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Article to appear in Journal of Experimental Psychology: General

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Word count: 16,994

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The authors would like to thank Magdalena Rychlowska for her helpful comments on an earlier draft of this manuscript.

The research reported in this article was supported by National Science Centre (Poland) grant 2013/09/B/HS6/02642 awarded to M.H., and Economic and Social Research Council (UK) grant ES/L00710X/1.

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Abstract

When presented with responses of another person, people incorporate these responses into memory reports: a finding termed memory conformity. Research on memory conformity in recognition reveals that people rely on external social cues to guide their memory responses when their own ability to respond is at chance. In this way, conforming to a reliable source boosts recognition performance but conforming to a random source does not impair it. In the present study we assessed whether people would conform indiscriminately to reliable and unreliable (random) sources when they are given the opportunity to exercise metamemory control over their responding by withholding answers in a recognition test. In Experiments 1 and 2, we found the pattern of memory conformity to reliable and unreliable sources in two variants of a free-report recognition test, yet at the same time the provision of external cues did not affect the rate of response withholding. In Experiment 3, we provided participants with initial feedback on their recognition decisions, facilitating the discrimination between the reliable and unreliable source. This led to the reduction of memory conformity to the unreliable source, and at the same time modulated metamemory decisions concerning response withholding: participants displayed metamemory conformity to the reliable source, volunteering more responses in their memory report, and metamemory resistance to the random source, withholding more responses from the memory report. Together, the results show how metamemory decisions dissociate various types of memory conformity and that memory and metamemory decisions can be independent of each other.

Keywords: Memory conformity, Metamemory, Recognition

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Remembering has long been considered exclusively as a process of encoding, storing and retrieving information from one's memory. This perspective neglects, however, a variety of factors that affect remembering yet do not concern the core memory processes. Two instances of such extra-memorial factors in remembering gained much attention in recent years. First, the social perspective underscores the fact that remembering often does not unfold in social isolation, but rather in the presence and with active participation of other people (Blank, 2009; Hirst & Echterhoff, 2012; Hirst & Rajaram, 2014; Rajaram & Pereira-Pasarin, 2010). A number of important studies have shown how collaborating with other people affects remembering, often in negative ways, reducing output from memory (Basden, Basden, Bryner, & Thomas, 1997) or introducing errors (Gabbert, Memon, & Allan, 2003; Meade & Roediger, 2002). Second, the metamemory perspective underscores the fact that the process of remembering does not stop when memory is retrieved but continues in the form of metamemory decisions which determine how information retrieved from memory will be used to build a memory report – that is, the overt answer provided to a memory question (Koriat & Goldsmith, 1996). Research on metamemory revealed a host of factors that determine whether certain information will be included in a memory report (Koriat & Goldsmith, 1994) or the level of specificity at which this information will be described (Goldsmith, Koriat, & Pansky, 2005; Luna, Higham, & Martín-Luengo, 2011).

Although these two perspectives – metamemory and social memory – provide a variety of novel insights into the nature of remembering, they are commonly applied separately. In the present study we merge these perspectives on remembering, revealing a novel layer of complexity where social factors interact with metamemory processes. By doing this, the present study serves to specify the ways in which social cues impact upon remembering, as well as answer more general questions about the relationship between memory and metamemory decisions.

The social perspective on remembering underscores that the core memory processes of encoding, storage and retrieval often unfold in a social milieu and that the presence of other people, as well as social interactions, affects the process of remembering. Two prominent strands of research in the area of social memory deserve a mention here. First, research concerning collaborative inhibition focuses on how remembering in groups of individuals may limit the quantity of remembered information compared to the output of nominal groups created from the same number of individuals remembering in isolation (Barber, Harris, & Rajaram, 2015; Basden et al., 1997; Congleton & Rajaram, 2014). Second, research concerning memory conformity, the topic of the present study, focuses on how information provided by other people affects the contents of a memory report (Gabbert, Memon, & Wright, 2006; Wright, Mathews, & Skagerberg, 2005; Wright, Self, & Justice, 2000). This line of research is therefore concerned with how information provided by one individual migrates to a memory report of another individual. Traditionally, the particular interest in the memory conformity studies lies in the costs of conforming, where costs are understood as incorporating erroneous information in the memory report.

Research on memory conformity is grounded in the investigations of a so-called misinformation effect (e.g., Loftus, Miller & Burns, 1978). In the misinformation paradigm, people witness a certain event and they are later presented with another, partially erroneous version of this event, introduced in a narrative, doctored photographs, etc. The misinformation effect is detected when people include these errors in their memory reports concerning the original witnessed event. Memory conformity viewed in this way boils down to a particular way in which retelling of the original event is introduced, namely by a memory report of another person who purportedly witnessed the same event (Gabbert, Memon, Allan, & Wright, 2004; Wright et al., 2000). From this perspective, it is unsurprising that much of the research concerning memory conformity has focused on errors in memory reports. However, a different perspective has been offered by a set of studies examining memory conformity in recognition tests. Starting from a seminal work by Schneider and Watkins (1996), researchers have investigated how conforming to other people's memory reports may also support correct responding. The logic is straightforward: under normal circumstances, memory reports of other people may not be entirely accurate, but they will rarely be purposefully misleading. As a consequence, there is a good chance that people's reports will contain accurate information that a consumer of these reports may incorporate into their own account of the remembered event.

Research on memory conformity in recognition has indeed found that conforming to other people's memory decisions can have beneficial effects on memory performance, explaining why people may wish to rely on other people's memory reports in the first place (e.g., Reysen, 2005). A striking example of this comes from a recent study by Jaeger, Lauris, Selmeczy, and Dobbins (2012). In this study, participants were asked to memorize lists of words and later perform a recognition test in which study words were intermixed with novel lures. For some recognition trials, participants were presented with cues from one of two external sources, specifying whether a test item is old or new.[1] Participants were told that these cues were responses of two participants who were tested earlier. In reality, these responses were programmed by the experimenter to achieve a certain level of overall accuracy: 75% for a reliable source and 50% for an unreliable (random) source. This study revealed that participants conformed to the same extent to reliable and unreliable sources. In

[1] Jaeger, Lauris, et al. (2012) used also double-cued trials in which contrasting cues from both sources were presented. As the present study is not concerned with contrasting cues, we do not discuss those results here.

terms of consequences for recognition performance, conforming to the reliable source in the study by Jaeger, Lauris, et al. increased participants' recognition performance. This finding underscores the fact that external information from a social source can be used to boost memory performance. Interestingly, although participants conformed to the unreliable source to the same extent as they did to the reliable source, this had no effect on their recognition performance, which was comparable to performance achieved in trials in which no external cue was provided. Jaeger, Lauris, et al. explained this result by evoking the concept of low-confidence outsourcing: participants rely on the external source only for trials on which they have very low confidence that they would respond correctly by themselves. Assuming that people are able to monitor the accuracy of their own memory processes (e.g., Sauer, Brewer, & Weber, 2008), participants' performance for such low-confidence trials would likely be close to chance level. In such a case, relying on a source whose performance is also at a chance level (50% overall accuracy) has little impact upon recognition performance. Low-confidence outsourcing explains how indiscriminate conformity to sources that differ in the accuracy of their cues boosts performance when a source happens to be reliable but does not impair performance when a source happens to be unreliable but not systematically misleading.

This surprising phenomenon of indiscriminate conformity to reliable and unreliable sources has recently been replicated by Numbers, Meade, and Perga (2014). Using a social contagion paradigm (Roediger, Meade, & Bergman, 2001) akin to the misinformation paradigm, the authors manipulated the proportion of incorrect details in the recall protocol provided by an experimenter's confederate in a collaborative recall procedure. Strikingly, when this proportion was 100% - that is, all details provided by the confederate were incorrect – the magnitude of the social contagion effect was indistinguishable from a condition when the proportion of errors was 33%. Thus, just as in Jaeger, Lauris, et al.

(2012), participants in the study of Numbers et al. conformed to the same extent to sources that were largely reliable and grossly unreliable. Importantly, this indiscriminate conformity was observed in a paradigm differing in a number of dimensions from the study of Jaeger, Lauris, et al., including a direct social interaction with another person during the collaborative recall phase. This strongly suggests that the phenomenon of indiscriminate conformity is not simply a by-product of using a computerized procedure in which social interaction is severely limited (like the one used by Jaeger, Lauris, et al.), but can be also found in more naturalistic procedures.

As mentioned earlier, indiscriminate conformity can be explained by assuming that people are willing to rely even on an unreliable source in the face of insufficient memory evidence. In the study by Jaeger, Lauris et al. (2012), such a state of insufficient evidence occurred for some cued trials on which participants were unable to retrieve relevant information. In the study by Numbers et al. (2014), the confederate suggested items that were not present in the original study episode and it may be particularly difficult to retrieve information supporting a judgment that something was not present at study. In describing indiscriminate conformity to reliable and unreliable sources, Jaeger, Lauris, et al. (2012) wrote that “observers naturally default to external sources when they experience high subjective uncertainty based on their internal evidence” (p. 110). This chimes with other studies showing that people conform in their memory decisions mostly when their own confidence is low (Schneider & Watkins, 1996; Wright & Villalba, 2012). However, research adopting the metamemory perspective on remembering stresses that people may deal with a situation of “high subjective uncertainty” in yet another way: namely, by withholding a memory response.

Research on metamemory has repeatedly shown that people are able and willing to control the accuracy of their memory report by withholding responses for which they are the least confident and which are therefore most likely to be incorrect (Arnold, Higham, & Martín-Luengo, 2013; Higham, 2007; Kelley & Sahakyan, 2003; Koriat & Goldsmith, 1994, 1996). This research has also shown that when the state of subjective uncertainty is removed by an experimental manipulation that creates an illusion of knowledge, people become more inclined to volunteer responses in a memory report (Hanczakowski, Pasek, Zawadzka, & Mazzoni, 2013; Hanczakowski, Zawadzka, & Coote, 2014; Hanczakowski, Zawadzka, & Macken, 2015). The crucial issue is that the study by Jaeger, Lauris, et al. (2012), as well as other studies investigating memory conformity in recognition paradigms, focused exclusively on a forced-report recognition procedure in which participants are not allowed to withhold responses. Thus, these studies essentially precluded participants from choosing an option which may be in fact a default option in the face of subjective uncertainty. This raises two specific questions about memory and metamemory conformity in a free-report recognition procedure (i.e., one that allows for response withholding) that have not yet been addressed: 1) Do people conform in their recognition decisions when they can withhold their responses from a memory report? In other words, if an option to withhold responses is available to participants, would volunteered responses still reflect the influences of external sources? 2) Is conformity evidenced in the rate at which response withholding occurs? In other words, would cues provided by external sources make people more likely to volunteer responses in a memory report compared to a situation in which cues are not provided and people need to rely solely on their memory? One aim of the present study is to answer these two specific questions about memory conformity.

Apart from investigating specific conditions under which memory conformity occurs, the broader aim of the present study is to shed more light on the relationship between factors shaping memory and metamemory decisions. Specifically, our interest lies in the extent to which two specific research questions concerning conformity are orthogonal. The first of these questions pertains to whether people rely on an external source to craft their own *memory* decisions in a recognition test. The second question pertains to whether people rely on an external source to craft their *metamemory* decisions of whether to volunteer their responses. The specific issue investigated here is whether in the same free-report recognition test it is possible for participants to display one type of conformity in the absence of the other type. In the broader theoretical terms, the problem is one of the extent to which memory and metamemory should be considered separate theoretical constructs.

One common approach ingrained in current theories of metamemory is that the constructs of memory and metamemory are not fully independent and metamemory is firmly grounded in memory. This approach is demonstrated by a common research practice to treat memory and metamemory decisions interchangeably. Researchers often collect metamemory judgments of confidence ('how confident are you that your decision is correct?') and translate them into memory judgments ('how confident are you that the item is old?'). For example, an 'old' recognition response coupled with a metamemory response of 'very sure this response is correct', is translated into a memory judgment of 'very sure this item is old' (see Gombos, Pezdek, & Haymond, 2012; Jaeger, Cox, & Dobbins, 2012, for examples of this translation). This approach is based on the assumption that metamemory is derived from memory information and thus factors that affect memory decisions necessarily affect metamemory decisions. For example, Koriat (2012) argued in his recent self-consistency model of confidence that confidence arises as a result of repeated sampling of the pool of evidence that underlies a memory decision, and more consistent samples lead to higher confidence. If it is assumed that evidence from external cues joins internally-generated memorial evidence in the overall pool of evidence, then in the state of subjective uncertainty, when little or no internal evidence is available, external evidence may become a dominant basis for memory and metamemory decisions. Indeed, in a few studies that looked directly at confidence in the context of memory conformity, it was found that confidence is indeed affected by cues provided by external sources (Jaeger, Cox, & Dobbins, 2012; Schneider & Watkins, 1996). Given that response withholding is almost invariably related to confidence (Koriat & Goldsmith, 1996), this allows for a prediction that conditions inducing memory conformity should also induce metamemory conformity. In other words, if in the absence of internal evidence people use cues provided by external sources to decide whether an item is old or new, they should also use these cues to decide that the response for a given item should be volunteered. Such a result would be consistent with the approach that metamemory knowledge of what a person knows is grounded in the evidence supporting a memory decision itself.

Another possibility is that memory and metamemory constructs are at least partially independent and that conditions leading to memory conformity may not necessarily lead to metamemory conformity. Some theoretical support for this perspective comes from a cue-utilization framework of metamemory developed by Koriat (1997). In this framework, Koriat distinguished between various cues used to formulate metamemory judgments that can be divided into three classes: intrinsic to the to-be-remembered material, like inter-item relatedness of studied cue-target pairs; extrinsic to the material, like presentation times of the material; and mnemonic, which refer to the subjective experience of the rememberer, like the ease of retrieval. Importantly, all these cues are related to memory decisions, but not all them are equally factored in metamemory decisions. Research has documented numerous examples in which metamemory is relatively unaffected by changes to extrinsic cues (e.g., Castel, 2008; Susser, Mulligan, & Besken, 2013). From the perspective of memory conformity, two issues are of note. First, information provided by an external source should obviously be considered an extrinsic cue, which may support the hypothesis that metamemory decisions could be uninfluenced by external cues, dissociating memory and metamemory conformity. Second, the cue-utilization framework has been almost invariably applied to judgments of learning (JOLs) made at encoding, but not metamemory decisions made at retrieval. In the JOL paradigm, metamemory judgments or decisions are elicited during study (‘how likely is it that you will later remember this item?’) and then compared to performance assessed at retrieval (did a person actually remember the item?). In this scenario it is perhaps unsurprising that some cues that determine memory performance at test are not factored into metamemory decisions made at a different time and under different conditions (e.g., at study). But does the same apply to a situation in which both memory and metamemory decisions are made simultaneously? In our study, we are interested in whether the same cues affect memory and metamemory decisions at test under exactly the same conditions of free-report recognition. Hence, although the cue-utilization framework of Koriat provides some suggestion that the use of extrinsic cues may dissociate memory and metamemory, it does not necessarily have to be applicable to metamemory decisions made at retrieval.

In this study we present three experiments concerning the influence of social cues on memory and metamemory. For this purpose, we adapted the paradigm for investigating memory conformity effects recently developed by Jaeger, Lauris, et al. (2012). That is, participants first studied a list of single words and later were tested on that list. At test, one word was presented at a time and participants’ task was to decide whether that word was old or new. Crucially, on some trials participants were also provided with external ‘old’ or ‘new’ cues regarding the status of the test word. These cues were provided by two sources, which differed in reliability: one of the sources was reliable, while the other was not. However, there was one crucial difference between the paradigm of Jaeger, Lauris, et al. and our own:

we provided participants with freedom to exert metamemory control over contents of their memory report. In Experiment 1 we coupled a simplified version of the paradigm with an option to respond ‘don’t know’. In Experiment 2 we coupled the same paradigm with a metamemory decision whether to bet on the correctness of a given recognition response. To preview, in both experiments we found evidence of memory conformity in the absence of metamemory conformity. In Experiment 3 we introduced initial feedback that helped participants to distinguish between reliable and unreliable external sources. Under these conditions, we got disparate results for the reliable and unreliable sources. For the reliable source, memory conformity was accompanied by metamemory conformity. At the same time, memory conformity for the unreliable source was accompanied by metamemory resistance – a lower likelihood of betting on a given response compared to the baseline rate for uncued trials. We discuss how metamemory decisions dissociate various types of memory conformity and how memory and metamemory decisions are independent of each other.

Experiment 1

In Experiment 1 we introduce a metamemory component to the memory conformity paradigm developed by Jaeger, Lauris, et al. (2012). In the original paradigm, participants studied lists of words for which recognition tests were administered. In the recognition tests, the status of test words was sometimes cued by one of two external sources, which provided ‘old’ and ‘new’ cues. The sources, although presented to participants in a social framework as participants who earlier completed the same procedure, were in fact artificial and provided cues of specified accuracy. In the original paradigm, participants were asked to respond whether a given item is old or new.[2] In the present paradigm, participants were asked to

[2] Jaeger, Lauris, et al. (2012) used a confidence scale for responding, ranging from 1 (sure new) to 6 (sure old) and then analyzed results by deriving ‘new’ responses from judgments 1-3 and ‘old’ responses from judgments

respond ‘old’, ‘new’ or ‘don’t know’ to each test item. The introduction of the ‘don’t know’ option meant that participants needed to make a metamemory decision for each of their responses. Our interest lies in the patterns of memory and metamemory conformity. We define memory conformity in the same way as in the study by Jaeger, Lauris, et al., that is, as a greater propensity to respond ’old’ rather than ‘new’ when the external source provides an ‘old’ rather than ‘new’ cue. Metamemory conformity is defined as a greater inclination to volunteer a response in a recognition test on trials for which information from the external source is available as compared to control trials with no such information (regardless of whether the information indicates the item to be ‘old’ or ‘new’). The specific questions examined here are whether participants display memory conformity even when the ‘don’t know’ option is available to them and whether participants display metamemory conformity in the face of cues provided by external sources.

Method

Participants. The participants were 26 undergraduate students who received course credit for participation. As the present study was aimed at extending the findings of Jaeger, Lauris, et al.’s (2012) Experiment 1, sample size was comparable to that used in their study (23 participants).

Materials and procedure. A total of 432 English nouns ranging from four to eight letters in length were chosen from the MRC database. These words were split into three lists consisting of 144 words each. Each list was then assigned to one of the three blocks. Within each list, 72 words were designated to serve as study words and targets at test, and the

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4-6. Although this scale can be seen as having a metamemory component of confidence judgment, it is in fact a memory scale in which participants judge the status of an item. A metamemory confidence scale would ask participants to judge the accuracy of their responses.

remaining 72 served as lures at test. The assignment of lists to blocks and words within each list to targets versus lures was fixed across participants.

Each block consisted of a study phase and a test phase. During the study phase, a list of 72 words was presented. The words were presented in random order for 700 ms, with a 300 ms interstimulus interval. The study phase was immediately followed by a recognition test for which the targets were intermixed with a set of 72 lures. The words were presented to participants one at the time, and participants' task was to decide whether the word was a target ('old') or a lure ('new'). In addition to the 'old' and 'new' response options, they were also given an option to respond 'don't know', which was displayed between the 'old' and 'new' response options. Choosing one of the options excluded the possibility to choose another; therefore if a participant chose to respond 'don't know' when presented with a word, they could no longer offer a guess regarding the status of this word.

On 48 out of 144 test trials (henceforth referred to as *uncued trials*), participants' sole task was to make a decision regarding the status of the presented word, or to opt out. On the remaining 96 trials (*cued trials*), they were also asked to pay attention to 'old' or 'new' responses provided by two external sources, with 48 trials of each source type. Following Jaeger, Lauris, et al. (2012), participants were told that these responses were provided by two participants who earlier took part in the same experiment. In fact, the sources' responses were determined by the experimenter, and had pre-programmed correctness: one of the sources (the *reliable* source) was correct in 83.3% of cases, that is on 40 out of 48 trials, whereas the other (*unreliable*) source was correct in 50% of cases, on 24 out of 48 trials. No information about the reliability of the sources was provided to participants. Responses of one source were accompanied by a depiction of a woman and were presented in purple font, and the other source's responses were accompanied by a depiction of a man and presented in green font. Participants were told that these depictions did not necessarily reflect the gender of ‘previous participants’, as their only purpose was to make distinguishing the sources easier. The assignment of source gender and font color to source correctness was constant across blocks but counterbalanced across participants.[3] Additionally, the assignment of test items to the 48 uncued, 48 cued-reliable, and 48 cued-unreliable test trials was counterbalanced across participants.

On each cued test trial, participants were presented with a “response” from only one source. This was a departure from the procedure of Jaeger, Lauris, et al. (2012), in which double-cue trials (with cues from both sources) were present in addition to single-cue trials. To facilitate paying attention to the cue, it was presented at the same time as the to-be-assessed word, and one second before participants could give their own response.

Following the test phase, the procedure progressed to the next study-test block. When all blocks were completed, participants were asked which of the sources gave more correct responses. The available options were “Woman”, “Man” or “Neither”.

Results

The analyses reported below for this experiment, as well as for Experiment 2, were conducted on pooled data from all study-test blocks, giving a total of 432 test trials per participant.

Accuracy. To assess accuracy across conditions, we calculated *d’*, a signal-detection measure of discrimination (see Table 1 for the descriptive statistics)[4] for all responses other than ‘don’t know’. A one-way repeated-measures Analysis of Variance (ANOVA)

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[3] Across experiments, source gender had no influence on conformity measures.

[4] For the purpose of the signal detection analyses described in the present manuscript, in cases when hit rates and false alarm rates equalled 1 or 0 we used a correction by which rates of 1 were converted to 1-1/(2N) and rates of 0 were converted to 1/(2N), where N is the number of trials on which those rates were based (see e.g., Macmillan & Creelman, 2005).

performed on *d'* scores with condition (reliable source, unreliable source, no source) as a factor revealed a significant effect, $F(2, 50) = 3.198$, $MSE = 0.12$, $p = .049$, $\eta_p^2 = .113$. We further conducted follow-up *t*-tests to compare *d'* in the two cued conditions to the baseline provided by the no-source condition. We found that cues provided by the reliable source improved accuracy as compared to the no-source condition, $t(25) = 2.868$, $SE = 0.08$, $p = .008$, $d = 0.56$. However, the unreliable-source condition accuracy did not differ from the baseline, $t(25) = 1.206$, $SE = 0.10$, $p = .24$, $d = 0.24$. Together, the results for accuracy mirror those observed by Jaeger, Lauris, et al. (2012) in their Experiment 1.

Bias. Improved recognition accuracy in the reliable-source condition as compared to baseline indicated that, at least for some items, participants followed the cue provided by the external source. In order to establish more precisely how cues provided by sources influenced participants' responses in the present experiment, we calculated *c*, a signal-detection measure of bias: the lower the *c* score, the more participants were willing to offer an 'old' response. Following Jaeger, Lauris et al. (2012), we analyzed *c* scores as a function of source and also as a function of the cue provided by the source. The difference in *c* scores between trials with an 'old' cue and trials with a 'new' cue constitutes our index of memory conformity. The results for *c* are presented in Table 2. A 2 (cue: old, new) x 2 (source: reliable, unreliable) repeated-measures ANOVA performed on *c* scores revealed only a significant effect of cue, $F(1, 25) = 13.715$, $MSE = 0.18$, $p = .001$, $\eta_p^2 = .354$. This was caused by lower *c* scores on 'old'-cued trials than on 'new'-cued trials, $M = -0.16$, $SD = 0.39$, and $M = 0.14$, $SD = 0.42$, respectively. The main effect of source was not significant, $F(1, 25) = 2.911$, $MSE = 0.07$, $p = .10$, $\eta_p^2 = .104$, and neither was the interaction, $F < 1$. These results demonstrate that participants were more liberal in responding 'old' when provided with an 'old' cue than when provided with a 'new' cue, revealing memory conformity to external sources. Crucially, this difference in propensity to respond 'old' did not depend on the particular source that provided the cue: participants relied on cues provided by both sources to a similar extent.

'Don't know' responses. The rates of 'don't know' responses across conditions are presented in Table 3. A one-way ANOVA conducted on the rate of 'don't know' responses revealed no differences across conditions, $F < 1$. This shows that even though participants relied on external sources when making memory decisions, the metamemorial decision of whether to refrain from giving an answer was impervious to the presence of external cues.

Identification of correct source. After completing the final study-test block, participants were asked to choose which of the two sources (if any) was more often correct. Out of 26 participants, 13 (50%) chose the reliable source, eight (30.8%) chose the unreliable source, and five (19.2%) chose the "neither" option, which differed significantly from a random distribution of responses, $X^2(2) = 14.675$, $p < .001$.

Discussion

In Experiment 1 we investigated the effects of external cues on responding in a recognition test in which participants were free to exert metamemory control over the contents of their memory reports. We assessed whether under these conditions memory conformity and metamemory conformity would be present. Our results revealed memory conformity but not metamemory conformity. Specifically, participants relied on external cues to shape their recognition decisions regarding whether a test item was old or new, but they were as likely to volunteer or withhold their recognition decisions on cued trials as on uncued trials. These results testify to the robustness of memory conformity, while showing at the same time that metamemory conformity is, at the very least, less likely to be revealed in a recognition paradigm. This dissociation has important consequences for our understanding of the relationship between memory and metamemory decisions, a topic we will return to when describing Experiment 3 and in the General Discussion.

The fact that we obtained clear indications of memory conformity both replicates and extends previous investigations of memory conformity in recognition testing, including the study by Jaeger, Lauris, et al. (2012). Similarly to Jaeger, Lauris, et al., we found that participants were more likely to say 'old' when an external source provided an 'old' rather than a 'new' cue. Also replicating Jaeger, Lauris, et al. (see also Numbers et al., 2014), we found that this memory conformity was indistinguishable for the reliable and unreliable source, indicating that participants do not restrict their reliance on external cues to situations in which these cues are characterized by above-chance accuracy. Finally, in terms of the consequences of reliance on external sources, we replicated the observation of Jaeger, Lauris et al. according to which conforming to the reliable source boosts the overall recognition performance but conforming to an unreliable source does not bear any consequences for recognition performance. This is consistent with the low-confidence outsourcing hypothesis, stating that participants restrict their reliance on external cues to trials for which the accuracy of their own memory would be at chance.

Crucially, we also extended the results obtained by Jaeger, Lauris, et al. (2012) by showing that all these effects hold in a free-report recognition test in which participants are able to withhold their recognition responses. Previous metamemory research would suggest that a 'don't know' response constitutes a default option when a person is in the state of high subjective uncertainty regarding a candidate response for a given memory question (Koriat & Goldsmith, 1996; Hanczakowski, Pasek, et al., 2013). On the other hand, Jaeger, Lauris, et al. suggested that conforming to an external source should be considered a default option. The present study shows that there is no one default option in this scenario. Memory conformity in a free-report test shows that participants may choose to follow external cues rather than to respond ‘don’t know’ for some low-confidence trials. However, equal rates of ‘don’t know’ responses in the presence and absence of external cues suggest that, at least for a subset of test trials, participants prefer to refrain from answering the memory question regardless of whether an external cue is present or not. Overall, conforming to external sources and withholding responses from a memory report are two independent ways people may choose to deal with uncertainty.

One caveat of the present experiment is that although we demonstrate the functionality of memory conformity – the boost to recognition performance coming from following the reliable external source – a similar demonstration of the functionality of using ‘don’t know’ responses is lacking. In other words, from the recognition performance results we may suspect that participants rely on external sources because it benefits their performance (see also Reysen, 2005; Schneider & Watkins, 1996). We cannot be sure, however, whether ‘don’t know’ responses are used to regulate the accuracy of a memory report in this scenario, because we do not have access to responses participants decided to withhold by answering ‘don’t know’. This leaves the possibility that ‘don’t know’ responses in our paradigm are not expressions of high subjective uncertainty but a result of demand characteristics, where participants use the ‘don’t know’ option for a random subset of recognition items only because it is implicitly required by the experimental task. If that were the case, then the fact that external cues do not modify the rate of ‘don’t know’ responding would not be surprising. In Experiment 2 we amended this problem by investigating another form of metamemory decisions: decisions whether to bet or refrain from betting on the accuracy of a candidate response (see Hanczakowski, Zawadzka, Pasek, & Higham, 2013; McGillivray & Castel, 2011; Zawadzka & Higham, 2015, for other examples of using betting decisions to investigate metamemory processes). The betting procedure allows for investigating accuracy of both ‘volunteered’ responses (as in Experiment 1) – that is responses which participants decide to bet on – and ‘withheld’ responses participants decide not to bet on.

Experiment 2

Experiment 2 followed the design of Experiment 1, but instead of providing participants with a ‘don’t know’ option as a way to withhold responses, it used a volunteer/withhold option in the form of a betting task. After providing a recognition decision, participants were required to make a metamemory decision about whether to bet on that response or not. For the betting task, participants were instructed that if they bet on a response that turns out to be correct, they would be awarded one point to their overall score. On the other hand, if they bet on a response that turns out to be incorrect, one point will be deducted from their score. Refraining from betting meant that no points were added or subtracted, regardless of the accuracy of the recognition response. For the remainder of the paper, we will refer for simplicity to responses participants decided to bet on as volunteered and responses participants decided to refrain from betting on as withheld. Again, our question was whether memory conformity effects would be present for volunteered responses as in Experiment 1. We were also interested in metamemory conformity, which, in this case, would be a greater inclination to bet on responses made in the presence of external cues. Finally, we assessed whether metamemory responses track the accuracy of candidate responses in such a way that decisions not to bet (akin to ‘don’t know’ responses from Experiment 1) are made for trials that are less likely to be correct.

Method

Participants. Thirty undergraduate students participated in this experiment for course credit.

Materials and procedure. The same materials as in Experiment 1 were used in this experiment. The experimental procedure differed only with respect to the way in which responses were elicited at test. For each test item, participants were first asked whether it was old or new. This time, no 'don't know' option was provided. Instead, after choosing their response, participants were asked to decide whether they wanted to bet on the correctness of that answer. They were told that if they ticked the 'Points' check box next to their answer, they would gain one point if that answer was correct, but lose one point if it was incorrect. If they ticked the 'No points' check box, they would neither lose nor gain any points regardless of the correctness of their answer.

Results

Accuracy. Results for *d'* are presented in Table 1. First, we analyzed *d'* scores for the whole data set, regardless of whether participants decided to volunteer or withhold the response, which is analogous to the analyses first presented by Jaeger, Lauris et al. (2012). A one-way repeated-measures ANOVA performed on *d'* scores across conditions revealed a significant effect, $F(2, 58) = 26.954$, $MSE = 0.12$, $p < .001$, $\eta_p^2 = .482$. As in in the study by Jaeger, Lauris et al., accuracy was higher in the reliable-source condition than in the no-source condition, $t(29) = 5.260$, $SE = 0.09$, $p < .001$, $d = 0.96$. This time, however, accuracy was worse in the unreliable-source condition as compared to the baseline, $t(29) = 2.666$, $SE = 0.07$, $p = .012$, $d = 0.49$, an effect that was not previously observed by Jaeger, Lauris et al.

Accuracy results for volunteered responses (i.e., those for which participants chose the 'points' option), which is analogous to the analysis presented in Experiment 1, returned the same results as those obtained from the full data set. A one-way repeated-measures ANOVA performed on *d'* scores revealed a significant effect of condition, $F(2, 58) = 31.858$, $MSE = 0.152$, $p < .001$, $\eta_p^2 = .523$. As compared to baseline, accuracy increased in the reliable source condition, $t(29) = 5.635$, $SE = 0.10$, $p < .001$, $d = 1.03$, but decreased in the unreliable source condition, $t(29) = 2.758$, $SE = 0.07$, $p = .01$, $d = 0.50$. Again, the first effect replicates Experiment 1 but the second one is not consistent with the previous results.

The aim of including the ‘points’/’no points’ decisional stage in this experiment was to give participants control over the quality of their memory reports: by choosing the ‘no points’ option, they could filter out those responses that they believed had a lower chance of being correct. If participants were indeed strategically withholding lower quality answers, then accuracy of volunteered answers should be higher than accuracy of the whole set of responses. We thus run a complementary analysis on the *d’* scores for volunteered answers and those for the whole data set with a 2 (response set: volunteered vs. all) x 3 (condition: reliable-source, unreliable-source, control) ANOVA. The ANOVA yielded a significant main effect of source, $F(2, 58) = 34.148$, $MSE = .23$, $p < .001$, $\eta_p^2 = .541$, and, crucially, a significant main effect of response set, $F(1, 29) = 20.803$, $MSE = .55$, $p < .001$, $\eta_p^2 = .418$. The latter effect indicates that accuracy for volunteered (i.e., betted on) responses was higher than for the overall set of responses, consistent with the hypothesis of strategic betting decisions. The interaction was not significant, $F(2, 58) = 2.303$, $MSE = .04$, $p = .11$, $\eta_p^2 = .074$.

Bias. Descriptive statistics for bias (*c*) are provided in Table 2. For the full data set, a 2 (cue: old, new) x 2 (source: reliable, unreliable) ANOVA performed on the *c* scores revealed a similar pattern of results to the one described by Jaeger, Lauris et al. (2012). The main effect of cue was again significant, $F(1, 29) = 23.072$, $MSE = 0.86$, $p < .001$, $\eta_p^2 = .443$, while the main effect of source and the interaction were not, both *F*s < 1. The results for bias suggest that participants were more liberal in endorsing items as studied when presented with the ‘old’ cue (M = -0.43, SD = 0.64) than when presented with the ‘new’ cue (M = 0.38, SD = 0.47).

The bias results for volunteered responses generally mirrored those for the full data set and the results observed in Experiment 1 (see Table 2). In a 2 (cue: old, new) x 2 (source: reliable, unreliable) repeated-measures ANOVA, only the main effect of cue was significant, $F(1, 29) = 21.001$, $MSE = 1.20$, $p < .001$, $\eta_p^2 = .420$, with more liberal responding on ‘old’-cued trials (M = -0.66, SD = 0.76) than on ‘new’-cued trials (M = 0.25, SD = 0.64). The main effect of source and the interaction were not significant, $F(1, 29) = 1.712$, $MSE = 0.13$, $p = .20$, $\eta_p^2 = .056$, and $F(1, 29) = 3.027$, $MSE = 0.08$, $p = .093$, $\eta_p^2 = .095$, respectively. This shows that participants were biased by external cues also for their volunteered responses, and the extent to which they relied on those cues was comparable for both sources.

Response withholding rate. In this experiment, participants could choose to ‘withhold’ their recognition responses by choosing the ‘no points’ option after giving their answer. We analyzed the proportion of ‘no points’ decisions across the three conditions (see Table 3) with a repeated-measures ANOVA. The ANOVA revealed that condition had no effect on how often participants decided to avoid betting on their response, $F(2, 58) = 1.555$, $MSE = 0.002$, $p = .22$, $\eta_p^2 = .051$.

Identification of correct source. In this experiment, fifteen participants (50%) correctly identified the reliable source as providing better cues, 11 (36.7%) indicated that none of the sources was more reliable, and four (16.3%) chose the unreliable source. Again, participants’ responses were not randomly distributed, $X^2(2) = 17.163$, $p < .001$.

Discussion

In the present experiment we investigated memory and metamemory conformity with a procedure that required participants to make metamemory decisions by deciding whether to 'report' their recognition decision by betting on it or 'withhold' it by refraining from betting. With respect to memory conformity for responses betted on, the results from the betting procedure resembled the results of Experiment 1 which employed the 'don't know' response option. Memory conformity effects were observed for responses participants decided to bet on, just as they were present previously for responses that participants decided to volunteer. This effect again shows that giving participants metamemory control over contents of their memory reports does not eliminate memory conformity. With respect to metamemory, the results of the two experiments were also consistent: Just as providing external cues did not make participants more likely to volunteer responses in Experiment 1, providing cues in Experiment 2 did not make participants more likely to bet on their responses. This pattern of results again suggests that memory conformity does not need to be accompanied by metamemory conformity.

One difference between the results of the present experiment and those of Experiment 1 pertains to the consequences of relying on an unreliable source for recognition performance. In Experiment 1, these consequences were nil, whereas in the present experiment performance suffered in the unreliable source condition as compared to the control condition that used uncued trials. The drop in performance observed here indicates that participants were unable or unwilling to restrict their memory conformity only to trials on which their level of performance would be at chance anyway. Why this pattern occurs in the present experiment, but not in Experiment 1 or the study by Jaeger, Lauris, et al. (2012) is not clear. One possibility is that the betting task used here imposes a greater cognitive load at the time of a recognition test, which disrupts participants' ability to restrict the influences of external sources (see Sacher, Isingrini, & Taconnat, 2013, for evidence that monitoring accuracy is affected by cognitive load). Nevertheless, any potential explanation of this result needs to be treated with caution, as the same pattern was not replicated in Experiment 3, which also employed the betting task.

One aim of Experiment 2 was to assess whether metamemory decisions to withhold responses from a memory report are restricted to recognition responses that are unsupported by reliable memory evidence. The fact that the recognition responses that participants volunteered were more accurate than the full set of recognition responses suggests that the metamemory decisions were deployed in such a manner. This result joins a long list of studies showing that people use metamemory decisions strategically to control accuracy of responses they eventually volunteer (e.g., Arnold et al., 2013; Bulevich & Thomas, 2012; Higham, 2007; Koriat & Goldsmith, 1996; Kelley & Sahakyan, 2003). The fact that these strategically used metamemory decisions were completely insensitive to the presence versus absence of external cues mirrors the findings for 'don't know' responses from Experiment 1. Together, these data demonstrate that insensitivity of metamemory decisions to social information can occur even under conditions which induce memory conformity. In other words, external sources were potent enough to determine participants' memory decisions but under the same testing conditions they were not capable of changing participants' metamemory decisions.

Both Experiments 1 and 2 documented how external cues dissociate memory and metamemory decisions. The question arises why metamemory decisions are so insensitive to external cues. There are two possibilities that are not mutually exclusive, and to which we will refer to as the *low-level* and *high-level* hypotheses. The low-level hypothesis touches upon the nature of conformity effects. In essence, the low-level hypothesis states that memory conformity arises because providing an external cue primes a certain response in a recognition test. This explanation is consistent with the results of a recent study by Kim and Hommel (2015). In this study, the authors found that external cues affected likeability judgments even if participants were fully aware that these cues were unrelated to judged stimuli and were, in fact, generated randomly. A simple explanation of this result is that cues do not alter how the stimulus is perceived, but merely make a cued response more accessible, and hence more likely to be chosen, due to a priming-like mechanism. Applying this logic to the memory conformity paradigm, it could be argued that participants presented with an external cue such as 'old', and in the face of a simultaneous lack of internal evidence supporting an 'old' or 'new' option, choose the 'old' option because it is more accessible and not because they are more convinced that the item was actually studied. This account predicts no effect of external cuing on metamemory decisions because the labels pertaining to these judgments differ from the cues provided: the 'don't know', 'points', and 'no points' labels bear no relationship to 'old' or 'new' cues. Importantly, the low-level hypothesis predicts that under no circumstances external cues would be able to affect metamemory decisions which do not employ the same label as the cues.

The high-level account is concerned with a relationship between memory and metamemory decisions. As described earlier, the cue-utilization framework developed by Koriat (1997) stresses that not all types of cues affect memory and metamemory in the same way. Specifically, the role of extrinsic cues is often downplayed in metamemory processes, even if these cues can powerfully shape memory processes. This approach postulates that memory and metamemory should be considered separate theoretical constructs. When a person faces a task of deciding whether a test item is old or new, then another's person's judgment of whether this item is old or new becomes relevant to the final decision. However, a metamemory decision induces a different processing framework in which a person needs to introspect into her own mental processes. In this situation, external cues might be discarded, and a person may concentrate on internal evidence only.

An important difference between the low-level and high-level accounts is that the latter does not make a strong claim that external cues are *never* factored into metamemory judgments. For example, research on predictions of future memory performance shows that extrinsic cues, such as number of learning trials, are often not factored into those predictions (a so-called stability bias, see, e.g., Kornell & Bjork, 2009). However, if the framing of a question is changed, the same cue of the number of learning trials becomes relevant to metamemory judgments which are affected by it (Ariel, Hines, & Hertzog, 2014). This example serves to demonstrate that insensitivity of metamemory to extrinsic cues can be modified by changes in the nature of the experimental task.

In Experiment 3, we attempted to test whether a dissociation of memory and metamemory decisions is inevitable, as the low-level account of our results would suggest, or can be modulated by changes to the experimental task, which is consistent with the high-level account. We reasoned that external cues are most likely to be incorporated into metamemory decisions when participants have a strong basis to differentiate between external sources differing in reliability. If participants can be made to better distinguish between these sources, they might also use the information about the reliability of these sources to craft their metamemory decisions. Specifically, we assumed that if participants were able to confidently determine which external source is reliable, then they would not only be more willing to rely on this source's cues, but would also be more likely to volunteer responses derived from this source in order to increase the accuracy of their memory reports (see Koriat & Goldsmith, 1996).

In Experiments 1 and 2, just as in the study by Jaeger, Lauris, et al. (2012), participants' degree of conformity was comparable for reliable and unreliable sources. The question is thus whether participants can be persuaded to conform more to a reliable source than to an unreliable one. One reason for the indiscriminate conformity for reliable and unreliable sources in Experiments 1 and 2 could be that participants were disinterested in source reliability. If participants limit conformity to trials for which they believe they do not have any viable information – low confidence outsourcing – then source reliability may seem largely irrelevant to them. If participants are not concerned with the reliability of the sources, then it could prove impossible to induce more conformity to the reliable source. However, another possibility is that participants aim at determining source reliability but in the present paradigm they do not have sufficient memory information to discriminate between the reliable and unreliable sources. One way to assess these two hypotheses is to examine the level of conformity to the reliable and unreliable source separately for participants who were and were not able to name the reliable source in the post-experimental question in Experiments 1 and 2.[5] If the problem lies with participants' lack of interest, then the ability to name the reliable source should not moderate the conformity effects. However, if participants are trying to establish source reliability, then those who were able to extract enough memorial information to correctly name the reliable source after the last test might have been willing to conform more to this source during the course of the experiment, as opposed to participants who responded incorrectly to this question.

We assessed this possibility by conducting a combined analysis of the conformity effects for volunteered responses in Experiments 1 and 2. The combined analysis was used to secure sufficient numbers of participants who correctly identified the reliable source *(n* = 28) or provided an incorrect response (*n* = 28), which could mean either naming the

[5] We thank Sarah Barber for suggesting this analysis.

unreliable source (12 participants) or choosing the ‘neither’ option (16 participants). The analysis was performed with a 2 (cue: old, new) x 2 (source: reliable, unreliable) x 2 (question response: correct, incorrect) x 2 (Experiment: 1, 2) mixed ANOVA on free-report *c* scores. The highest-order significant effect was a three-way interaction of cue, source, and question response, $F(1, 52) = 4.44$, $MSE = .06$, $p = .04$, $\eta_p^2 = .079$. This interaction arose because the two-way interaction of cue and source was significant when participants responded correctly to the post-experimental question, $F(1, 27) = 6.60$, $MSE = .06$, $p = .016$, $\eta_p^2 = .196$, indicating that a difference in bias between ‘old’ and ‘new’ cues was larger for the reliable source ($\Delta c = 0.85$, where larger differences in c reveal greater memory conformity) than for the unreliable source ($\Delta c = 0.61$). On the other hand, the same interaction was not significant for participants who responded incorrectly to the post-experimental question, $F < 1$, with comparable conformity to the reliable ($\Delta c = 0.53$) and unreliable ($\Delta c = 0.54$) sources for these participants. Overall, these analyses provide preliminary support for the idea that participants try to establish the reliability of the sources and conform more to the source identified as reliable. However, only some participants are successful in extracting information concerning source reliability, which means that this effect is occluded when considered across the whole sample.[6] In Experiment 3 we attempted to strengthen this inclination towards greater conformity to the reliable source by providing more information supporting source differentiation.

Experiment 3

[6] We also checked whether the ability to correctly identify the reliable source moderates the rate of response withholding across experimental conditions. We conducted two mixed ANOVAs on the proportions of withhold decisions (DK responses in Experiment 1 and ‘no points’ decisions in Experiment 2) in a 2 x 2 x 2 plan. Both ANOVAs included the factors of post-experimental question response (correct, incorrect) and Experiment (1, 2). The first ANOVA included a comparison of the reliable source to the baseline uncued condition, and the second one a comparison of the unreliable source to the baseline condition. Both ANOVAs yielded only significant main effects of Experiment, showing that participants used the ‘no points’ option more often than the DK response. These results show that with a limited ability to differentiate the reliability of the sources in Experiments 1 and 2, external cues do not affect metamemory decisions. We return to this issue in Experiment 3, which assessed the same hypothesis after increasing participants’ ability to differentiate between the sources.

In the present experiment, the design of Experiment 2 was repeated with a single change: on the first study-test cycle, participants were provided with feedback about the accuracy of their recognition responses. Feedback was introduced to augment participants' ability to distinguish between the reliable and unreliable external sources. Whereas in the previous experiments the accuracy of external sources could only be judged against the standard of one's own memory, in Experiment 3 feedback provided participants with an objective standard for such judgments. Our main interest in the present experiment lies again in the responsiveness of memory and metamemory decisions to external cues. Regarding memory decisions, we were interested in whether additional information provided by feedback on the first test would induce different levels of memory conformity in subsequent cycles in the overall results – a strengthening of the pattern observed for some participants in the combined analysis of Experiments 1 and 2. More importantly, regarding metamemory decisions, we were interested in whether feedback would result in metamemory conformity for the reliable source.

Method

Participants. Thirty-six undergraduate students participated in this experiment for course credit or monetary compensation. We slightly increased our sample size in this experiment as compared to Experiments 1 and 2, as one of the central predictions rested on an interaction for memory responses.

Materials and procedure. The same materials as in Experiments 1 and 2 were used. The procedure was based on that from Experiment 2, with one crucial exception: the first study-test block was substituted with a feedback phase. The feedback phase differed from the study-test blocks used in the later part of the experiment in three aspects. First, the 'points'/'no points' stage of responding was omitted. Hence, participants' task at test was only to provide either an 'old' or 'new' response for each item. Second, immediately after submitting their response, participants were informed whether this response was correct. Third, uncued trials were eliminated from the feedback phase, and items which were presented on those trials in Experiments 1 and 2 were evenly redistributed between the reliable- and unreliable-source conditions. The overall accuracy of the external sources in the feedback phase, 83.3% (correct on 60 out of 72 trials) for the reliable and 50% (correct on 36 out of 72 trials) for the unreliable source, was the same as in the later phases. The remaining two study-test blocks were identical to Experiment 2.

Results

As the first study-test block was replaced in this experiment with a feedback phase, the analyses reported below were performed only on the data from the remaining two study-test blocks, consisting of 288 trials in total.[7]

Accuracy. The descriptive statistics for *d'* are presented in Table 1. A one-way repeated-measures ANOVA performed on *d'* scores for the full data set revealed that condition affected accuracy, $F(2, 70) = 36.526$, $MSE = 0.10$, $p < .001$, $\eta_p^2 = .511$. Again, we found an improvement in accuracy in the reliable source condition, as compared to the no-source condition, $t(35) = 6.363$, $SE = 0.08$, $p < .001$, $d = 1.06$. This time, there was no decrease in accuracy in the unreliable source condition as compared to baseline, $t = 1$. This stands in contrast to the results of Experiment 2, but is consistent with the results of Jaeger, Lauris, et al. (2012).

As evidenced by a one-way ANOVA performed on *d*' scores for volunteered responses, condition influenced accuracy, $F(2, 68) = 26.973$, $MSE = 0.19$, $p < .001$, $\eta_p^2 =$

[7] For the sake of comparability with the results of Experiment 3, we also reanalyzed the results of Experiments 1 and 2 by restricting data sets to cycles 2 and 3. This did not change any of the conclusions from these experiments.

.442.[8] As in the overall data set, accuracy was higher in the reliable source condition than in the no source condition, $t(34) = 5.099$, $SE = 0.12$, $p < .001$, $d = 0.86$, while it did not differ between the unreliable source and no source conditions, $t < 1$. Similarly to Experiment 2, we also performed an additional 2 (response set: volunteered vs. all) x 3 (condition: reliable-source, unreliable-source, control) ANOVA, which yielded again a significant main effect of condition, F(2, 68) = 36.789, MSE = 23, p < .001, $\eta_p^2 = .520$, and, more importantly, a significant main effect of response set, F(1,34) = 48.134, MSE = .31, p < .001, $\eta_p^2 = .586$, which again indicated that volunteered responses were, on average, of higher quality than the overall set of responses. The interaction was not significant, F(2,68) = 1.214, MSE = .06, p = .30, $\eta_p^2 = .034$.

Bias. Bias scores are presented in Table 2. A 2 (cue: old, new) x 2 (source: reliable, unreliable) repeated-measures ANOVA performed on *c* scores for the full data set revealed a significant main effect of cue, $F(1, 35) = 29.221$, $MSE = 0.39$, $p < .001$, $\eta_p^2 = .455$: responding was overall more liberal on trials on which the ‘old’ cue was presented, $M = -0.27$, $SD = 0.57$, than on those on which participants were presented with the ‘new’ cue, $M = 0.29$, $SD = 0.45$. This time, however, this main effect was qualified by a significant cue x source interaction, $F(1, 35) = 13.890$, $MSE = 0.13$, $p = .001$, $\eta_p^2 = .284$. The interaction arose because despite the fact that participants still conformed to both sources, $t(35) = 5.576$, $SE = .14$, $p < .001$, $d = 0.93$ for the reliable source, and $t(35) = 3.544$, $SE = .09$, $p = .001$, $d = 0.59$ for the unreliable source, the extent to which participants relied on the reliable source was greater than that to which they followed the unreliable source. This crucial difference between the results of the present experiment and that of Experiments 1 and 2 shows that the feedback manipulation was successful in inducing greater sensitivity to source reliability.

[8] In this and further analyses, degrees of freedom occasionally differ. This is due to the fact that some participants withheld all of their responses, making it impossible to calculate any of the free-report measures.

A 2 (cue: old, new) x 2 (source: reliable, unreliable) repeated-measures ANOVA on *c* scores for volunteered responses only (see Table 2) revealed the same pattern of results as in the full data set. The main effect of cue was again significant, $F(1, 33) = 38.086$, $MSE = 0.62$, $p = .001$, $\eta_p^2 = .536$, with lower *c* scores for the subset of items presented with the 'old' cue, $M = -0.53$, $SD = 0.62$, than for those presented with the 'new' cue, $M = 0.30$, $SD = 0.57$. The interaction was significant as well, $F(1, 33) = 12.796$, $MSE = 0.24$, $p = .001$, $\eta_p^2 = .279$, demonstrating that even though participants conformed to both sources, $t(33) = 7.390$, $SE = .15$, $p < .001$, $d = 1.27$ for the reliable source, and $t(33) = 3.271$, $SE = .16$, $p = .003$, $d = 0.56$ for the unreliable source, they relied more on the reliable than the unreliable source. The main effect of source was not significant, $F < 1$.

Response withholding rates. A one-way ANOVA performed on the proportion of 'no points' responses revealed a significant effect of condition, $F(2, 70) = 10.985$, $MSE = 0.005$, $p < .001$, $\eta_p^2 = .239$ (see Table 3 for the descriptive statistics). As compared to the baseline no-source condition, participants chose the 'no points' response less often in the reliable-source condition, $t(35) = 2.759$, $SE = 0.02$, $p = .009$, $d = 0.46$, and more often in the unreliable-source condition, $t(35) = 2.685$, $SE = 0.01$, $p = .011$, $d = 0.45$. This demonstrates that for the first time in this series of experiments, participants' metacognitive decisions were affected by external source.

Correlations. The present experiment revealed not only how external cues affect memory decisions, but also the sensitivity of metamemory decisions to the same external cues. Here we present correlations between the effects exerted by external cues on memory and metamemory decisions. When the cues came from the reliable source, the correlation between the difference in the bias measure between 'old' and 'new' cues (an index of memory conformity) and the difference in the rate of 'no points' decisions between cued and uncued trials (an index of metamemory conformity) was positive and significant, both when the bias measure was derived from the full data set, $r = .62$, $p < .001$, and when it was derived from volunteered responses only, $r = .42$, $p = .012$. These correlations show that participants who conformed in their memory decisions to the reliable source were also more likely to conform in their metamemory decisions to the same source. When the cues came from the unreliable source, the same correlations were not significant, $r = .07$, p = .68 and $r = .01$, $p = .95$, for the full and volunteered data set, respectively. These non-significant correlations indicate that memory conformity and the metamemory effect for the unreliable source are not related to each other.

Identification of reliable source. For the final question regarding the overall reliability of the two sources, 25 participants (69.4%) were able to identify correctly which of the sources was more reliable, six (16.7%) incorrectly chose the unreliable source, and five (13.9%) incorrectly believed that neither of the sources was more reliable. The distribution of participants' responses again was significantly different from the random distribution, $X^2(2) = 57.438$, $p < .001$. We also assessed whether the addition of feedback increased the proportion of correct identifications as compared to Experiments 1 and 2, where feedback was absent. As correct identification rates were equal in Experiments 1 and 2 (50% in both cases), for the purpose of this analysis we binned the data from the first two experiments ($n = 56$) to obtain more power. A one-tailed two-proportion z-test revealed that participants in Experiment 3 identified the reliable source more often than in Experiments 1 and 2, $z = 1.84$, $p = .033$.

Memory and metamemory effects across participants. We used the results of the post-experimental question to divide participants into those who correctly identified the reliable source ($n = 25$) and those who answered the question incorrectly ($n = 11$), either naming the unreliable source (six participants) or choosing the ‘neither’ option (five participants). We used the resulting factor to further analyze the effects of external cues on memory and metamemory decisions. The following analyses need, however, to be treated with caution given a limited number of participants who were unable to correctly identify the reliable source in this experiment. We first compared memory conformity across these two groups of participants for volunteered responses only (in order to remain consistent with the analysis presented in the discussion of Experiment 2; the analysis of conformity for all responses gives the same results). The highest-order significant effect in the 2 (cue: old, new) x 2 (source: reliable, unreliable) x 2 (question response: correct, incorrect) mixed ANOVA was the three-way interaction, $F(1, 32) = 11.26$, $MSE = .18$, $p = .002$, $\eta_p^2 = .260$. This interaction arose because a two-way interaction of cue and source was significant for participants who correctly answered the post-experiment question, $F(1, 22) = 24.87$, $MSE = .20$, $p < .001$, $\eta_p^2 = .531$, indicating that these participants conformed more to the reliable than to the unreliable source. On the other hand, the same two-way interaction was not significant for participants who answered the question incorrectly, $F < 1$. These results mirror those from the combined analysis of Experiments 1 and 2, presented in the discussion of Experiment 2.[9]

Second, we compared the rate of ‘no points’ decisions in two mixed ANOVAs, both including the factor of the final question response. The first 2 (condition: reliable-source, control) x 2 (final question response: correct, incorrect) ANOVA yielded only a significant

[9] In the analyses conditionalized on responses to the final question, we considered all incorrect responses together, whether they were incorrect identifications of the unreliable source or ‘neither’ responses. This was done because incorrect identifications of the unreliable source were rare. Across three experiments, only 18 participants (out of 92; 20%) made such an error. When volunteered memory responses of these 18 participants were analyzed separately in a 2 (cue: old, new) x 2 (source: reliable, unreliable) mixed ANOVA, only the main effect of response was significant, $F(1, 17) = 7.78$, $MSE = .93$, $p = .013$, $\eta_p^2 = .314$, showing memory conformity for these participants. Crucially, the interaction was not significant, $F < 1$. Thus, participants who incorrectly indicated the unreliable source as more reliable showed equal conformity to the reliable and unreliable sources. Although tentative, this analysis suggests that participants need positive evidence to support their choice of the reliable source and to modify their conformity to source the reliable versus the unreliable source.

interaction, $F(1, 34) = 8.07$, $MSE = .005$, $p = .008$, $\eta_p^2 = .19$, which arose because participants who correctly identified the reliable source in the post-experiment question demonstrated reduced response withholding when cued by the reliable source ($M = .32$, $SD = .21$) compared to the uncued trials ($M = .40$, $SD = .21$), $t(24) = 3.74$, $SE = .02$, $p = .001$, $d = 0.72$, whereas participants who answered the same question incorrectly showed no difference ($M = .41$, $SD = .21$ and $M = .39$, $SD = .20$, for the reliable-source and control condition, respectively), $t < 1$. Note that these results differ from the results for combined analysis of Experiments 1 and 2 (see footnote 5), where no evidence of metamemory conformity were obtained even for participants who correctly identified the reliable source. This discrepancy suggests that stronger evidence for the reliability of the external source is required to induce metamemory conformity than merely to identify it correctly.

The second 2 (condition: unreliable-source, control) x 2 (final question response: correct, incorrect) ANOVA yielded a significant main effect of condition, $F(1, 34) = 4.94$, $MSE = .002$, $p = .03$, $\eta_p^2 = .127$, confirming that participants withheld more responses when cued by the unreliable source, but no interaction, $F < 1$. This result suggests that the ability to identify the reliable source is not related to more cautious metamemory responding in the presence of cues from the unreliable source.

Discussion

The results of Experiment 3 stand in contrasts to results of the previous experiments reported here and in the study by Jaeger, Lauris, et al. (2012). The first major difference is that the degree to which participants conformed to external cues clearly depended on source reliability. This chimes with the analysis of the combined results of Experiments 1 and 2, where it was evident that participants who correctly named the reliable source demonstrated greater conformity to the reliable than to the unreliable source. The proportion of participants who were able to correctly identify the reliable source in Experiments 1 and 2 was relatively low, which led to the pattern of indiscriminate memory conformity in the overall set of results. In contrast, in the current experiment, participants provided with feedback on the first study-test cycle had more diagnostic information on source reliability at their disposal. As a result, they conformed more to the reliable source, evinced by a cue type by source reliability interaction on bias. This clearly demonstrates that that the feedback manipulation was effective in providing participants with information about source reliability, and that participants were able to make use of this information to shape their decisions in the recognition test.

The second major way in which the present results differ from the results of Experiments 1 and 2 can be found in the pattern of metamemory decisions. In previous experiments, these decisions were unaffected by external cues, with the same level of 'don't know' responses and 'no points' decisions in the presence and the absence of these cues. The same was true even for those participants who were able to correctly identify the reliable source, as evidenced by the combined analysis of data from Experiments 1 and 2. However, it was no longer the case in Experiment 3, in which external cues affected the rate of 'no points' decisions. The effects of external cues on 'no points' decisions were twofold. When external cues came from a reliable source, participants were more likely to volunteer their responses than on uncued trials. This effect confirms our initial predictions, according to which participants should be more willing to volunteer their responses if they are strongly convinced that a source is reliable, as in this way they can easily increase the accuracy of a final report. This is a first demonstration that conditions leading to memory conformity can also lead to *meta*memory conformity, revealing an association between memory and metamemory decisions. By contrast, when external cues came from an unreliable source, participants were less likely to volunteer their responses than on uncued trials. We term this novel effect *metamemory resistance*. An important aspect of the present results is that cues from the unreliable source led simultaneously to memory conformity and metamemory resistance. This provides an example of a particularly strong dissociation of memory and metamemory decisions.

With respect to the theoretical aim of the present experiment, the implication of these results is that the low-level hypothesis, derived from a study by Kim and Hommel (2015), cannot account on its own for the conformity effects. Two lines of evidence support this claim. First, the pattern of memory conformity differing in magnitude between the reliable and unreliable sources is inconsistent with the low-level hypothesis inasmuch as priming effects should not depend on source reliability. Second, the patterns of metamemory conformity and resistance observed here are not explained by the low-level account, which predicts that conformity effects should only be present in responses that match in format the responses of the external source. The fact that the low-level hypothesis cannot account for the full pattern of results should not be taken to indicate, however, that priming effects played no role in the present paradigm. Indeed, priming still seems well suited to explain the residual memory conformity effect for the unreliable source in the present experiment. Participants explicitly expressed their distrust in the unreliable source by making more 'no points' decisions on trials cued by this source, yet still the pattern of memory decisions revealed the memory conformity effect. The priming mechanism is a good candidate for the account of such a dissociated pattern of memory and metamemory.

The results of the present experiment support the high-level hypothesis formulated with respect to results of Experiments 1 and 2. In these experiments, no effects of external cues on metamemory decisions were observed. We suggested that a resulting dissociation of memory and metamemory effects may be an example of discounting extrinsic cues in metamemory processes (see e.g., Koriat, 1997), by which a cue that affects decisions about a recognition item is not used when making decisions about one's own mental processes. We also suggested that this discounting should not be absolute, and highlighting the reliability of the cues should increase their role in shaping metamemory. This was indeed observed, inasmuch as participants in the present experiment used the same cues for memory and metamemory decisions when they faced cues from a reliable source. More interestingly, a pattern indicating the use of external cues for both memory and metamemory decisions emerged also when cues were provided by the unreliable source. In this case, however, cues were used rather differently across the tasks. They were used to arrive at memory decisions congruent with the cue and at the same time they were used to arrive at metamemory decisions reflecting an opposition to external cues. This discordant pattern provides even stronger evidence for the independence of memory and metamemory processes.

General Discussion

In the present study we described three experiments concerned with the effects of social cues on memory and metamemory decisions. In Experiment 1, we used Jaeger, Lauris, et al.'s, (2012) paradigm for investigating memory conformity in recognition, while giving participants an opportunity to exert metamemory control by responding 'don't know' and thus withholding responses. We observed memory conformity patterns for reliable and unreliable sources in this free-report recognition test, but external cues had no effect on metamemory decisions. The same dissociation was observed in Experiment 2, in which we changed the metamemory task into decisions whether to bet on or refrain from betting on the accuracy of memory responses. Finally, in Experiment 3 we showed that providing participants with feedback regarding the accuracy of their own responses improved participants' ability to discriminate between reliable and unreliable sources. This led participants to conform in their recognition responses more to the reliable than the unreliable source. Also, unlike in the previous experiments, external cues exerted influence on metamemory decisions, increasing the chances participants would bet on their response when the source was reliable but decreasing the chances participants would make such a bet when the source was unreliable. We will now discuss in turn the implications of this research for the study of memory conformity and the relationship between memory and metamemory decisions.

Memory Conformity

Research on memory conformity conducted to date has shown that people readily rely on other people's memory judgments to craft their own memory reports (e.g., Meade & Roediger, 2002; Schneider & Watkins, 1996). The present study constitutes yet another piece of evidence in this long line of research. One of the most important moderators of the memory conformity effect discovered to date is the credibility of the external source. This moderation has been repeatedly shown with different ways of varying credibility, including explicit information on how good the encoding conditions for the external source were (Allan, Midjord, Martin, & Gabbert, 2012; Gabbert, Memon, & Wright, 2007), features of the external source such as age and/or professional status (e.g., Skagerberg & Wright, 2009), or particular expertise of the external source in a given domain (e.g., Horry, Palmer, Sexton, & Brewer, 2012). In this context, it is particularly surprising that the studies by Jaeger, Lauris, et al. (2012) and Numbers et al. (2014) have failed to show moderating effects of source credibility on memory conformity. In these two studies, source credibility was not provided explicitly to participants but instead it could be derived from the responses provided by sources which differed in their overall accuracy. With the exception of Jaeger, Lauris, et al.'s Experiment 2 (in which the accuracy of one of the sources was below chance level), in all other cases the level of memory conformity was the same for sources of clearly different credibility.

There are two reasons why people may fail to tailor their memory conformity to the level of accuracy displayed by an external source. First, people may not be motivated to discern how reliable the source is. Second, they may be unable to extract information about source reliability based only on the source responses and their own memories. The results of the present study firmly support the latter explanation. The combined analysis of the results of Experiments 1 and 2 showed that participants who correctly identified the reliable source at the end of the experiment conformed more to the reliable than to the unreliable source. Experiment 3 showed that when participants are supported with feedback in deriving information about the accuracy of external sources, source credibility reliably moderates the magnitude of memory conformity in the overall results. These results reconcile the two strands of research on the role of conformity by showing that implicit cues about source credibility, if potent enough, have the same effect as more explicit cues.

The facilitative role of feedback in informing participants' memory decisions that was documented in the present study can be seen in light of other research revealing the role of feedback in recognition memory. Although feedback generally does not seem to affect memory accuracy (see e.g., Kantner & Lindsay, 2010), it does affect memory decisions by changing participants' willingness to adjust recognition criteria in response to a change in the features of the tested items. For example, Verde and Rotello (2007) examined how participants adjust their recognition criterion – that is, the overall propensity to respond old versus new – in response to the strength of the tested items. In experiments in which feedback was not provided, participants set a conservative criterion when the test began with a set of strongly rather than weakly encoded items but they did not adjust this criterion when the strength of the tested items changed halfway through the test. This contrasted with the results of their final experiment, in which Verde and Rotello documented a criterion adjustment halfway through the test when feedback was provided. These results show that feedback facilitates dynamic adjustments of the recognition criteria (see also Han & Dobbins, 2008; Rhodes & Jacoby, 2007, for further evidence regarding the role of feedback).

In the present study, we adopted the method of measuring memory conformity effects as a change in recognition criteria induced by cues provided by the external sources (cf. Jaeger, Cox, & Dobbins, 2012; Jaeger, Lauris, et al., 2012; although see Scoboria et al., 2014, for a discussion of an alternative approach, in which context cues are considered to be incorporated into evidence supporting decisions rather than criteria set on the evidence dimension). The fact that feedback facilitated adaptive criterion adjustments in response to different sources of external cues, an effect analogous to the previous research on criteria in recognition memory, strengthens the case for considering memory conformity in recognition as resulting from criterion changes. It is worth noting, however, that research on criterion setting in recognition memory commonly uses feedback throughout the whole test, whereas in our study, feedback was provided only on the first study-test cycle and its effects were considered for cycles in which feedback was no longer included. This raises the question of whether in recognition memory studies feedback may also facilitate criteria adjustments even if it is already withdrawn on the cycles on which these adjustments are assessed. To our knowledge, this possibility has not as yet been tested.

Apart from elucidating the way in which memory conformity is moderated by source credibility, our study revealed that not all types of memory conformity are created equal. In all conditions included in our experiments, participants' memory decisions were influenced at least to some extent by responses provided by an external source, yet this qualitatively similar pattern of memory conformity was accompanied by a whole array of different metamemory patterns. In Experiments 1 and 2, memory conformity was obtained even though external sources failed to affect metamemory decisions. In Experiment 3, memory conformity was accompanied by two different metamemory effects. First, there was concordant metamemory conformity, by which information from the reliable source *increased* the volunteering rate relative to the no-cue baseline. Second, there was metamemory resistance, by which information from the unreliable source *decreased* the volunteering rate relative to the no-cue-baseline. We argue that these patterns should be taken to indicate that there is no one general effect of memory conformity but rather there are several different mechanisms that can lead to the same pattern of memory conformity. Critically, however, these different conformity mechanisms can be isolated with the use of additional measures such as metamemory decisions.

The precise nature of the mechanisms leading to conformity and resistance in recognition tests clearly requires additional experimental work. The mechanisms of memory conformity have often been considered in light of the distinction between informational and normative influence (Deutsch & Gérard, 1955). According to this distinction, people may conform either because they use external cues to inform their judgements and modify their own beliefs or because they simply yield to the group pressure. However, this distinction does not seem particularly well suited to discuss varying patterns of conformity in the basic computerized procedure with artificial external sources, in which the normative component of conformity remains somewhat implausible. We propose a distinction, which is partially overlapping and not mutually exclusive with the distinction of informational and normative influences, according to which the crucial stress should be placed upon the belief component rather than the problem of social pressure (for the role of beliefs in remembering see Mazzoni, Scoboria, & Harvey, 2010; Scoboria et al., 2014; Scoboria, Talarico, & Pascal, 2015). What our study suggests is that different types of conformity can be delineated by considering whether evidence from external cues is internalized, modifying the beliefs, or not internalized, relied upon without belief adjustment.

The mechanisms of internalized conformity are well described by previous research on information influence on people's judgements and decisions. This leaves the question what mechanisms, other than social pressure, can be responsible for non-internalized conformity. We argue here that the priming mechanism described by Kim and Hommel (2015) is a good candidate for describing conformity without the accompanying belief adjustment. Apart from the evidence provided by Kim and Hommel, the priming mechanism is also supported by research documenting inadvertent influence of external cues on one's own responses made in the same format. For example, Parmentier (2008) showed how semantic content of to-be-ignored auditory stimuli – 'up' and 'down' utterances – affect decisions that are made with a response key matching or mismatching these utterances. Clearly, if to-be-ignored cues affect decisions, one can only expect that cues people actively attend to should matter even more. Response priming seems capable of accounting for memory conformity that is not accompanied by metamemory conformity and seems particularly well suited to account for the residual memory conformity accompanied by metamemory resistance. An obvious way for testing this hypothesis is to examine memory conformity effects when external cues do not match participants' format of responding. The problem of match versus mismatch in responding format has already been found to be of fundamental importance in studies on anchoring in decision-making, an effect apparently confined to conditions in which a match between the anchoring information and response options is preserved (Frederick & Mochon, 2012), and we argue that its role for memory conformity should also be examined in future studies.

Whatever the mechanism of non-internalized conformity is, the crucial point of our study lies in showing that metacognitive measures are capable of distinguishing between internalized and non-internalized conformity. We argue that internalized conformity is accompanied by metamemory conformity whereas non-internalized conformity is either not accompanied by any change to metamemory decisions or may even be accompanied by metamemory resistance. Recently, Edelson, Sharot, Dolan, and Dudai (2011) in their study of memory conformity claimed that two manifestations of this phenomenon, to which they referred to as private and public conformity, 'initially convey similar explicit behavior' and 'are often behaviorally indistinguishable'. They argued that the two types of conformity nevertheless manifest themselves with distinct brain signatures, a finding that can be useful in delineating cognitive mechanisms of memory conformity. We argue here that different types of memory conformity can be relatively easily distinguished behaviorally with the use of metacognitive measures, which, given the challenges of conducting advanced brain imaging studies, we consider good news for cognitive researchers.

One final point related to the discussion of memory conformity concerns the consequences of using a computerized procedure in our study. Although external sources were presented as social ones, using the cover story of presenting 'responses of previous participants', the cues were not provided in the context of a face-to-face interaction with another person. A question therefore arises whether our results would generalize to a situation in which external sources were physically present at test. For several reasons, we believe this would be the case. First, the aforementioned studies by Jaeger, Lauris, et al. (2012) and Numbers et al. (2014) produced the same pattern of indiscriminate memory conformity, even though the former employed a computerized procedure, and the latter a direct interaction with a confederate. Second, the related literature on the misinformation effect suggests that both face-to-face interactions and written statements are effective as means of introducing suggestions about an earlier event.[10] Therefore we remain confident that our results are not simply a by-product of presenting external cues outside a direct social interaction.

Nevertheless, we believe that there are strong reasons for applying the methods used in the present study, which constitutes only the first indication of how investigating metamemory aspects of responding in a memory task can enrich our understanding of conformity effects, to paradigms involving social face-to-face interactions. Here we will only briefly outline two issues these further studies could investigate. First, as noted earlier, our computerized procedure most likely limits the contribution of normative influence to participants' behavior. In interactions with another person, for example when a person is subjected to questioning by an interviewer, normative influence can not only shape the person's initial responses but also decisions whether the initial response should be shifted to that provided by the interviewer (e.g., Dukała & Polczyk, 2013; although see Gorassini, Harris, Diamond, & Flynn-Dastoor, 2006, for an example of a computerized procedure producing shifts in participants' responses). It is thus possible that normative influence would be a more potent way to shape the person's other metamemory decisions, such as response volunteering, as compared to informational influence, which, as evidenced in our study, is not always revealed in metamemory decisions.

Second, the present study raises a question of how prevalent non-internalized conformity, expressed in memory but not metamemory decisions, is in various settings. One could hypothesize that such a non-internalized conformity will occur more often in

[10] There is no consensus, though, regarding the relative efficacy of these methods of providing misinformation. For example, some research on the misinformation effect suggests that misleading suggestions might be more readily incorporated into people's memory reports if they are introduced in an interaction with an actual person than if they are introduced in a post-event narrative prepared by the experimenter (e.g., Gabbert et al., 2004; Paterson & Kemp, 2006). However, other studies have shown similar degrees of conformity when misinformation was introduced in a face-to-face interaction and in a written format (e.g., Meade & Roediger, 2002, Experiment 4; Szpitalak, Polak, Polczyk, & Dukała, in press), and some have even found *greater* conformity when a written statement was provided (Blank et al., 2013).

laboratory settings, when participants have very limited knowledge about external sources, than in everyday encounters with other people, when a host of additional factors, including information derived from prior contacts with a particular source (Hope, Ost, Gabbert, Healey, & Lenton, 2008), may bear on people's perceptions of this source. We believe that this particular limitation is not specific to computerized laboratory procedures, such as the one used in the present study or by Jaeger, Lauris, et al. (2012), but applies to laboratory studies involving face-to-face interactions with an unknown person as well (e.g., Numbers et al., 2014). The prevalence and boundary conditions of non-internalized conformity in different social contexts thus require further investigation.

Memory and Metamemory Decisions

The broader theoretical aim of the study was to investigate the relationship between memory and metamemory decisions. As outlined earlier, we assessed the extent to which factors that affect memory decisions affect also metamemory decisions made under the same conditions. Two broad theoretical approaches can be distinguished. The first approach would argue that metamemory is firmly grounded in memory and thus any factor that affects memory decisions should also affect metamemory decisions. According to the second approach, metamemory is to a certain extent independent of memory, and thus factors affecting memory decisions do not necessarily need to be reflected in metamemory decisions. The results of the present study are consistent with the latter approach, documenting that although memory and metamemory decisions can be entangled – as in the case of concordant memory and metamemory conformity – they can also be robustly dissociated – as evidenced by memory conformity without metamemory conformity and memory conformity with metamemory resistance.

A large chunk of research on metamemory is devoted to proving that metamemory and memory can be dissociated. By far the most commonly used paradigm revealing such dissociations is the one used for investigating JOLs – predictions of memory performance at a later point in time. This research has revealed a host of dissociations, prominently featured in the literature on metamemory. It has been suggested, for example, that greater fluency of processing of study items inflates JOLs, even though it has no discernible effect on subsequent memory performance (Rhodes & Castel, 2008; Susser et al., 2014). The dissociations in the opposite direction have also been observed, with factors affecting subsequent memory performance, such as reading words in a normal or inverted form (Sungkhasettee, Friedman, & Castel, 2011), not being reflected in JOLs. Finally, recent research revealed a double-dissociation of JOLs and memory performance, where item generation from auditory cues led to better subsequent performance but lower JOLs compared to hearing items intact (Besken & Mulligan, 2014). All this research seems to indicate that metamemory is largely independent of memory. However, it is also limited by one major factor: the discrepancy between conditions in which metamemory and memory are assessed. It is not theoretically informative that metamemory and memory can be dissociated if they are assessed under vastly differing conditions, with testing differing from study in terms of information available to participants (intact stimuli vs. cues for retrieval), participants' cognitive mode (learning vs. retrieval), spatiotemporal context, and so on. Indeed, given that both memory and metamemory are known to be highly dependent on cues present at their assessment, it would be highly surprising if these two processes remained perfectly correlated despite differences in the available cues.

In our view, the relationship between memory and metamemory can be assessed more meaningfully if the focus is directed toward post-retrieval metamemory processes, such as metacognitive monitoring as assessed by confidence judgments or metacognitive control as assessed by decisions whether to volunteer or withhold answers. Post-retrieval judgments and decisions are commonly collected immediately after a memory decision is made and the conditions for assessment of memory and metamemory are thus virtually identical. In this area of research, dissociations between memory and metamemory are rare. Research on confidence shows that factors affecting memory almost invariably affect also confidence judgments (e.g., Roediger, Wixted, and DeSoto, 2012; but see Busey, Tunnicliff, Loftus, & Loftus, 2000; Hanczakowski, Zawadzka, Jacobi, Beaman, & Jones, 2015; Tulving, 1981, for rare exceptions). Against this background, our study constitutes a rare example of a factor – external social cues – clearly shaping memory decisions, yet, at least under some conditions, having no effect on metamemory decisions. The key element is that the presence of external cues exerts its influence on memory decisions but apparently not on internal evidence supporting this decision – a case of non-internalized conformity. Metamemory decisions are affected by internal evidence supporting memory decisions. However, what we refer to as ‘memory’ decisions are often based on more than just internal evidence: they incorporate as well external information, and in such cases, memetamemory decision that are based on internal evidence may be unaffected.

One theoretical approach that can be easily extended to encompass our results concerning memory and metamemory decisions is the cue-utilization model developed by Koriat (1997). In this model, it is explicitly assumed that a variety of cues are differentially weighted in arriving at memory and metamemory decisions. The most commonly cited example of this unequal weighting is the relative discounting of extrinsic cues in assigning JOLs. Even though extrinsic cues, such as the duration of study or the number of study trials, determine subsequent memory performance, JOLs are relatively insensitive to those cues. From this perspective, our Experiments 1 and 2 serve to extend this basic observation to metamemory decisions. However, in Experiment 3 our study goes further in showing exactly how the role of extrinsic cues depends on information available at the time of making both memory and metamemory decisions. Ultimately, the study serves to demonstrate that memory and metamemory are highly cue-dependent processes, with people using the variety of cues in a flexible manner for different decisions, occasionally producing robust memory-metamemory dissociations.

However, a question remains whether our results cannot be explained by a simpler model. Figure 1 depicts a unidimensional signal detection model with multiple criteria that – as suggested by an anonymous reviewer – could potentially account for our results. In this model, old and new items are normally distributed over an evidence dimension, which ranges from 'certain new' to 'certain old,' with old items having, on average, more evidence for oldness than new items. Recognition memory decisions are based on the location of an item relative to this memory criterion, depicted in the model as a vertical solid line. Items with evidence that is equal to or higher than this criterion elicit an 'old' response, whereas those with evidence below the criterion elicit a 'new' response. In addition to the memory criterion, there are also two metamemory criteria that determine whether a memory response is reported or withheld.[11] These criteria are at the extremes of the dimension and are depicting in Figure 1 as vertical dashed lines. The lower metamemory criterion on the far left determines reporting decisions for 'new' responses, whereas the upper metamemory criterion on the far right determines analogous decisions for 'old' responses. In both cases, items with more extreme evidence are reported, whereas items with less extreme evidence are withheld. If one assumes that that 'new' versus 'old' responses from the external source count as evidence for newness versus oldness, respectively, conformity would be modelled in Figure 1 by relocating a portion of items accordingly. That is, some items would shift to

[11] The same metamemory criteria could be used to determine other metamemory decisions such as whether to bet or pass.

the left if the external source responds ‘new’, whereas some would shift to the right if the source responds ‘old.’

Applying this model to our data can explain some of the dissociations we observed. For example, in Experiments 1 and 2, there was memory conformity in the absence of metamemory conformity. To account for this pattern of results, one might assume that the conformity effect was weak and occurred primarily for withheld items that were associated with low-confidence memory decisions (i.e., items in the middle region of the evidence dimension). Indeed, this is consistent with Jaeger, Lauris, et al.’s (2012) low confidence outsourcing hypothesis. Because the effect of the external source was weak, it could shift some items from a ‘new’ decision to an ‘old’ decision if the source responded ‘old’, or vice versa if the source responded ‘new’, but the effect would not be strong enough to redistribute items over the metamemory criteria. In other words, old/new memory decisions might have been affected (memory conformity), but the extreme location of the metamemory criteria on the evidence dimension meant that metamemory decisions were unaffected by the external source.

Although the simplicity of this model is appealing and it can account for some of our results, other critical results are inconsistent with it. First, the model predicts that memory conformity only occurs for withheld items (i.e., in the region where the memory criterion is located). However, across all three of our experiments, memory conformity occurred for high-confidence recognition judgments as well, regardless of whether high confidence was indicated by volunteering (Experiment 1) or betting (Experiments 2 & 3). However, even more damaging to the unitary dimension model was the finding of metacognitive resistance in Experiment 3. In that experiment, participants given unreliable source information were more likely to withhold items compared to the no-source baseline whilst simultaneously demonstrating some level of memory conformity. The model in Figure 1 cannot reasonably account for this finding. One would have to posit that only items that engendered high-confidence memory responses were affected by how the unreliable source responded (by shifting items from the extremes of the dimension where they would be reported toward the middle region where they were withheld). Although some such high-confidence items might be affected by the reliable source, it is highly unlikely that information from the unreliable source would selectively affect high confidence items while leaving low-confidence responses alone, particularly given that participants in Experiment 3 were conforming less to the unreliable source than the to the reliable one. In our view, metacognitive resistance constitutes the strongest evidence against a signal detection model like that depicted in Figure 1.

Conclusions

In this study we employed a novel approach to investigate how the presence and reliability of social cues influence memory and metamemory decisions. For memory decisions, our main finding lies in demonstrating that low confidence outsourcing (Jaeger, Lauris, et al., 2012) is not limited to cases in which people are required to provide a memory response. We have shown that people can decide to follow cues from an external source even when they can refrain from answering a question, which, in social interactions, is arguably a more common situation than forced report. Our results therefore demonstrate that the range of situations in which people engage in low confidence outsourcing – referred to by Jaeger, Lauris, et al. as an 'ingenious yet simple metacognitive strategy' (p. 111) – is broader than it might be expected. It is worth noting, though, that in certain cases it might be beneficial to refrain from relying on cues coming from other people: for example, eyewitnesses are expected to provide information based on their own memory of the witnessed event. Our finding that it is not possible to eliminate memory conformity by simply indicating that an overt opt out option is available might therefore be of practical importance to police officers or legal practitioners.

Moreover, our results provide a clear demonstration that memory and metamemory decisions in memory tasks are dissociable, and that the pattern of metacognitive decisions cannot be predicted on the basis of memory decisions only. In three experiments, we observed memory conformity accompanied by all three possible patterns of metamemory decisions. In Experiments 1 and 2, memory conformity was not followed by any change in metacognitive responding. In Experiment 3, we documented memory conformity accompanied by an increase in the proportion of reported answers (when cued by the reliable source), as well as memory conformity accompanied by a decrease in the proportion of reported answers (when cued by the unreliable source). This strongly suggests that there is at best only partial overlap between the information that feeds into memory decisions of what the answer to a memory question should be and that which determines metamemory decisions of whether to report or withhold that answer.

Finally, we would like to underscore the practical gains that memory conformity researchers can obtain simply by introducing metamemory decisions into their paradigms. In our study we have shown that internalized and non-internalized memory conformity can be distinguished with metamemory measures such as the rate of ‘don’t know’ responses or the proportion of bets. By our definition, internalized conformity occurs when a person believes that the cues provided by the external source are reliable – as in the case of the reliable source in Experiment 3. Importantly, we demonstrate that a pattern of memory conformity can be observed also when people do not necessarily believe that the cues are reliable. Such a non-internalized conformity can be distinguished from internalized conformity because it is not accompanied by increased response volunteering. Future studies should investigate the conditions under which conformity is likely to be internalized or non-internalized, as well as, given the importance of conformity effects to eyewitness investigations, methods for reducing the impact of both of these phenomena.

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Table 1

Accuracy (d') as a function of the source condition and the subset of analyzed responses in Experiments 1, 2, and 3. Standard deviations are given in parentheses.

	d' all			*d'* volunteered		
Experiment and Source	reliable	unreliable	no source	reliable	unreliable	no source
Experiment 1	-	-	-	1.32 (0.53)	1.20 (0.63)	1.08 (0.67)
Experiment 2	1.30 (0.65)	0.67 (0.50)	0.85 (0.59)	1.90 (1.01)	1.12 (0.95)	1.32 (0.91)
Experiment 3	1.33 (0.60)	0.74 (0.51)	0.81 (0.53)	1.94 (0.95)	1.24 (0.92)	1.32 (0.91)

Table 2

Bias (c) presented as a function of the subset of analyzed responses, source condition and external cue in Experiments 1, 2, and 3. The lower the c value, the greater the propensity to respond 'old'. Standard deviations are given in parentheses.

	c all					*c* volunteered				
		reliable		unreliable			reliable		unreliable	
Experiment, Source, and Cue	uncued	old	new	old	new	uncued	old	new	old	new
Experiment 1	-	-	-	-	-	-0.06 (0.34)	-0.22 (0.36)	0.11 (0.48)	-0.11 (0.41)	0.18 (0.36)
Experiment 2	-0.09 (0.36)	-0.45 (0.65)	0.37 (0.46)	-0.42 (0.64)	0.39 (0.49)	-0.21 (0.50)	-0.75 (0.76)	0.25 (0.62)	-0.58 (0.77)	0.25 (0.67)
Experiment 3	0.07 (0.30)	-0.39 (0.64)	0.39 (0.48)	-0.14 (0.47)	0.19 (0.40)	-0.01 (0.50)	-0.67 (0.52)	0.46 (0.55)	-0.39 (0.68)	0.14 (0.56)

Table 3

The rates of response withholding (i.e., 'don't know' and 'no points' metamemory decisions) as a function of the source in Experiments 1, 2, and 3. Standard deviations are given in parentheses.

	Don't Know			No Points		
Experiment and Source	reliable	unreliable	no source	reliable	unreliable	no source
Experiment 1	0.21 (0.18)	0.21 (0.17)	0.22 (0.16)	-	-	-
Experiment 2	-	-	-	0.34 (0.22)	0.35 (0.22)	0.33 (0.21)
Experiment 3	-	-	-	0.35 (0.21)	0.43 (0.20)	0.40 (0.20)

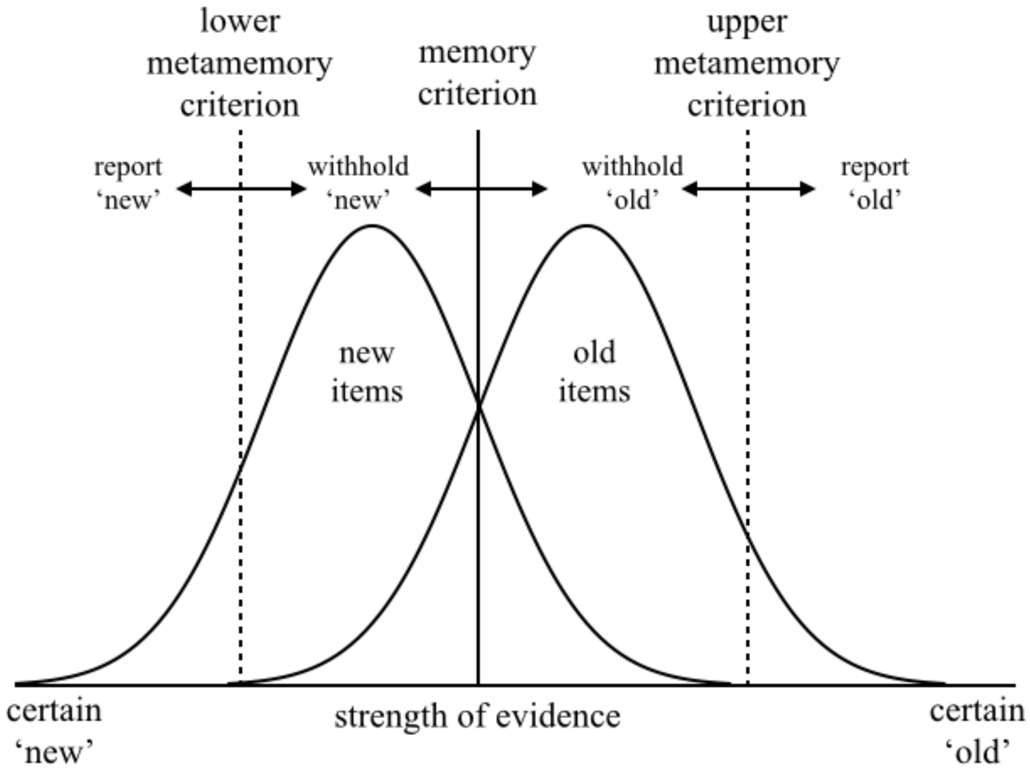

Figure 1. Unidimensional signal detection model with a single memory criterion that determines old/new recognition decisions and two metamemory criteria that determine reporting behavior.