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Item-method directed forgetting and perceived truth of news headlines

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ABSTRACT

Research on item-method directed forgetting (IMDF) suggests that memories can be voluntarily forgotten. IMDF is however usually examined with relatively simple study materials, such as single words or pictures. In the present study, we examined voluntary forgetting of news headlines from (presumably) untrustworthy sources. Experiment 1 found intact IMDF when to-be-forgotten headlines were characterised as untrustworthy and to-beremembered headlines were characterised as trustworthy. Experiment 2 separated remember/forget cues and trustworthiness prompts. Forget cues alone had a large effect on memory, but only a small reducing effect on perceived truth. In contrast, trustworthiness prompts alone had essentially no effect on memory, but a large effect on perceived truth. Finally, Experiment 3 fully crossed forget/remember cues and trustworthiness prompts, revealing that forget cues can reduce memory irrespective of whether headlines are characterised as trustworthy or untrustworthy. Moreover, forget cues may bias source attributions, which can explain their small reducing effect on perceived truth. Overall, this work suggests that news headlines can be voluntarily forgotten. At least when people are motivated to forget information from untrustworthy sources, such forgetting may be helpful for curtailing the spread of false information.

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KEYWORDS

Voluntary forgetting; itemmethod directed forgetting; memory for news headlines; perceived truth

People follow the news to stay up to date with what happens in the world. News reports can be focused on events of local, national or international importance, and covered topics can range from important political developments to less significant issues. Public events are routinely remembered in daily life and people seem to predominantly learn about such events via the media (Abel & Berntsen, 2021). Media consumption has however changed within the last two decades, with online news and social media gaining importance. This development may have increased people's exposure to untrustworthy sources, misinformation and fake news (e.g., Del Vicario et al., 2016; Vosoughi et al., 2018). The initial impetus for the present study was to examine if news headlines from untrustworthy sources can be voluntarily forgotten. If this were the case, so our reasoning, such voluntary forgetting could potentially help to curtail the spread and impact of untrustworthy information.

Research on voluntary forgetting

Rich evidence from the directed forgetting literature indeed suggests that people can voluntarily forget previously studied information (for reviews, see Anderson & Hanslmayr, 2014; Bäuml et al., 2020; MacLeod, 1998). One task used to study voluntary forgetting is the itemmethod directed forgetting (IMDF) task. Here, participants are usually presented with single words or pictures and, after each item, receive cues to try to remember or forget the item. Remember cues supposedly signal than an item is relevant for a later test, whereas forget cues indicate that the item is irrelevant and will not be tested. On a final test, memory for all items is however tested, and is typically reduced for to-be-forgotten relative to to-beremembered information.

Importantly, this forgetting effect in IMDF arises across a variety of memory tests. It is not limited to recall but is usually found on recognition tests (Basden et al., 1993; Davis & Okada, 1971; MacLeod, 1975, 1999) and sometimes also on indirect tests of memory (Basden & Basden, 1996; MacLeod, 1989; Vonk & Horton, 2006; but see Paller, 1990). These findings are consistent with the proposal that voluntary forgetting in IMDF operates at the encoding stage and widely reduces the mnemonic representation of to-be-forgotten relative to to-be-remembered information. As such, the findings are also relevant to theoretical conceptualizations of item-method directed forgetting. In particular, the forgetting effect has been attributed to selective rehearsal of to-be-remembered and stopped rehearsal of to-be-forgotten information (e.g., Basden

CONTACT Magdalena Abel a magdalena.abel@ur.de Department of Experimental Psychology, Regensburg University, 93040 Regensburg, Germany Supplemental data for this article can be accessed online at https://doi.org/10.1080/09658211.2023.2267191. © 2023 Informa UK Limited, trading as Taylor & Francis Group et al., 1993; Basden & Basden, 1996; Bjork, 1972; Woodward & Bjork, 1971), and thus to differences in encoding. One perspective is that forgetting due to stopped rehearsal arises rather passively, because to-be-forgotten information is not further processed after cues are presented. More recently, it has however been suggested that the forgetting may be effortful (e.g., Fawcett & Taylor, 2008, 2012) and at least partly based on an active process, potentially involving inhibition (e.g., Fellner et al., 2020; Jing et al., 2019; van Hooff & Ford, 2012; Wylie et al., 2008).

Our first goal in the present study was to examine whether IMDF extends to news headlines from untrustworthy sources. Although IMDF is usually examined with words and pictures, single studies used more complex materials. For instance, IMDF has been observed for seqments of videos showing common events (e.g., baking cookies; Fawcett et al., 2013). It has also been demonstrated for brief statements, which for example described simple actions (e.g., "to eat candy", "open the umbrella"; Li et al., 2017; Sahakyan & Foster, 2009), events that might happen in one's personal life (e.g., "to get caught cheating in an exam"; Lee & Hsu, 2013), or behaviours associated with presented faces (e.g., "He returned the lost wallet with all the money in it"; Hupbach et al., 2022). Because news headlines also often take the form of short statements, IMDF might be expected to extend to these materials, too. On the other hand, news headlines often contain actual facts, capturing points of societal interest, or portraying what is going on in the world. Due to this connection and immediate relevance of news headlines to real-world issues, it is by no means trivial to examine if corresponding contents are subject to IMDF as well.

We conducted an initial pilot study with news headlines as study materials (for a full account, see Supplemental Materials 1 on the OSF project page: https://osf.io/csa39/). The results indeed suggested that item-method directed forgetting could be extended to such real news headlines, on both a free-recall task and a recognition test, thus also replicating a hallmark finding from the literature. Open questions were however whether the valence of the news headlines as well as the characterisation of headlines as trustworthy or untrustworthy had an impact on the magnitude of item-method directed forgetting, and we attempted to address these questions in the present project.

Voluntary forgetting as a way to limit the consequences of exposition to false information?

Our main motivation for starting this project was indeed the idea that voluntary forgetting of news headlines from untrustworthy sources could potentially be helpful and curtail their spread. For one, people should be less likely to share false news headlines with others if the information no longer lingers on in their minds. There might be another way in which voluntary forgetting could reduce the impact of false information, however. Exposure to information alone can increase its perceived truth (relative to information not encountered before; Hasher et al., 1977; for reviews, see Dechêne et al., 2010; Henderson et al., 2022). Such effects are often examined with trivia statements (e.g., Fazio et al., 2019, 2022), but have also been shown with real and fake news headlines (Brashier et al., 2021; Calvillo & Smelter, 2020; Pennycook et al., 2018; Polage, 2012; Smelter & Calvillo, 2020). Our second goal in the present study was to examine if voluntary forgetting of news headlines might also help to reduce the perceived truth of previously encountered information.

Several theoretical accounts have been proposed to explain increases in perceived truth on the basis of prior exposure, and most of them rely on memory in some form (for overviews, see Brashier & Marsh, 2020; Unkelbach et al., 2019). Hasher et al. (1977) for instance suggested that frequency of occurrence was stored in memory and acted as a signal for later judgments of certainty and truth. Arkes et al. (1989, 1991) argued that feelings of familiarity might be increased with prior exposure, whereas others have suggested a critical role of enhanced processing fluency (e.g., Reber & Schwarz, 1999; Unkelbach, 2007; Wang et al., 2016). Finally, Begg et al. (1992) reported evidence that statement familiarity and source recollection contributed separately to increases in perceived truth. Statements remembered to come from an untrustworthy source were judged to be less true than statements remembered to come from a trustworthy source, but they were nevertheless still judged to be more true than completely new statements (see also Henkel & Mattson, 2011; Unkelbach & Stahl, 2009).

Could increases in perceived truth that arise due to prior exposure be affected by item-method directed forgetting? Assuming that increases in perceived truth arise due to a memory-based mechanism, voluntary forgetting might indeed also reduce perceived truth. As noted above, IMDF is typically found on recognition tests (e.g., Davis & Okada, 1971; MacLeod, 1975, 1999) and sometimes also on indirect tests of memory (e.g., MacLeod, 1989; Vonk & Horton, 2006), which suggests that it operates at the encoding stage and widely reduces the representation of to-be-forgotten contents in memory. If IMDF reliably extends to untrustworthy news headlines, the forgetting could also reduce perceived truth of the headlines. A single prior study reported data relevant to this suggestion. Santos et al. (2017) cued participants to remember or forget trivia statements. Immediately afterwards, participants were asked to judge the perceived truth of some of these statements. Old statements from the initial study phase were generally judged as more true than completely new statements, but to-be-forgotten statements were judged as less true than to-be-remembered statements. Participants subsequently also took an old/new recognition test for some remaining statements from the study phase, which showed evidence of IMDF (in a onetailed test, p = .034). These findings by Santos et al. (2017) are consistent with the proposal that voluntary forgetting in the form of IMDF may reduce perceived truth. If IMDF extends to news headlines, then similar forgettingbased reductions in perceived truth could potentially help to limit the negative influence of prior exposition to untrustworthy information.

The present study

In the following, we report three experiments, in which participants studied real news headlines. In Experiment 1, participants were asked to try to remember headlines marked as coming from a trustworthy source and to try to forget headlines marked as coming from an untrustworthy source (i.e., cues and trustworthiness prompts were combined in these experiments). This was the starting point in our series of experiments, because our initial thinking was that it would be most useful in daily life if motivated remembering and forgetting could be implemented such that trustworthy information is maintained, whereas untrustworthy information is forgotten. Yet, the results of Experiment 1 made it necessary to implement changes. In Experiment 2, participants received either trustworthiness prompts or remember/forget cues after each headline (but not both), and Experiment 3 fully crossed trustworthiness prompts and remember/ forget cues. In each experiment, we examined memory for the news headlines, but additionally also included a truth judgment task for the old (to-be-remembered and to-be-forgotten) headlines, intermixed with new headlines. Moreover, Experiments 1 and 2 also varied the emotionality of headlines, differentiating between neutral and negative headlines. Together, the experiments will show whether headlines can be voluntarily forgotten, and whether such forgetting can contribute to curtailing effects of prior exposure on perceived truth of news headlines.

Experiment 1

Experiment 1 pursued two goals. The first goal was to confirm IMDF for news headlines, while also adding certain variations. Because many news headlines that people are exposed to in daily life are negative or neutral (rarely positive; Soroka & McAdams, 2015; Trussler & Soroka, 2014; van der Meer et al., 2019), Experiment 2 differentiated between negative and neutral headlines.

Table 1. Outcome of sensitivity analyses for within-subject main effects in repeated measures ANOVAs, showing detectable effect sizes (f) based on the sample sizes of each experiment ($\alpha = 0.05$, $1-\beta = 0.80$, correlation among repeated measures set to 0.5).

	n = 36 (Exp.1)	n = 42 (Exp. 2)	n = 59 (Exp. 3, full sample)	n = 30 (Exp. 3, recognition first)
2 factor levels	0.24	0.22	0.19	0.27
3 factor levels	0.22	0.20	0.17	0.24

According to a recent meta-analysis, IMDF can be slightly reduced for negative relative to neutral information (Hall et al., 2021). Examining whether IMDF for news headlines differs as a function of emotional tone of the headline is important when evaluating the potential usefulness of voluntary forgetting for decreasing the spread of untrustworthy information.

The second goal was to examine the potential influence of IMDF on perceived truth. In Experiment 1, half the participants completed a free recall test on the studied headlines, whereas the other participants completed a truth judgment task instead (followed by an old/new recognition test). The truth judgment task was included in the experiment to enable a test of the hypothesis that perceived truth of old headlines encountered during the study phase might be reduced by voluntary forgetting in the form of IMDF (see also Santos et al., 2017).

Method

Participants. For all experiments reported in this manuscript, sample sizes were determined before starting data collection by anticipating the maximum number of subjects that we would be able to test at the respective times. Sample sizes were similar to those commonly used in research on IMDF (e.g., Burgess et al., 2017; Fawcett et al., 2013; Taylor et al., 2018), and sensitivity analyses conducted in G*Power (Faul et al., 2007) suggested that they enabled us to detect within-subject main effects of medium size (see Table 1 for details).¹

For Experiment 1, a total of 72 participants were recruited. Half of the participants received a free recall test at the end of the experiment; the other half received a truth judgment task (plus a subsequent recognition test) instead. Mean age was 23.72 years (range 18–35 years). All subjects were fluent in German. 52 participants were female, 20 male. Participants were recruited via social media posts and received online gift vouchers for participating. All experiments reported in this manuscript were carried out in accordance with the provisions of the World Medical Association Declaration of Helsinki.

Material. One difficulty when developing this project was deciding what materials to use. Since we wanted to examine voluntary forgetting of untrustworthy news headlines, it would have made sense to directly use such materials, i.e., inaccurate headlines from untrustworthy sources. This approach has been used in prior work on perceived truth (e.g., Pennycook et al., 2018), which showed that exposure to such fake news headlines indeed increases their perceived truth. We looked into corresponding German materials but noticed that we would likely have to include headlines spreading inaccuracies about vaccines, specific politicians, refugees and marginalised groups in Germany. We considered it unethical to expose our participants to such false information just for the sake of a psychological experiment, especially given prior demonstrations of increases in perceived truth. We therefore decided to only apply news headlines from trustworthy sources in our study.

Materials as well as data for all experiments are available on the Open Science Framework (https://osf.io/ csa39/). Study materials were compiled in three steps. First, we collected 60 news headlines; some were recycled from the pilot study (see the OSF project page), others were newly gathered from the websites of major German news outlets (such as sueddeutsche.de, faz.net, zeit.de, spiegel.de). Our goal was to select headlines that contained facts unlikely to change during data collection (e.g., "Bitcoin consumes as much electricity as Norway"), and in Experiment 1, we now also tried to include headlines that varied in emotionality. Second, 24 additional pilot participants rated all headlines on 7-point scales with regard to perceived emotion (scale from 1 = very negative to 7 = very positive) and perceived truth (scale from 1 =false to 7 =true). Third, based on these rating data, we chose 30 news headlines as study materials for Experiment 1. Three sets of 10 headlines each were compiled such that half of the events in each set referred to negative headlines (mean rated emotion: M = 1.87, SD = 0.54), whereas the other half referred to neutral headlines (M = 4.08, SD = 0.63). Additionally, we tried to pick headlines with a medium rating of perceived truth (negative headlines: M = 4.51, SD = 0.77; neutral headlines: M = 4.55, SD = 0.63), to make sure that our experimental manipulations had room to both decrease and increase truth judgments. Mean number of words per headline was similar across the three sets (namely M =6.60, M = 6.90, M = 6.90). Materials were counterbalanced and, across participants, the three sets served equally often as trustworthy/to-be-remembered, untrustworthy/ to-be-forgotten and new headlines. At the end of the experiment, participants were debriefed that all news headlines had in fact been taken from trustworthy sources.

Design. The design of the experiment differed slightly, depending on whether the focus was on memory or perceived truth. The memory experiment applied a 2×2 within-subject design with the factors cue (remember cue, forget cue) and emotionality of headlines (negative, neutral). At study, participants received cues to try to remember trustworthy headlines and forget untrustworthy headlines. We also controlled emotionality of headlines, and half the headlines in each cue condition were negative or neutral.

The experiment on truth judgments applied a 3×2 within-subject design with the factors cue (remember cue, forget cue, new headline) and emotionality of headlines (negative, neutral). The only difference to the memory experiment was that a set of new headlines had to be included during the truth judgment task as a baseline for evaluating the influence of prior occurrence of old headlines in the study phase.²

Procedure. Due to the Covid-19 pandemic, all experiments reported in this manuscript were conducted via the video conference software Zoom. Participants received an individual invitation link after signing up for the study. In the Zoom meeting, they were greeted by an experimenter who gave them basic information about the study and their rights as participants. All participants provided verbal consent to participate. The experimenter kept their camera and microphone activated to facilitate communication, and participants were asked to do the same. Importantly, to protect participants' privacy, no video or audio recordings were made, which was also emphasised to participants. Task and stimuli were presented to participants via screensharing.

After some demographic questions, participants were asked to study the news headlines. Each headline was followed by a cue, which supposedly indicated whether the headline came from a trustworthy or an untrustworthy source. Participants were asked to remember only trustworthy headlines for a later memory test and to try to forget untrustworthy headlines. Two practice trials were presented (with "Headline X" and "Headline Y" as place fillers), to familiarise participants with the cuing procedure. At the beginning of each trial, a fixation cross was presented for 2 s, centrally on the screen. The headline was then presented for 7 s, followed by one of two cues for 3 s (either "Trustworthy – Remember" or "Untrustworthy – Forget"). During the study phase, the 20 news headlines were presented in random sequence for each subject.

Next, all participants completed a 15-min distractor phase. They first rated pictures of touristic places from around the world for roughly 3 min, indicating how much they would like to visit them. Participants then completed standard progressive matrices (Raven, 2000) for about 10 min. Finally, participants worked on a Sudoku puzzle for the remaining time.

The final phase of the experiment differed, depending on the focus of the experiment. For half the participants, the focus was on memory, and they received a final free recall test. Participants were debriefed about the purpose of the study before the test started, and were asked to try to recall all headlines from the study phase, including those that supposedly came from an untrustworthy source. They had a maximum of 5 min to recall all news headlines that they could remember. Participants responded orally, and their responses were written down verbatim by the experimenter. Afterwards, the experimenter read the responses back to participants and asked them to indicate for each headline whether it had been presented as coming from a trustworthy or an untrustworthy source.

For the remaining participants, the experiment focused on truth judgments. The 20 headlines from the study phase were presented again, this time randomly intermixed with 10 new (unstudied) headlines. Participants were asked to rate each headline's perceived truth (on a scale from 1 = false to 7 = true). The judgement phase was self-paced and headlines stayed on the screen until the participant's oral response was entered by the experimenter. Participants were specifically asked to provide their own personal judgment for each headline, irrespective of the cues that had been presented during study. After all headlines were rated for perceived truth, participants completed an additional old/new recognition test. The 30 headlines were again presented in random order, and participants were asked to indicate for each headline whether it was an old headline from the study phase or had not been presented during the study phase. For each headline identified as old, participants were also asked to indicate whether the headline was marked as trustworthy or untrustworthy during the study phase.

When the test phase was completed, participants were thanked for their participation. We made sure to carefully debrief them that all headlines used in the study actually came from trustworthy news outlets.

Coding of the free-recall data. The accuracy of participants' responses on the free recall test was coded by two independent coders. Completely accurate descriptions of news headlines from the study phase were scored with 1 point, whereas descriptions that were not 100% correct but still contained the main gist of the headlines were scored with 0.5 points (e.g., "Bitcoin consumes an incredible amount of electricity" instead of the full headline "Bitcoin consumes as much electricity as Norway"). Interrater agreement was at 89.12%; disagreements were resolved through discussion. For each subject, the total score was calculated separately for to-be-remembered and to-be-forgotten news headlines and was transformed into percentage correct (out of all to-be-remembered and to-be-forgotten news headlines during the study phase).³

Results

Memory. We first examined directed forgetting of news headlines. A 2×2 ANOVA showed a significant main effect of cue, F(1, 35) = 59.99, MSE = .03, p < .001, $\eta_p^2 = .63$, reflecting better recall of to-be-remembered/ trustworthy headlines than of to-be-forgotten/untrustworthy headlines. There was no significant main effect of emotionality of headlines, F(1, 35) = 1.84, MSE = .02, p = .183, $\eta_p^2 = .05$, and also no significant two-way interaction, F(1, 35) = 0.07, MSE = .04, p = .792, $\eta_p^2 = 0.002$, suggesting no major influence of emotionality on the amount of directed forgetting (see also Figure 1a).

Further analyses on memory performance can be found in Appendix A. In brief, results for old/new recognition (which may be contaminated by prior completion of the truth judgment task) paralleled those for free recall. Source memory performance for correctly recalled/recognised headlines was relatively high, with no significant difference between to-be-remembered and to-be-forgotten headlines.

Perceived truth. We next examined truth judgments for old versus new headlines. A 3×2 ANOVA showed a significant main effect of cue, F(1.63, 57.16) = 23.56, MSE = 1.52, p < .001, $\eta_p^2 = .40$,⁴ reflecting differences in mean truth judgments for to-be-remembered/trustworthy

headlines, new headlines and to-be-forgotten/untrustworthy headlines. There was no significant main effect of emotionality of headlines, F(1, 35) = 0.001, MSE = 0.84, p = .976, $\eta_p^2 < .001$, and also no significant two-way interaction, F(2, 70) = 0.81, MSE = 0.75, p = .449, $\eta_p^2 = .02$, suggesting that emotionality did not influence truth judgments. Truth judgments were higher for to-beremembered/trustworthy headlines than for new headlines, and this was the case for negative headlines, t(35) = 4.06, p < .001, d = 0.68, 95% Cl [0.31, 1.04], as well as for neutral headlines, t(35) = 5.37, p < .001, d = 0.90, 95% CI [0.50, 1.28]. In contrast, there was no significant difference between truth judgments for to-beforgotten/untrustworthy headlines and new headlines; neither for negative headlines, t(35) = 1.64, p = .109, d = 0.27,95% CI [-0.06, 0.61], nor for neutral headlines, t(35) = 0.87, p = .389, d = 0.15, 95% Cl [-0.18, 0.47] (see also Figure 1b).

Discussion

Experiment 1 confirmed that (presumably) untrustworthy news headlines can be intentionally forgotten. A recent meta-analysis had suggested reduced IMDF for negative materials (Hall et al., 2021). In Experiment 1, however, the emotionality of headlines did not significantly modulate the amount of IMDF. One caveat here may however be that the headlines for Experiment 1 were only chosen to differ in rated valence, whereas arousal was not controlled.

Experiment 1 also examined perceived truth. Participants rated to-be-remembered/trustworthy headlines as more true than completely new headlines, but ratings for to-be-forgotten/untrustworthy headlines did not differ from those for completely new headlines. On the one hand, these findings could be seen as consistent with the idea that voluntary forgetting reduces perceived truth by decreasing the representation of presumably untrustworthy information in memory (see also Santos et al., 2017). On the other hand, however, the findings can also be seen as consistent with previous work, which showed that explicit source recollection (i.e., identifying information as coming from a trustworthy vs. untrustworthy source) can affect perceived truth (e.g., Begg et al., 1992). In the present study, remembered headlines were largely attributed to the correct source (trustworthy vs. untrustworthy), which shows that participants could have based their truth judgments on these source attributions. Indeed, in Experiment 1 (as well as in our pilot study; see the OSF project page), participants were always instructed to remember trustworthy headlines and to forget untrustworthy headlines. Our initial thinking was that it would be most useful in daily life if people were able to maintain trustworthy information in memory while forgetting untrustworthy information, which made us choose this task implementation. Yet, this task set-up also confounds cues and trustworthiness prompts. As



a) Free recall of old/studied headlines

b) Truth judgments (scale from 1=false to 7=true)

Figure 1. Results of Experiment 1. Panel (a) shows mean recall of to-be-remembered and to-be-forgotten headlines, panel (b) shows mean truth judgments for old (to-be-remembered and to-be-forgotten) as well as new headlines. Error bars represent 95% confidence intervals of the means.

such, Experiment 1 cannot address whether the observed reduction in perceived truth for to-be-forgotten headlines arose on the basis of voluntary forgetting or because the headlines were explicitly marked as untrustworthy.

Experiment 2

Experiment 2 was conducted to separate effects of remember and forget cues from those of prompts about the trustworthiness of each headline (i.e., participants received either trustworthiness prompts or cues, not both). With regard to perceived truth, we expected that trustworthiness prompts alone would have a large influence, and that headlines marked as untrustworthy would receive lower truth judgments. Based on the results reported by Santos et al. (2017), forget relative to remember cues might however also serve to reduce perceived truth, even in the absence of trusthworthiness prompts. With regard to memory, and based on decades of research on item-method directed forgetting, we assumed that remember and forget cues without trustworthiness prompts would continue to affect memory for news headlines. We did however not have clear expectations for the influence of trustworthiness prompts alone on memory. One could argue that participants might be more motivated to memorise information that is trustworthy, rather than information that is untrustworthy. If so, characterising information as untrustworthy could potentially mimic the effect of a forget cue. Alternatively, one could however also argue that a more or less random characterisation of information as trustworthy or untrustworthy should not have a major effect on memory.

Method

Participants. 168 participants were recruited for Experiment 2 (42 subjects per condition). Half the sample

completed a free recall test at the end of the experiment, whereas the other half completed a truth judgment task instead. In addition, half the participants in each version of the experiment received remember/forget cues during study, whereas the other half received trustworthy/ untrustworthy prompts instead. Mean age was 23.81 years (range 18-34 years). All subjects were fluent in German. 122 participants were female, 46 male.

Neutral

Material. Study materials were compiled by following the same three steps as in Experiment 1. First, 60 news headlines were gathered (some recycled from Experiment 1, some newly collected). Second, 20 additional pilot participants rated all headlines on 7-point scales with regard to perceived valence (scale from 1 = very negative to 7 =very positive) and perceived truth (scale from 1 = false to 7 = true); in addition, they now also rated headlines for perceived arousal (scale from 1 = exciting to 7 = calming). Third, based on these rating data, we chose 30 news headlines as study materials. Three sets of 10 headlines each were chosen such that half of the events in each set referred to negative, arousing headlines (valence: M = 1.98, SD = 0.32; arousal: M = 2.27, SD = 0.39), whereas the other half referred to more neutral, nonarousing headlines (valence: M = 4.53, SD = 0.83; arousal: M = 4.28, SD = 0.57). Additionally, we again tried to pick headlines with a medium rating of perceived truth (negative headlines: M = 5.03, SD = 0.88; neutral headlines: M = 5.02, SD = 0.66). Mean number of words per headline was roughly matched across the three sets (M = 6.70, M = 6.70, M = 7.40). Sets served equally often as trustworthy or to-be-remembered, untrustworthy or to-be-forgotten and new headlines.

Design. The design of Experiment 2 included a between-subjects manipulation of task instructions during study. In one condition, participants were only presented with a trustworthiness prompt after each headline, but not with a remember/forget cue. In the other



Figure 2. Mean recall of headlines across different task instructions in Experiment 2. Error bars represent 95% confidence intervals of the means.

condition, participants only received a remember/forget cue after each headline, but no trustworthiness prompt. Also, as in Experiment 1, emotionality of headlines (neutral, negative) was varied within-subject.

Procedure. The experimental procedure was largely identical to Experiment 1, the main difference being that task instructions for the study phase were varied. In one condition, participants were initially asked to memorise all headlines. They did not receive remember/forget cues during encoding, but instead saw trustworthiness prompts only (i.e., "Trustworthy" or "Untrustworthy") after each headline. In the other condition, participants did not receive any information about the trustworthiness of the news headlines but were simply instructed to try to remember some headlines and forget other headlines in preparation for a final test. After each headline, one of two cues was presented ("Remember" or "Forget").

The final phase of the experiment again differed across participants. Half the participants in each instructions condition completed a final free recall test (plus a subsequent source memory test). The other participants completed a truth judgment task (and, subsequently, an old/new recognition plus source memory test). During the source memory test, participants who received cues instead of trustworthiness prompts were asked to indicate which cue the headlines were paired with at study (remember vs. forget); with trustworthiness prompts, participants indicated whether the headlines were marked as trustworthy or unstrustworthy.

Coding of the free-recall data. All responses on the free recall test were again coded by two independent raters. Interrater agreement was at 89.74%; disagreements were resolved through discussion.

Results

Memory. Mean recall of headlines is shown in Figure 2. Providing trustworthiness prompts during encoding did not affect memory. A 2×2 ANOVA on the data of this subgroup of participants showed a significant main effect of

emotionality of headlines, F(1, 41) = 5.10, MSE = 0.03, p = .029, $\eta_p^2 = .11$, reflecting higher recall of neutral relative to negative headlines. The ANOVA however showed no significant main effect of trustworthiness prompt, F(1, 41) = 0.16, MSE = 0.04, p = .689, $\eta_p^2 = .004$, and no significant interaction between emotionality of headlines and trustworthiness prompt, F(1, 41) = 0.23, MSE = 0.03, p = .636, $\eta_p^2 = .01$.

In contrast, the presentation of remember and forget cues during study had a large effect on memory. A 2×2 ANOVA on the data of this subgroup of participants showed a significant main effect of emotionality of head-lines, F(1, 41) = 14.92, MSE = 0.02, p < .001, $\eta_p^2 = .27$, reflecting higher recall of neutral relative to negative headlines. Most importantly, the ANOVA also showed a significant main effect cue, F(1, 41) = 103.14, MSE = 0.03, p < .001, $\eta_p^2 = .72$, reflecting higher recall after remember relative to forget cues. There was no significant interaction between emotionality of headlines and cue, F(1, 41) = 2.53, MSE = 0.03, p = .119, $\eta_p^2 = .06$, suggesting no major influence of emotionality on the amount of directed forgetting.

Further analyses on memory performance can be found in Appendix B. Analysis of old/new recognition (completed by subjects after working on truth judgments) revealed a pattern of results similar to that observed for free recall. Analysis of source memory was partly hampered by low recall rates; levels for correct source attributions continued to be good, however.

Truth judgments. Mean truth judgments are shown in Figure 3. Trustworthiness prompts alone had a large effect on perceived truth. A 3×2 ANOVA showed a significant main effect of emotionality of headlines, F(1, 41) = 10.24, MSE = 0.66, p = .003, $\eta_p^2 = .20$, reflecting higher truth judgments for negative relative to neutral headlines. The ANOVA also showed a significant main effect of trustworthiness prompt, F(1.58, 64.64) = 16.59, MSE = 1.98, p < .001, $\eta_p^2 = .29$, but no significant interaction between trustworthiness prompt and emotionality of headlines, F(2, 82) = 1.34, MSE = 0.60, p = .267, $\eta_p^2 = .03$. Headlines



Figure 3. Mean truth judgments across different task instructions in Experiment 2 (scale from 1 = false to 7 = true). Error bars represent 95% confidence intervals of the means.

that were characterised as trustworthy were subsequently given higher truth judgments than completely new headlines or headlines that were characterised as untrustworthy, $ts(41) \ge 4.95$, ps < .001, $ds \ge 0.76$. There was no significant difference between new headlines and headlines characterised as untrustworthy, t(41) = 1.36, p = .181, d = 0.21, 95% *CI* [-0.10, 0.51].

The presentation of remember and forget cues also affected truth judgments, though not in the same manner. A 3×2 ANOVA showed no significant main effect of emotionality of headlines, F(1, 41) = 2.29, MSE = 0.86, p = .138, $\eta_p^2 = .05$, but a significant main effect of cue, *F*(1.67, 68.28) = 11.97, *MSE* = 0.78, p < .001, $\eta_p^2 = .23$. There was no significant interaction between cue and emotionality of headlines, F(2, 82) = 0.42, MSE = 0.49, p = .662, $\eta_p^2 = .01$. To-beremembered headlines were given higher truth judgments - not just relative to completely new headlines, t(41) = 4.40, p < .001, d = 0.68, 95% Cl [0.34, 1.01], relative to to-be-forgotten also headlines, but t(41) = 2.50, p = .017, d = 0.39, 95% CI [0.07, 0.70]. To-be-forgotten headlines were however also given higher truth judgments than completely new headlines, t(41) = 2.70, p = .010, d = 0.42, 95% CI [0.10, 0.73]. Thus, forget cues alone did not eliminate increases in perceived truth for old headlines from the study phase relative to new headlines. Nevertheless, truth judgments were still significantly reduced after forget relative to remember cues.

Discussion

Experiment 2 provided important clarifications. Voluntary forgetting of news headlines only arose with explicit instructions to forget some of the headlines. With trustworthiness prompts only, memory for the headlines was not affected (for related findings on memory for trivia statements, see Begg et al., 1992; Nadarevic & Erdfelder, 2019; Niedziałkowska & Nieznański, 2021). This pattern is also consistent with an overarching body of research on voluntary forgetting, suggesting that people must be motivated to engage in voluntary forgetting (e.g., Anderson & Hanslmayr, 2014). As in Experiment 2, the amount of IMDF was similar for negative and neutral headlines, suggesting that the emotional tone of headlines may have no large effect on the amount of IMDF.

Neutral headlines were slightly better remembered than negative headlines in Experiment 2. This particular pattern was not expected, because studies often show no difference in memory or better memory for negative relative to neutral contents (e.g., Kensinger, 2007). Although our reasoning is post-hoc, our suspicion is that at least some of the neutral headlines may have had more overlap with participants' realities than most negative headlines. For example, the neutral headline "New Zealand moves away from zero-Covid strategy" may have had at least some overlap with participants' lives at the respective time (i.e., dealing with the repercussions of Covid here in Germany; for evidence of self-reference effects in memory, see Rogers et al., 1977; Symons & Johnson, 1997). In contrast, clearly negative headlines covering horrible crimes or natural disasters in distant places may not have overlapped with the lives of the majority of participants in a similar manner. Overall, the unexpected finding of better memory for neutral headlines may underscore how difficult it is to anticipate and control all potentially relevant stimulus dimensions in advance when working with complex materials that reflect real-world issues.

Experiment 2 however also provided clarifications concerning the influence of voluntary forgetting on perceived truth. In particular, the results observed on the truth judgment task suggest that voluntary forgetting may contribute much less to reductions in perceived truth than explicit prompts about information being untrustworthy. Source attributions were again mostly correct, enabling explicit source recollection to have a large effect on truth judgments for headlines marked as untrustworthy in the present experiments. When forget/remember cues were presented without trustworthiness prompts, to-beforgotten headlines were judged as more true than completely new headlines, but still as less true than to-beremembered headlines. Voluntary forgetting therefore did have an effect on truth judgments and also served to reduce perceived truth, which is consistent with the results of prior work by Santos et al. (2017). This effect, however, pales in comparison to the large reduction in perceived truth that arose on the basis of explicit prompts about headlines coming from untrustworthy sources.

Experiment 3

In Experiment 1, subjects were asked to forget supposedly untrustworthy headlines and to remember supposedly trustworthy headlines. Thus, type of cue was confounded with type of trustworthiness prompt. The results of Experiment 2 suggest that headlines can also be voluntarily forgotten without any trustworthiness prompts. What is still unclear, however, is whether headlines that are explicitly marked as trustworthy can also be voluntarily forgotten. If this were the case, and if voluntary forgetting indeed had a small reducing effect on perceived truth, forget cues should be able to reduce perceived truth for headlines marked as trustworthy or untrustworthy. Experiment 3 was conducted to address this issue. Because Experiments 1 and 2 had consistently shown no significant influence of the emotionality of headlines on the magnitude of IMDF, emotionality was no longer included as a factor in Experiment 3.

Method

Participants. 60 participants were recruited for Experiment 3, but the data of one subject had to be discarded due to technical error. For the remaining sample, mean age was 23.80 years (range 18–31 years). All subjects were fluent in German. 34 participants were female, 25 male.

Material. Materials were compiled as in the previous experiments. First, 80 news headlines were gathered, then 20 additional pilot participants rated all headlines on 7-point scales with regard to perceived truth (scale from 1 = false to 7 = true). Based on these rating data, 48 news headlines with medium ratings of perceived truth (M = 4.16, SD = 0.63) were selected as materials. Materials were divided into three sets of 16 headlines and roughly matched for mean number of words per headline (M =6.06, M = 6.44, M = 7.31). Across participants, the three sets were equally often used as to-be-remembered, tobe-forgotten and new headlines. Moreover, when used as study materials, 8 items in each set were marked as trustworthy, whereas the remaining 8 items were marked as untrustworthy. Trustworthiness prompts were also counterbalanced across subjects, such that all headlines were equally often presented as trustworthy and untrustworthy.

Design. The experiment applied a $2 \times 2 \times 2$ mixed design with the two within-subject factors cue (to-beremembered, to-be-forgotten) and trustworthiness prompt (trustworthy, untrustworthy). Half of all headlines presented during the study phase were marked as trustworthy or untrustworthy, respectively. In addition, half of all trustworthy/untrustworthy headlines were followed by remember cues, whereas the remaining headlines were followed by forget cues. Finally, task sequence (recognition first, truth judgments first) was manipulated between-participants. Half of the participants started the final phase of the experiment with the recognition test (and then moved on to complete the truth judgment task), whereas the other half started the final phase with the truth judgment task (and then moved on to the recognition test). We were hoping that task sequence would not affect the pattern of results, such that the data of all participants could be used to analyse recognition memory and truth judgments. In case of a significant influence of task sequence, analysis of performance on each task would have to be more conservative and rely on only half the sample, however.

Procedure. The experimental procedure was similar to Experiment 2, with the following differences. At study, participants were now asked to study 32 headlines, presented in random sequence. They were asked to memorise headlines that were followed by a remember cue for a later memory test, and to try to forget headlines that were followed by a forget cue. On each trial, a fixation cross was presented for 2 s, centrally on the screen. The headline was then presented for 7 s, but in Experiment 3, the prompt "TRUSTWORTHY" or "UNTRUSTWORTHY" was placed directly below each headline (in capital letters). Half of all headlines were marked as coming from a trustworthy source in this manner, the other half as coming from an untrustworthy source. Each headline was followed by one of two cues (either "Remember" or "Forget") for 3 s.

After the 15-min distractor phase, all participants completed a recognition test and a truth judgment task, with task sequence being manipulated between participants. The recognition test was an old/new recognition test. The 32 old headlines from the study phase were presented intermixed with 16 new headlines, in random order. Participants were asked to indicate for each headline whether it was an old headline from the study phase or had not been presented during the study phase. For each headline identified as old, participants also indicated whether the headline had been marked as coming from a trustworthy or an untrustworthy source during the study phase. For the truth judgment task, the 32 old headlines were also presented randomly intermixed with the 16 new headlines. Participants were asked to rate each headline's perceived truth (on a scale from 1 =false to 7 =true). Both the recognition test and the truth judgment task were self-paced and each headline stayed on the screen until the participant's oral response was entered by the experimenter.

Results

Memory. We first analysed performance on the old/new recognition test and used d' as the dependent variable (i.e., z[hits]-z[false alarms], which measures the discrimination between old and new items; hit and false alarm rates are also provided separately in Appendix C). A $2 \times$ 2×2 ANOVA conducted on data from the full sample showed a significant main effect of task sequence, F(1, 57) = 4.13, MSE = 1.20, p = .047, $\eta_p^2 = .07$, as well as a significant three-way interaction (cue x trustworthiness prompt x task sequence), F(1, 57) = 5.55, MSE = .17, p = .022, $\eta_p^2 = .09$. Performance on the recognition test was thus clearly affected by task sequence, which made a more conservative analysis necessary. The following analyses are therefore restricted to data of those participants who started the final test phase with the recognition test (but see Appendix C for data of the other participants, who started the final test phase with the truth judgment task instead).

Figure 4a shows mean d'. A 2 × 2 ANOVA showed a significant main effect of cue, F(1, 29) = 32.18, MSE = .16, p < .001, $\eta_p^2 = .53$, but no significant main effect of trustworthiness prompt F(1, 29) = 1.06, MSE = .22, p = .313, $\eta_p^2 = .04$, and no significant interaction of the two factors, F(1, 29) = 0.01, MSE = .23, p = .943, $\eta_p^2 < .001$. Performance was reduced for to-be-forgotten relative to to-be-remembered headlines, irrespective of whether headlines were marked as trustworthy or untrustworthy.

Truth judgments. Regarding mean perceived truth, a $2 \times 2 \times 2$ ANOVA showed no significant main or interaction effects involving the factor task sequence, all $Fs \le 0.85$, $ps \ge .362$, $\eta_p^2 \le .02$. As a consequence, there was no need for a more conservative analysis and we proceeded with analysing the full sample.⁵ Mean perceived truth is shown in Figure 4b.

wThe 2 × 2 × 2 ANOVA revealed significant main effects of cue, F(1, 57) = 8.89, MSE = 0.42, p = .004, $\eta_p^2 = .14$, and trustworthiness prompt, F(1, 57) = 29.31, MSE = 1.13, p < .001, $\eta_p^2 = .34$, but no significant interaction between the two factors, F(1, 57) = 2.24, MSE = 0.23, p = .140, $\eta_p^2 = .04$. Thus, cues and trustworthiness prompts seemed to have separate effects on truth judgments that did not influence each other. Headlines marked as trustworthy were judged as more true than headlines marked as untrustworthy. In addition, headlines followed by a remember cue were also judged as slightly more true than headlines followed by a forget cue.

Separate t-tests showed that truth judgments were enhanced for old headlines marked as trustworthy relative to new headlines (indicated by the dashed line in Figure 5b). This was the case when trustworthy headlines were paired with remember cues (M = 5.16 vs. M = 4.32; t(58) = 6.36, p < .001, d = 0.83, 95% Cl [0.53, 1.12]), and when they were paired with forget cues (M = 4.82t(58) = 4.29,p < .001, d = 0.56, vs. M = 4.32;95% CI [0.28, 0.83]). In contrast, there were no significant differences in perceived truth between old headlines marked as untrustworthy and new headlines; neither when untrustworthy headlines were paired with remember cues (M = 4.32 vs. M = 4.32; t(58) = 0.02, p = .988, d = 0.002, 95% Cl [-0.26, 0.25]), nor when they were paired with forget cues (M = 4.16 vs. M = 4.32; t(58) = 1.18, p = .242, d = 0.15, 95% Cl [-0.10, 0.41]). In sum, an increase in perceived truth on the basis of prior exposure was present for headlines marked as trustworthy, but not for headlines marked as untrustworthy.

Source memory. The previous experiments found no major or systematic influences of cues or trustworthiness prompts on source memory, but this changed in Experiment 3. A $2 \times 2 \times 2$ ANOVA again showed no significant main or interaction effects involving the factor task sequence, all $Fs \le 0.35$, $ps \ge .558$, $\eta_p^2 \le .01$. Therefore, we again proceeded with analysing the full sample.⁶ Figure 4c shows mean percentage of correct source



Figure 4. Results of Experiment 3 as a function of cue (to-be-remembered, to-be-forgotten) and trustworthiness prompt (trustworthy, untrustworthy): (a) mean performance on the old/new recognition test, (b) mean ratings on the truth judgment task (the dashed line indicates mean ratings for new head-lines) and (c) mean performance on the source memory test (trustworthy vs. untrustworthy source). Error bars represent 95% confidence intervals of the means.

attributions (trustworthy vs. untrustworthy) for all headlines correctly recognised as old.

The ANOVA revealed no significant main effects of cue, F(1, 57) = 3.75, MSE = .03, p = .058, $\eta_p^2 = .06$, and trustworthiness prompt F(1, 57) = 2.03, MSE = .05, p = .160, $\eta_p^2 = .03$, but a significant interaction of the two factors, $F(1, 57) = 21.17, MSE = .05, p < .001, \eta_p^2 = .27.$ Headlines marked as trustworthy during the study phase were more often correctly attributed to a trustworthy source when they had been cued to be remembered rather than to be forgotten (76.03% correct vs. 58.59% correct), t(58) = 5.34, p < .001, d = 0.70, 95% Cl [0.41, 0.98]. In contrast, headlines marked as untrustworthy were more often correctly attributed to an untrustworthy source when they had been cued to be forgotten rather than to be remembered (67.51% correct vs. 58.96% correct), t(58) = -2.18,p = .033, d = -0.28, 95% CI [-0.54, -0.02]. In other words, remember and forget cues had a biasing effect on source attributions.

Additional analysis on the relationship between source memory and truth judgments. Were truth judgments affected by incorrect source attributions? We reanalysed the data to address this question, differentiating between trustworthy/untrustworthy headlines with correct vs. incorrect source attributions. The data of 48 participants could be included in the analysis; there were too few observations per condition for the remaining datasets.

Figure 5 shows mean truth judgments as a function of correct vs. incorrect source attributions. A 2×2 ANOVA revealed no significant main effect of source attribution, F(1, 47) = 0.28, MSE = .67, p = .596, $\eta_p^2 = .006$, but a significant main effect of trustworthiness prompt, F(1, 47) = 16.75, MSE = .46, p < .001, $\eta_p^2 = .26$, which was accompanied by a significant interaction between



Figure 5. Additional analysis for Experiment 3: Mean ratings on the truth judgment task shown as a function of correct vs. incorrect source attribution. Error bars represent 95% confidence intervals of the means.

trustworthiness prompt and source attribution, F(1, 47) = 32.10, MSE = 2.05, p < .001, $\eta_p^2 = .41$. Mean truth ratings for headlines marked as trustworthy were significantly reduced when participants' source attribution was incorrect, i.e., when they incorrectly attributed the headlines to an untrustworthy source (M = 4.32 vs. M = 5.43), t(47) = 4.60, p < .001, d = 0.66, 95% Cl [0.35, 0.97]. In contrast, mean truth ratings for headlines marked as untrustworthy were significantly enhanced when participants' incorrectly attributed the headlines to a trustworthy source (M = 5.09 vs. M = 3.85), t(47) = -5.26, p < .001, d = -0.76, 95% CI [-1.07, -0.43]. Taken together, when source attributions were incorrect, truth judgments shifted accordingly.

Discussion

Experiment 3 demonstrated that voluntary forgetting of headlines is not affected by whether they are marked as trustworthy or untrustworthy; recognition memory for both types of headlines was reduced when participants were given a reason to try to forget them. The effect of instructions to forget the headlines also carried over to the truth judgment task. As in Experiment 2, explicitly marking headlines as trustworthy or untrustworthy had the largest effect on perceived truth, with increases in perceived truth relative to new headlines only emerging for headlines marked as trustworthy. Experiment 3 however confirmed that voluntary forgetting can have a small additional effect and, to some degree, reduce perceived truth (see also Santos et al., 2017). Moreover, the data suggested a similar effect of instructions to forget on trustworthy and untrustworthy headlines.

The previous experiments had suggested no major influence of cues on source memory (see Appendices A and B for details), but trustworthy headlines were always paired with remember cues and untrustworthy headlines were always paired with forget cues. After eliminating this confound, the results of Experiment 3 suggested a biasing influence of cues on source judgments. Headlines were more likely to be attributed to a trustworthy source after remember cues and more likely to be attributed to an untrustworthy source after forget cues. In particular, this may suggest that the influence of cue on truth judgments could operate via biasing source attributions. The tendency to attribute to-be-forgotten headlines to an untrustworthy source may have reduced their perceived truth. This proposal is further supported by an additional analysis, which showed that incorrect source attributions are indeed connected to corresponding shifts in truth judgments (see Begg et al., 1992; for further work on the connection between source and truth judgments, see also Bell et al., 2021; Fragale & Heath, 2004).

General discussion

The present study demonstrates that news headlines can be voluntarily forgotten. Experiment 1 combined

remember and forget cues with trustworthiness prompts and found IMDF for supposedly untrustworthy news headlines. Experiment 2 separated remember and forget cues from trustworthiness prompts and found intact IMDF with cues alone; trustworthiness prompts alone did not affect memory. Finally, Experiment 3 showed that voluntary forgetting can arise irrespective of whether headlines are initially marked as untrustworthy or trustworthy. Thus, voluntary forgetting of news headlines was not affected much by the characteristics of the headlines. In Experiments 1 and 2, the amount of IMDF was also similar for negative and neutral headlines.

The experiments additionally examined truth judgments. In Experiment 1, when cues were combined with trustworthiness prompts, increases in perceived truth due to prior exposure only emerged for trustworthy/tobe-remembered headlines, but not for untrustworthy/tobe-forgotten headlines. In Experiment 2, with separation of cues and trustworthiness prompts, however, the increase in perceived truth was only found to be eliminated for headlines explicitly marked as untrustworthy. With forget cues only, perceived truth was slightly reduced, but this effect was smaller relative to that of marking a headline as untrustworthy. Similar findings also emerged in Experiment 3, with forget cues slightly reducing perceived truth irrespective of whether headlines were marked as trustworthy or untrustworthy. Thus, although forget cues greatly reduce memory, their power in reducing perceived truth seems more limited.

Voluntary forgetting of news headlines

Studies on IMDF typically use simple words or pictures, but single previous studies reported intact IMDF for slightly more complex materials (Fawcett et al., 2013; Hupbach et al., 2022; Lee & Hsu, 2013; Li et al., 2017; Sahakyan & Foster, 2009). The present findings show that IMDF can be extended to real news headlines, too, which capture developments in the world as well as other matters of societal interest. This constitutes an important extension of voluntary forgetting to real-world information. Moreover, consistent with the larger IMDF literature (e.g., Basden et al., 1993; Davis & Okada, 1971; MacLeod, 1975, 1999), IMDF of news headlines was not only observed in free recall, but also in recognition, in line with the proposal that the observed forgetting operates at the encoding stage.

The present experiments suggest that, up to some degree, people can leave memories of news headlines behind. For such voluntary forgetting to kick in, people must however be motivated to really try to forget the information. The present experiments relied on the typical IMDF approach, with instructions that to-be-forgotten materials would not be relevant for a later test motivating participants to engage in forgetting. What may act as a motivator for voluntary forgetting outside of the lab is an open question for future research, however. For instance, if a person was motivated to maintain an accurate representation of what is going on in the world, voluntary forgetting of information tagged as untrustworthy could help to achieve this goal. In such a scenario, the forgetting could also curtail the spread of false information, because untrustworthy headlines should be less easily accessible in memory and, as a consequence, less likely to be shared with others. This was also the starting point for our series of experiments, because we thought that it would be most helpful in daily life if trustworthy information could be maintained in memory and untrustworthy information could be forgotten. Yet, other scenarios are entirely plausible as well. For instance, a person identifying with a certain political movement might be motivated to engage in voluntary forgetting of information that runs counter the movement's goals or ideology (even when its source is trustworthy). The data reported in Experiment 3 indeed suggest that IMDF of news headlines does not depend on trustworthiness prompts and can arise for both headlines marked as trustworthy and headlines marked as untrustworthy. As such, whether voluntary forgetting of news headlines hinders or helps the spread of false information could very much vary with an individual's goals and motivations.

The present experiments all used news headlines from reliable media outlets as study materials, which were then presented as coming from a trustworthy or untrustworthy source. Although this was a deliberate choice made on the basis of ethical concerns, it also poses a limitation. The present experiments cannot address whether the same pattern of results would also be found when actual fake news items are used as study materials. Fake news may more often clash with participants' prior knowledge and beliefs, and it could be harder to engage in voluntary forgetting of more incendiary, polarising information. Nevertheless, future work needs to carefully weigh the potential benefits of using actual fake news items relative to the risks that may come with exposing participants to such materials (see also the following section on perceived truth).

Influences of source attributions and voluntary forgetting on perceived truth

Marking headlines as coming from a trustworthy or an untrustworthy source had large effects on subsequent truth judgments. Increases in perceived truth on the basis of prior exposure were only observed for headlines marked as trustworthy, and were eliminated for headlines marked as untrustworthy. This is consistent with prior work that emphasised the role of explicit source recollection for judgments of truth (Begg et al., 1992; see also Unkelbach & Stahl, 2009). Source memory performance was good in Experiments 1 and 2, and participants likely based their truth judgments on their (mostly accurate) source attributions. Consistent with prior work on perceived truth of trivia statements (see Santos et al., 2017), Experiments 2 and 3 suggested an additional effect of cues on perceived truth of news headlines, with to-be-forgotten headlines receiving slightly lower judgments of truth than to-beremembered headlines. Importantly, Experiment 3 revealed a biasing influence of cues on source attributions. In particular, to-be-forgotten headlines were more likely to be attributed to an untrustworthy source, which could explain the (small) effect of forget cues on perceived truth. An additional analysis in Experiment 3 suggested that incorrect source attributions were indeed connected to corresponding shifts in perceived truth (see also Begg et al., 1992).

Previous work on IMDF and source memory mostly examined correct classification of information as to-beremembered or to-be-forgotten (e.g., Davis & Okada, 1971; MacLeod, 1975). Here, participants have been suggested to rely on a memory-strength heuristic (e.g., Goernert et al., 2006; Horton & Petruk, 1980; Hourihan, 2021; Thompson et al., 2011). Due to differential rehearsal, to-be-remembered information is better encoded than tobe-forgotten information. At test, a specific piece of information may then be classified as to-be-remembered when memory strength exceeds some threshold, and as to-beforgotten when memory strength remains below this threshold. Relying on such a heuristic facilitates correct classification of information as to-be-remembered or tobe-forgotten. The present study, however, examined memory for information from trustworthy and untrustworthy sources, and the results of Experiment 3 suggest that participants may (partly) also rely on heuristic judgments when source categories (trustworthy vs. untrustworthy) are unrelated to cueing. When this is the case, relying on a strength-based heuristic may bias source attributions.

The proposal of a heuristic judgment also fits well with the literature on increases in perceived truth on the basis of prior exposure. Encoding and memory strength increase as information is repeated, and several studies show that perceived truth is, up to a certain point, enhanced with greater numbers of repetitions (e.g., Arkes et al., 1991; Fazio et al., 2022; Hassan & Barber, 2021; Pennycook et al., 2018; Udry et al., 2022). Theoretical accounts have attributed such effects to increased feelings of familiarity and fluency (e.g., Arkes et al., 1989; Reber & Schwarz, 1999; Unkelbach, 2007), which - in contrast to memory strength - can be directly examined. At least potentially, the influence of forget cues on perceived truth might also have arisen because voluntary forgetting not only reduces memory strength, but more specifically, metacognitive judgments of processing fluency or feelings of familiarity (but see Basden & Basden, 1996; and Gardiner et al., 1994, for prior work on the influence of IMDF on recollection and familiarity). Since none of these aspects were examined in the present study, this suggestion remains to be tested, however.

As described above, the finding that explicitly marking information as coming from an untrustworthy source affects perceived truth is consistent with some previous work (e.g., Unkelbach & Stahl, 2009). It should be noted, however, that such prompts and similar labels have not always been shown to affect perceived truth (Henkel & Mattson, 2011; Nadarevic et al., 2020), or have been shown to reduce increases in perceived truth rather than to eliminate them (Begg et al., 1992; Pennycook et al., 2018; for related work on the influence of factual knowledge, see also Brashier et al., 2017; Fazio et al., 2015). Because the present work was concerned with the role of intentional forgetting, we applied intentional encoding to initially expose participants to news headlines from (presumably) trustworthy and untrustworthy sources. Although intentional encoding has been used in some previous studies on perceived truth (Mitchell et al., 2005, 2006; Schwartz, 1982), most studies seem to rely on incidental encoding. To our knowledge, how intentional vs. incidental encoding affects judgments of truth has not been examined yet. One possibility is that source memory plays a more prominent role with intentional encoding, which could explain why increases in perceived truth were eliminated for information from an untrustworthy source in the present work, but not in some of the previous work.

Conclusions

The present study extends IMDF to news headlines. News headlines can be voluntarily forgotten, irrespective of whether the headlines are marked as trustworthy or untrustworthy. In addition, voluntary forgetting also had a small effect on truth judgments and served to reduce perceived truth – again, for both headlines marked as trustworthy and headlines marked as untrustworthy. Voluntary forgetting may affect truth judgments by biasing source attributions.

Notes

- G*Power does not allow analyses for within-within interaction effects. At least for 2×2 designs, interactions could however also be conceptualized as main effects for difference scores (e.g., subtracting memory performance after forget cues from memory performance after remember cues to capture voluntary forgetting; this difference score could then for example be compared across two different valence conditions). If conceptualized this way, the sensitivity analyses for main effects might also apply to interaction effects.
- Originally, additional control conditions without cues were collected for this experiment as well; they are now reported in Supplemental Materials 2 on the OSF project page.
- 3. This approach to analyzing the free recall data was used in all experiments reported in this manuscript. To make sure that the scoring of partially correct responses with 0.5 points did not skew the results, we examined two alternative ways of coding (namely, strict coding, with all partially correct responses scored as 0s; and lenient coding, with all partially correct responses scored as 1s). For all experiments, the main results for the free recall data stayed the same irrespective of which type of coding was applied. We therefore

decided to stick with the coding as reported in the main text, because it most closely captures different types of responses as provided by participants.

- When the sphericity assumption in repeated-measures ANOVAs was violated, Greenhouse-Geisser corrections were applied.
- 5. The pattern of results for the ANOVA on truth judgments was however the same when analysis was restricted to participants who completed the truth judgment task first.
- The pattern of results for the ANOVA on source memory was however the same when analysis was restricted to participants who completed the recognition (plus source memory) test first.

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Data availability statement

Data and materials for all experiments are available on the Open Science Framework (https://osf.io/csa39/). None of the experiments were preregistered.

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