpretation is that people who distrust their memories tend to be less motivated and/or more cynical about the worthwhileness of investing time and resources in questioning past events. This account of our findings merits further investigation.

If our "unmotivated cynic" account of memory distrust is correct, then how might this account fit with prior findings that suggest memory distrusters (based on

Table 5. Correlations between reliability ratings and memory distrust.

Variable	*M*	*SD*	1	2	3	4	5	6
1. SSMQ	−1.43	1.13						
2. MDS	2.79	1.06	.54** [.48, .60]					
3. Reliability (Other People)	3.96	1.55	−.05 [−.14, .03]	.04 [−.04, .13]				
4. Reliability (Physical)	5.83	1.17	−.03 [−.11, .06]	−.05 [−.13, .04]	.12** [.04, .21]			
5. Reliability (Location)	3.81	1.59	−.05 [−.14, .03]	.04 [−.05, .12]	.21** [.13, .29]	.18** [.09, .26]		
6. Reliability (MCR)	4.56	1.31	−.20** [−.28, −.12]	−.19** [−.27, −.11]	.20** [.12, .28]	.10* [.01, .18]	.20** [.11, .28]	
7. Reliability (Plausibility)	4.10	1.41	−.21** [−.29, −.13]	−.17** [−.25, −.08]	.13** [.05, .21]	.07 [−.01, .15]	.10* [.02, .18]	.60** [.54, .65]

Note. MCR = Mental Context Reinstatement. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. * indicates $p < .05$. ** indicates $p < .01$.

either the SSMQ or the MDS) are more likely to accept misinformation about a witnessed event (e.g., van Bergen et al., 2010b), more likely to report experiencing nonbelieved memories (Zhang et al., 2022a, 2022b), and more likely to change their memory decisions in response to feedback which falsely implies that their memories are incorrect (Zhang et al., 2023)? Perhaps the most obvious interpretation is that memory-distrusters, because of their belief that their own memories are unreliable, frequently judge that it is better to simply accept suggestions about their past experiences, rather than wasting time and effort in disputing and investigating them. Together with those of prior studies, our findings suggest that memory distrust could act as a double risk factor in terms of individual suggestibility and susceptibility to false memories. That is, people with memory distrust may be more willing to accept suggestions, yet less willing to take precautionary steps to validate those suggestions.

Limitations and future directions

It is important to highlight certain limitations of the current study. First, the measures of cost, reliability, and likelihood were quite general, unable to probe considerations regarding different aspects of cost or reliability, or the nuanced contexts or circumstances that might inform people's likelihood of checking their memories. Second, the use of a hypothetical scenario offered better experimental control than would inviting a broader range of genuine memories (as in Nash et al., 2017, Studies 1 and 2), but it is important to consider that the strategies people truly choose and use in the face of a memory challenge may differ from those strategies they anticipate using in a hypothetical scenario. For example, people differ in their ability to form mental imagery when engaging in imagination and autobiographical recall, with one extreme being aphantasia, the inability to form mental imagery (e.g., Dawes et al., 2022). Variation in imagery ability would likely affect how effectively participants put themselves in the hypothetical situation, and perhaps also how they judge the reliability and costs of the strategies. Such variation would be especially problematic if it were confounded with memory distrust. We cannot test this possibility directly with the data; however, insofar that we might expect participants with greater imagery ability to write longer descriptions of the hypothetical event, it is informative to note that there was no significant correlation between memory distrust and the number of words used in these descriptions (MDS: $r\ (535) = .00$, $p = .94$; SSMQ: $r\ (535) = .07$, $p = .12$). This finding enhances confidence in the validity of our approach somewhat, as indeed do Nash et al.'s (2017) data which showed a similar cheap-strategy bias with an imagined scenario as with a remembered event. Nevertheless, the observed moderation effect could still be confounded by some other unmeasured variable that influences the construction of the fictitious event, such as working memory or cognitive ability, and future studies could seek to tease apart these variables further.

In addition, the current study only used one scenario (i.e., sharing their memory with family) where the stakes of misremembering were not high. Therefore, although the cheap-strategy bias appears robust in this controlled paradigm, it is important to understand whether the moderating effect of memory distrust could be replicated and generalised in more-realistic tasks where the veracity of a memory needs to be investigated (e.g., eyewitness testimony). We would also highlight that some of the findings differed between the two measures of memory distrust: SSMQ and MDS, which could either be of theoretical relevance or a sign of measurement noise. Further studies could systematically investigate the differences between the two aspects of memory distrust. Finally, the current study as well as Nash et al. (2017) was conducted using Western samples (mostly British). However, there could be cultural differences in memory (Ross & Wang, 2010; Wang, 2021) as well as the appraisal of memory functioning (Zhang et al., 2023) that lead people to take vastly different approaches to memory verification. It is therefore important to conduct similar research in different cultures to examine its generalizability.

Conclusions

As discussed by Nash et al. (2022), the beliefs that people hold about their memory functioning, accurate or not, can shape their decisions about what they did and did not experience in the past. When making decisions about the veracity of their memories, people do not just take into account first-order information such as the phenomenological characteristics of their memories, but also second-order judgments about their memory functioning. This information, jointly, influences how individuals re-construct their memories (Zhang et al., 2022b), but so too can other verifying evidence that people might seek, gather, and be exposed to. Indeed, people use various strategies to verify their memories when challenged. Here we replicated the finding that when deciding which strategy to use, the strategy's cost is a more important factor than its reliability, a phenomenon termed the cheap-strategy bias. More importantly, contrary to our prediction, people with high memory distrust exhibited greater cheap-strategy bias, compared with their low memory distrust counterparts, possibly due to a lack of motivation to substantiate one's memories. While for people who place high levels of trust to their memory, the cheap-strategy bias is smaller in magnitude and less robust. We call for more future studies to examine the generalizability of the cheap-strategy bias as well as to replicate and explain the moderating effect of memory distrust.

Notes

1. Nash et al.'s (2017) data are available via https://d oi.org/10.17036/dcf4b463-35fd-41da-8710-b91b5967c2b4
2. Note that because reliability positively predicted likelihood while cost negatively predicted likelihood (i.e., they have opposite signs), to compare the absolute value of these two coefficients, we first reversed the cost ratings before the z-transformation.

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Data availability statement

All data and analyses scripts are at https://osf.io/my3rw/.

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References

Bates, D., Mächler, M., Bolker, B., & Walker, S. (2014). Fitting linear mixed-effects models using lme4. *arXiv preprint arXiv:1406.*5823.

Bluck, S. (2003). Autobiographical memory: Exploring its functions in everyday life. *Memory (Hove, England)*, *11*(2), 113–123. https://doi.org/10.1080/741938206

Bluck, S., Alea, N., Habermas, T., & Rubin, D. C. (2005). A tale of three functions: The self-reported uses of autobiographical memory. *Social Cognition*, *23*(1), 91–117. https://doi.org/10.1521/soco.23.1.91.59198

Burnell, R., Nash, R. A., Umanath, S., & Garry, M. (2022). Memories people no longer believe in can still affect them in helpful and harmful ways. *Memory & Cognition*, *50*(6), 1319–1335. https://doi.org/10.3758/s13421-022-01328-9

Dawes, A. J., Keogh, R., Robuck, S., & Pearson, J. (2022). Memories with a blind mind: Remembering the past and imagining the future with aphantasia. *Cognition*, *227*, 105192. https://doi.org/10.1016/j.cognition.2022.105192

Gudjonsson, G. H., & MacKeith, J. A. C. (1982). False confessions: Psychological effects of interrogation. *Reconstructing the Past: The Role of Psychologists in Criminal Trials*, 253–269.

Kool, W., McGuire, J. T., Rosen, Z. B., & Botvinick, M. M. (2010). Decision making and the avoidance of cognitive demand.. *Journal of Experimental Psychology: General*, *139*(4), 665–682. https://doi.org/10.1037/a0020198

Kuczek, M., Szpitalak, M., & Polczyk, R. (2021). Anxious and distrustful– How do state anxiety and memory distrust influence the misinformation effect? *Polish Psychological Bulletin*, *52*(4), 341–348. https://doi.org/10.24425/ppb.2021.139168

Kumle, L., Võ, M. L. H., & Draschkow, D. (2021). Estimating power in (generalized) linear mixed models: An open introduction and tutorial in R. *Behavior Research Methods*, *53*(6), 2528–2543. https://doi.org/10.3758/s13428-021-01546-0

Li, C., Wang, J., & Otgaar, H. (2020). Creating nonbelieved memories for bizarre actions using an imagination inflation procedure. *Applied Cognitive Psychology*, *34*(6), 1277–1286. https://doi.org/10.1002/acp.3722

Mazzoni, G., Scoboria, A., & Harvey, L. (2010). Nonbelieved memories. *Psychological Science*, *21*(9), 1334–1340. https://doi.org/10.1177/0956797610379865

Nash, R. A., Saraiva, R. B., & Hope, L. (2022). Who doesn't believe their memories? Development and validation of a new memory distrust scale. *Journal of Applied Research in Memory and Cognition*. Advance online publication. https://doi.org/10.1037/mac0000061

Nash, R. A., & Takarangi, M. K. (2011). Reconstructing alcohol-induced memory blackouts. *Memory (Hove, England)*, *19*(6), 566–573. https://doi.org/10.1080/09658211.2011.590508

Nash, R. A., Wade, K. A., Garry, M., & Adelman, J. S. (2017). A robust preference for cheap-and-easy strategies over reliable strategies when verifying personal memories. *Memory (Hove, England)*, *25*(7), 890–899. https://doi.org/10.1080/09658211.2016.1214280

Otgaar, H., Bücken, C., Bogaard, G., Wade, K. A., Hopwood, A. R., Scoboria, A., & Howe, M. L. (2019). Nonbelieved memories in the false memory archive. *Journal of Applied Research in Memory and Cognition*, *8*(4), 429–438. https://doi.org/10.1016/j.jarmac.2019.07.003

Otgaar, H., Howe, M. L., Smeets, T., & Wang, J. (2016). Denial-induced forgetting: False denials undermine memory, but external denials undermine belief. *Journal of Applied Research in Memory and Cognition*, *5*(2), 168–175. https://doi.org/10.1016/j.jarmac.2016.04.002

Rajaram, S. (2022). Collective memory and the individual mind. *Trends in Cognitive Sciences*. https://doi.org/10.1016/j.tics.2022.09.014

R Core Team. (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing; 2020.

Ross, M. (1997). Validating memories. In N. L. Stein, P. A. Ornstein, B. Tversky, & C. Brainerd (Eds.), *Memory for everyday and emotional events* (pp. 49–81). Erlbaum.

Ross, M., & Wang, Q. (2010). Why We remember and what We remember. *Perspectives on Psychological Science*, *5*(4), 401–409. https://doi.org/10.1177/1745691610375555

Scoboria, A., Otgaar, H., & Mazzoni, G. (2018). Defending and reducing belief in memories: An experimental laboratory analogue. *Memory & Cognition*, *46*(5), 770–786. https://doi.org/10.3758/s13421-018-0800-1

Sheen, M., Kemp, S., & Rubin, D. (2001). Twins dispute memory ownership: A new false memory phenomenon. *Memory & Cognition*, *29*(6), 779–788. https://doi.org/10.3758/BF03196407

Sheen, M., Kemp, S., & Rubin, D. C. (2006). Disputes over memory ownership: What memories are disputed? *Genes, Brain and Behavior*, *5*(S1), 9–13. https://doi.org/10.1111/j.1601-183X.2006.00189.x

Stanovich, K. E. (2018). Miserliness in human cognition: The interaction of detection, override and mindware. *Thinking & Reasoning*, *24*(4), 423–444. https://doi.org/10.1080/13546783.2018.1459314

Stanovich, K. E. (2021). Why humans are cognitive misers and what it means for the great rationality debate. *Routledge Handbook of Bounded Rationality*, 196–206.

van Bergen, S., Brands, I., Jelicic, M., & Merckelbach, H. (2010a). Assessing trait memory distrust: Psychometric properties of the squire subjective memory questionnaire. *Legal and Criminological Psychology*, *15*(2), 373–384. https://doi.org/10.1348/135532509X471960

van Bergen, S., Horselenberg, R., Merckelbach, H., Jelicic, M., & Beckers, R. (2010b). Memory distrust and acceptance of misinformation. *Applied Cognitive Psychology*, *24*(6), 885–896. https://doi.org/10.1002/acp.1595

Wade, K. A., & Garry, M. (2005). Strategies for verifying false autobiographical memories. *The American Journal of Psychology*, *118*(4), 587–602. https://doi.org/10.2307/30039087

Wade, K. A., Nash, R. A., & Garry, M. (2014). People consider reliability and cost when verifying their autobiographical memories. *Acta Psychologica*, *146*, 28–34. https://doi.org/10.1016/j.actpsy.2013.12.001

Wang, Q. (2021). The cultural foundation of human memory. *Annual Review of Psychology*, *72*(1), 151–179. https://doi.org/10.1146/annurev-psych-070920-023638

Zhang, Y., Battista, F., Thissen, D., Otgaar, H., Wang, J., & Jelicic, M. (2022a). Examining the associations between nonbelieved memories and memory distrust, self-esteem, and rumination. *Psychology of Consciousness: Theory, Research, and Practice*, https://doi.org/10.1037/cns0000344

Zhang, Y., Otgaar, H., & Wang, J. (2022b). Memory distrust is related to memory errors, self-esteem, and personality. *Applied Cognitive Psychology*, 283–292. https://doi.org/10.1002/acp.3917

Zhang, Y., Qi, F., Otgaar, H., Nash, R. A., & Jelicic, M. (2023). A tale of two distrusts: Memory distrust towards commission and omission errors in the Chinese context. [Manuscript submitted for Publication].