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### Metacognition and the accuracy of retrieval: Integration of new ideas

**Abstract:** *There is a general agreement that remembering depends not only on the memory processes as such but rather that encoding, storage and retrieval are under the constant influence of the overarching, metacognitive processes. Moreover, many interventions designed to improve memory refer in fact to metacognition. Most attempts to integrate the very different theoretical and experimental approaches in this domain focus on encoding, whereas there is relatively little integration of approaches that focus on retrieval. Therefore, we reviewed the studies that used new ideas to improve memory retrieval due to a “metacognitive intervention”. We concluded that whereas single experimental manipulations were not likely to increase metacognitive ability, more extensive interventions were. We proposed possible theoretical perspectives, namely the Source Monitoring Framework, as a means to integrate the two, so far separate, ways of thinking about the role of metacognition in retrieval: the model of strategic regulation of memory, and the research on appraisals in autobiographical memory. We identified venues for future research which could address, among other issues, integration of these perspectives.*

**Keywords:** *metacognition, remembering accuracy and quantity, recollection and belief in autobiographical memory, accuracy appraisals, improving retrieval*

#### Introduction

Many interventions that aim at improving accuracy in memory tasks, whether explicitly or not, refer to metacognitive processes (e.g. attending to the source of information). The idea of relating memory performance to metacognition is in line with a very general idea about human cognition, i.e. that the processing of information involves at least two separate but interrelated levels: the level of basic processes (object-level), and the meta-level. The basic framework for this idea has been provided by Nelson and Narens' theory (1990). The crucial part of their theory is the flow of information between these two levels. Most importantly, they assume that the meta-level modifies the object-level which is called control. To keep the control processes adequate, the meta-level is informed by monitoring processes about any changes in the object-level.

This idea also translates into models of memory. In this sense, remembering is not a simple retrieval of what is (or is not) in memory, but more complex judgement process, the outcome of which depends on both memorial and other, external to the memory system, sources

of information (Nash, Wheeler, & Hope, 2015). This understanding of remembering is in line with Blank's (2009) model of the remembering process. The model assumes that the accessed memory information is subject to conversion processes, first to be translated into memory beliefs, and then into memory statements.

The idea that overarching, more complex processes influence and control more basic ones is definitely not new. Unsurprisingly, there is a considerable number of studies on the role of metacognition in retrieval, including the impact of metacognition on memory performance. Also, many interventions from other research areas, e.g. postwarnings in the misinformation effect literature or interventions in the forensic studies that are aimed at improving memory performance, refer to metacognitive processes. At the same time, according to Blank and Launay (2014, p. 86), “compared to what we know about the ‘hard’ memory processes involved in encoding, storage, and retrieval, we know very little about these ‘soft’ memory conversion processes”. This may stem from the fact that studies, at least partly, use very different approaches. Thus, theoretical and empirical integration is likely to provide valuable insights.

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Such an integration is the main goal of this article. When analysing the existing theoretical proposals and most up-to-date empirical data, our goal will be to answer two questions: (1) through what processes and mechanisms metacognition affects retrieval, (2) how memory accuracy and/or quantity can be improved with metacognitive interventions. Based on these analyses, we will identify and discuss the problems that need to be solved and propose new venues for research.

### **Core assumptions regarding the relationship between metacognition and memory retrieval**

#### **The strategic regulation of memory performance: Monitoring and control**

A significant part of research that has focused on improving memory performance via metacognition referred to Koriat and Goldsmith's (1996) model of strategic regulation of memory by metamemorial processes of monitoring and control. Their model is similar to the model of Nelson and Narens (1990) that was described in the first paragraph. However, whereas Nelson and Narens' model is relatively general and refers to various aspects of human cognition, the model proposed by Koriat and Goldsmith is focused on retrieval and is more applicable to remembering events (Niedzwieńska, 2004a). In the real-life situations, a significant part of the remembering process is individual's control over volunteering (or not) each piece of information, including details connected to it. This control is highly influenced by situational characteristics, such as incentives to be accurate or potential costs of making a mistake (Koriat & Goldsmith, 1996). As different contexts require different levels of accuracy, such strategic regulation of remembering plays a major role in making memory a useful system when situational demands change. The control processes are influenced not only by external information, like situational characteristics and functional incentives, but also by another metamemory process, i.e. monitoring. The monitoring mechanism is used "to subjectively assess the correctness of potential memory responses" (Koriat & Goldsmith, 1996, p. 493). This assessment strongly contributes to strategic control, as only when the assessed probability that the piece of information is correct is higher than the criterion of probability assumed as necessary, the response will be provided. Importantly, the authors claim that while memory accuracy is under strategic control, memory quantity is not: incentives affect accuracy performance, but not quantity performance.

The crucial question of this paper is how exactly metacognition influences memory accuracy. According to Koriat and Goldsmith's framework (1996), the accuracy of retrieval largely depends on the monitoring effectiveness (monitoring resolution). As the monitoring process serves to assess if (and with what probability) a particular candidate answer is correct, monitoring resolution describes the extent to which this assessment is correct, which is a sort of monitoring ability. The general rule is that as monitoring resolution increases, the improvement in accuracy can

be gained with smaller costs in quantity. Therefore, if resolution was perfect, no quantity-accuracy trade-off would be observable. Some level of monitoring resolution is essential as otherwise the exercise of strategic regulation would be useless or even detrimental (Koriat & Goldsmith, 1996). Apart from monitoring effectiveness, memory performance strongly depends on control sensitivity, i.e. the level to which the control process (withholding vs volunteering an answer) responds to the monitoring output.

#### **Metamemory appraisals in autobiographical memory**

Another, more recent idea on how metacognition influences retrieval stems from autobiographical memory research and is not strictly related to accuracy. Various metacognitive appraisals contribute to the remembering process (Otgaar, Scoboria, & Mazzoni, 2017). Scoboria, Talarico and Pascal (2015) have found that recollection of the event, belief in its occurrence and belief in the accuracy of the recollection are distinct aspects of remembering episodes. When participants rated recalled events on various characteristics, structural equation modelling revealed that variance in ratings was best explained by these three latent variables. The findings were replicated in the second study in which confirmatory modelling techniques were used. The distinction between autobiographical recollections and autobiographical beliefs has also been present in previous research and theorising (e.g. Mazzoni & Kirsch, 2002; Scoboria, Jackson, Talarico, Hanczakowski, Wysman, & Mazzoni, 2014).

Many researchers (e.g. Otgaar et al., 2017; Scoboria et al., 2015) argue that the distinction between recollection and autobiographical belief has been much overlooked and that they have often been confounded in memory research. This confusion may result from the fact that research, both using cued- and spontaneous recall, typically elicits events which are both vividly recollected and strongly believed (Scoboria & Talarico, 2013). However, this is only one of many possible combinations of these two constructs (Otgaar et al., 2017).

Another reason for this confusion is the counter-intuitiveness of the notion that the recollection and belief are separate constructs that do not necessarily co-vary. However, in most cases, recollections resemble reality and therefore some default reliance on the recollection is adaptive. This is well described in Blank's (2017) theoretical proposal, in which recollection is "a raw output of the memory system" (p. 869) and has to be "reality checked" before it becomes a believed memory. Both recollection and the sources of information that are external to the memory system (e.g. knowledge about event's plausibility) contribute to building one's memories, i.e. they contribute to the validation process. The validation process may be executed in an automatic, heuristic way (System 1-type) or it may involve more elaborate, effortful way of information processing and decision making (System 2-type). This distinction corresponds to the difference between the two systems of thinking that was introduced by Kahneman (2011). In most cases, the "rule"

is to just rely on recollections and the automatic reality checking. However, more extensive reality checking that involves elaborate and effortful processing is sometimes required. Whether recollections will be transformed into memory beliefs through System 1-type or System 2-type processing depends on three main factors.

The first one is the quality of recollections. Scoboria et al. (2015) have found that event's plausibility predicts belief in its occurrence more strongly for uncertain events, which is consistent with their more general argument that autobiographical belief is more likely to be derived directly from recollection if the recollection is strong and clear. In contrast, when recollection is vague and perceived as unreliable, other sources of information become more significant and the divergences between recollections and beliefs are more likely to occur. However, Scoboria et al. (2014a) argue that the degree of correspondence between the dimensions of recollection and belief in occurrence is not strong even for strongly recollected, believed memories. This suggests that the decision whether the event took place cannot be based on the recollection alone.

The second factor is the availability of resources. When resources are low, relying on one's recollection accompanied by only superficial reality check is more likely to be chosen. The third factor that influences the choice of strategy is the representation of the situation, i.e. "how much is at stake". When accuracy is vital and the costs of making a mistake are high, the more extensive, System 2-type validation is more adequate (Blank, 2017). This last factor is well illustrated in the case study of a person who clearly changed his public narrative of the event in which he had participated a decade before (Rechdan, Sauerland, Hope, & Ost, 2016). The story was repeated many times, and when the final distorted report was given, not only many years had passed from the original event, but also the report was given at the night show. That circumstance most likely shifted the criterion towards entertainment rather than accuracy, and boosted the role of such mechanisms as audience tuning, bringing the Self closer to the action or confounding the own account with that of other people. A more thorough and systematic way of validation would have probably been chosen if the aim of re-telling the story was not to entertain, but to be as accurate as possible (Rechdan et al., 2016).

### **Accuracy regulation**

The relationship between the validation process in autobiographical memory and memory performance is less clear, compared to Koriat's and Goldsmith's framework (1996), and there is hardly any research in which the predictions presented in the previous paragraph have been tested. This perspective, in spite of the interest it has aroused, currently does not explain how different sources of evidence are weighted and combined (Scoboria et al., 2014a). Yet, the perspective differs substantially from the understanding of the context information that has been proposed in the misinformation effect studies or false memories studies (e.g. McCloskey &

Zaragoza, 1985; Mazzoni, Loftus, & Kirsch, 2001), in which the context information is simply incorrect and presented to mislead a participant. In contrast, Scoboria and colleagues argue (2014a, p. 36) that the context information is a complementary source, which can serve to enhance memory performance: "non-memorial, belief-like information is often used for the better to inform recognition judgments, particularly in situations in which memory is absent or fails". In other words, the best accuracy is not to be gained due to constant relying on recollection only, but rather due to using information from both recollection and context for the better. This way, the judgements of accuracy and decisions about the occurrence of an event or specific details, which represent the final step in any memory task (Scoboria et al., 2014a), are those aspects of memory monitoring that are used together with recollection to arrive at beliefs about the past. By analogy to the strategic regulation of memory model (Koriat & Goldsmith, 1996), we assume that these monitoring processes can be better or worse calibrated and, regardless of calibration, have better or worse resolution. Depending on these characteristics, monitoring processes can be beneficial or detrimental for accuracy of translating recollections into believed memories.

The basic assumption is that just as the exercise of strategic control can be more or less present in the situation of retrieval, autobiographical memories are sometimes "directly accessed, and sometimes they are more generative" (Ost, Scoboria, Grant, & Pankhurst, 2016, p. 43). Accordingly, just like the exercise of strategic control in the conditions of poor monitoring resolution is likely to reduce quantity without increasing accuracy, the monitoring processes in autobiographical memory can also sometimes hinder retrieval and lead to worse results, compared to relying simply on recollection (Scoboria et al., 2014a). Similarly, as in the conditions of good resolution the exercise of strategic control improves performance, the monitoring processes in autobiographical memory (e.g. considering social input, weighing evidence about the past) can lead to better memory performance, compared to relying simply on recollection. However, it is worth stressing that, generally, the exercise of strategic control does improve accuracy; the accuracy is higher in the conditions of free recall compared to the conditions of forced recall, as the latter makes the strategic control impossible (Koriat & Goldsmith, 1996). The strategic control in autobiographical memory also includes encouraging (and sometimes enabling) the "I don't know" responses as well as other methods of regulating the memory report, such as changing grain size. The research suggests that witnesses may not spontaneously engage in strategic control by, for instance, changing grain size for "coarser", unless they are told that they can or are required to do so (Goldsmith, Pansky, & Koriat, 2014). Promoting the "don't know" or "haven't seen that" responses is widely known to enhance the quality of memory report (Scoboria & Fisico, 2013; Scoboria, Memon, Trang, & Frey, 2014b).

### In search of theoretical integration

Both perspectives outlined above argue that decision processes play an important role in retrieval, and that retrieving items from memory (or recollecting events) and deciding about their source arise from distinct processes.

The ideas from metamemory research about setting response criterion (e.g. Koriat & Goldsmith, 1996), and ideas of more or less extensive validation processes (System 1-type vs System 2-type) that have been proposed in the autobiographical memory literature (e.g. Blank, 2017) are in many ways consistent with the source monitoring framework (SMF). Therefore, SMF may serve as a common ground for these two perspectives.

The SMF (Johnson, Hashtroudi, & Lindsay, 1993; Lindsay, 2008) derives from the theory of persuasion and attitude change, i.e. the Heuristic-Systematic Model (Chaiken, 1980) which is based on the general principle that people can make attributional judgements either heuristically or systematically (Nash, Wheeler, & Hope, 2015). The SMF assumes that the continuum of these two ways of processing provides a choice of strategy for deciding whether particular mental experience is a memory or not. The heuristic way of processing is rapid and requires less resources, whereas the systematic way is effortful and analytic. Importantly, the very choice of the strategy is influenced by the set of motivational and social factors. One of these factors is the rememberer's current orientation either to (1) volunteer only accurate information and report only those aspects of the event which truly took place, or, for example, (2) entertain, or be as informative as possible, even at the cost of making a mistake (Lindsay, 2006). This is very much in line with the idea of the control mechanism, i.e. setting the criterion, according to which the decision about volunteering a candidate answer is made.

The key question in the SMF is thus the origin of mental experiences; whether they come from perception of the event/information (i.e. are real memories) or originate from other sources (e.g. imagination, other events, information from other people) (Nash et al., 2015). In autobiographical memory research, the key process is the reality checking which involves accepting a particular recollection as a belief about the past or rejecting it as not being a real memory. These two processes (deciding about the origin of mental experience and reality check) have similar assumptions and thus correspond to each other. Working of the motivational factors in the SMF is likely to be mediated by the mechanisms of control that are based on setting the control criterion, and informed by monitoring processes, as proposed by Koriat and Goldsmith's theory (1996).

The compatibility of the SMF and the validity processes in autobiographical memory is even more visible when the reality monitoring framework (Johnson & Raye, 1981) is taken into consideration. Reality monitoring framework is a now classic theory which preceded the SMF. Reality monitoring refers to "the processes by which a person attributes a memory to an external or an internal source" (p. 67). The authors acknowledge that the memories of thoughts

are as "real" as those coming from perception. For example, both types of remembered information have a potential to direct human behaviour (Johnson & Raye, 1981). However, in the language of the reality monitoring model, "real" refers to the external to one's "mind" (Johnson & Raye, 1981).

The general premise of the reality monitoring framework is the same as the general idea of the reality checking model that was proposed by Blank (2017). That is that the content of our cognition (e.g. a thought, something that feels like memory) is attributed to one's personal past due to a decision processes, and not just by virtue of appearing in one's mind. However, the Blank's idea is mostly focused on the judgements of plausibility and the interpretation of social information (e.g. accepting others' memories as a credible source of knowledge about the past), whereas the reality monitoring model puts more emphasis on the characteristics of mental contents. For example, memories coming from the external sources have more spatial, perceptual and temporal characteristics encoded in the structure of representation than those of the internal origin (Johnson & Raye, 1981; Johnson, Foley, Suengas, & Raye, 1989). Garrison and colleagues (Garrison, Bond, Gibbard, Johnson, & Simons, 2017, p. 109) summarize this difference in the following way: "Memory traces of perceived information and imagined events are different on average, with greater cognitive operations content for self-generated information and greater sensory and contextual detail in memories of perceived information". Johnson and colleagues (Johnson & Raye, 1981; Johnson & Raye, 2000; Garrison et al., 2017) acknowledge that other types of information that are related to more deliberate processes of considering knowledge about the past and external evidence also play a role in the attribution process, but the qualities of mental contents are the key component.

The models that distinguish autobiographical belief and recollection usually also name the third aspect of autobiographical remembering, i.e. belief in accuracy. Scoboria, Talarico and Pascal (2015) argue that, at least in some ways, confidence ratings as the outcome of monitoring and beliefs in accuracy appraisals are conceptual relatives. However, the authors claim (p. 346) that the relationship between "confidence in individual event details (measured in much of the work on memory and metacognition) and overarching accuracy appraisals for whole events are unknown at this time".

### How to improve retrieval accuracy and/or quantity via metacognitive cues: New ideas

The key assumption about the relationship between metacognition and memory performance is straightforward: more accurate metacognition leads to better memory performance. As mentioned in the previous section, strategic regulation of memory became a useful framework for further exploration. Apart from monitoring resolution described above, another index of the quality of monitoring processes can be calculated, i.e. calibration. Calibration is the measure of absolute correspondence between assessed

probabilities and proportions correct. Good calibration is not automatically accompanied by good resolution. For example, the assessment of .50 subjective correctness, when accompanied by .50 actual correctness, means perfect calibration. But only the index of monitoring resolution provides the information about how effectively the person distinguished between correct and incorrect responses among the total of correct and incorrect answers.

### **Reducing overconfidence**

In their seminal work (1996), Koriat and Goldsmith have noticed that monitoring processes are usually well calibrated but people often tend to be overconfident. Indeed, research shows that people are overconfident not only in memory and knowledge, but also in relation to many other abilities such as time needed to complete an academic assignment (Buehler, Griffin, & Ross, 1995) or dating popularity (Preuss & Alicke, 2009). Thus, reducing overconfidence seems a reasonable way of enhancing the accuracy of metacognition.

This was investigated by Miller and Geraci (2014). They found that failing to report practice items decreased the participants' predictions of performance for the target questions. Those who experienced a "proper dose" of retrieval failure were thus more accurate; their predictions were more like their actual recall performance. It is noteworthy that the experience of failure does not always lead to better metacognitive accuracy. For example, the prior exam performance was not sufficiently used by the school students to adjust their performance predictions and they remained overconfident irrespectively of the exams results (Foster, Was, Dunlosky, & Isaacson, 2016). Though the nature of overconfidence in episodic and autobiographical memory is unclear, when we take into consideration that the witnesses do not usually regulate their memory spontaneously (see the second section), it is vital to provide and encourage "linguistic opt-outs", i.e. the option not to answer the questions if the answer is unknown (Ost et al., 2016).

### **Affecting the relative retrieval fluency**

A similar idea was implemented by Pansky and Goldsmith (2014). They focused on the metacognitive cue, namely the relative retrieval fluency that is defined as "the relative ease or difficulty of answering questions from memory" (Pansky & Goldsmith, 2014, p. 1255). The "relative" means that the discrepancy between the expected and actual fluency is of particular importance (Portnoy & Pansky, 2016). This cue is used as a heuristic in remembering and serves to evaluate the accuracy of a particular piece of information. The prediction was that the relative retrieval fluency would affect monitoring and control processes and thus influence decision whether to give an answer to the question or not (Pansky & Goldsmith, 2014). Indeed, they found that presenting the initial set of difficult questions to the participants resulted in the higher confidence held for the target questions, which translated into the higher rate of reported answers. What is more, this gain in memory quantity for the free-report tasks had no costs in accuracy.

The study by Pansky and Goldsmith (2014), in which semantic material was used, was then replicated to check their predictions on episodes (Portnoy & Pansky, 2016). The results of the two studies were similar: when preceded by the difficult initial questions, answers to the target questions concerning the event were rated with more confidence and thus more frequently volunteered. In neither experiment, the relative fluency influenced the ability to answer the set of target questions; unlike the free-report performance, forced-report performance was not influenced by the initial questions. This confirms the view that strategic control of memory is exercised only under free-report conditions (Koriat & Goldsmith, 1996). Another way of improving the overall memory performance is the moderation of accuracy incentive. The research (e.g. Koriat & Goldsmith, 1996) shows that very high incentive for accuracy (e.g. loss of all the monetary bonuses won so far due to any incorrect answer given) provides gain in accuracy, but leads to substantial quantity costs, while the moderate-incentive conditions are much more "profitable" in the sense of quantity-accuracy trade off.

### **The metamemory training procedures**

Scoboria, Memon, Trang and Frey (2014) used a procedure that was aimed at improving metacognitive accuracy and enhancing responding to questions. The training procedure was based on research on memory and metacognition and involved the set of prompts that had been previously identified as having the potential to improve responding. For example, based on the source monitoring framework, the training involved attending to the source from which the retrieved information came from. Based on the finding that people sometimes respond to the questions they do not in fact understand, or even entirely meaningless ones, another prompt was to attend to the features of the question. Other prompts encouraged the participants to search memory thoughtfully and thoroughly, weigh confidence and select the best possible answer rather than rely on automatic responses. This training procedure proved to be effective, i.e. it enhanced responding to the questions about a witnessed event. More specifically, the trained group correctly rejected more unanswerable questions (questions about the information that was not present in the witnessed event and thus cannot be answered correctly) compared to the control group. Moreover, this happened with no cost in the number of attempted questions. Also accuracy, measured as the ratio of correct responses to questions answered, was higher in the trained group. The second experiment was conducted to rule out the explanation that the more frequent rejection of responding to unanswerable questions was the effect of sheer awareness that the set of questions might have included unanswerable ones. Indeed, when participants received the information that: "it is possible that some of the questions that I ask may not have an answer" (Scoboria, Memon, Trang, & Frey, 2014, p. 213), the warned group simply responded to fewer questions compared to the control group, with no improvement in accuracy.

The interventions to improve metacognitive accuracy presented above were confined to a short period of

time and their effects were measured immediately after the intervention. It is possible, though, that the change caused by a single experimental manipulation and observed immediately after that, may not stem from the same mechanisms as the change caused by a long-term manipulation. Such a manipulation was used by Niedzwińska (2004b). The aim of the study was to explore whether participation in a 30-hour course on autobiographical memory, and thus exposure to scientific-based beliefs about memory and a gain in metamemory knowledge, would influence participants' recollections of personal events. More specifically, if the participants provided with metamemory knowledge would be more accurate in their subsequent recalls than those who did not receive a training.

In the recollections of both groups, a large number of new elements was introduced in the second recall of a personal event, which were not present in the first recall. Participation in the course between the first and the second recall did not influence the number of new elements, but this variable cannot be classified as the memory distortion measure. The change of context of retrieval may account for this result. In fact, research shows that different elements may constitute the reports of the same event given in different contexts, and yet the accuracy of these reports will be similar (e.g. Drivdahl & Hyman, 2014).

However, the participants who experienced the training committed significantly fewer overt errors, which was the "proper" memory distortion measure based on the number of details given in the second recall that contradicted the information given by the participant in the first recall. What is more, this difference did not result from changing grain size (how general or specific the answers to the questions were), changing the length of the answers or skipping some questions. Not only their accuracy was better, but also a rise in quantity due to participation in the course was observed.

### The cognitive interview procedures

A cognitive interview (Geiselman, Fisher, McKinnon, & Holland, 1986) represents a different category of interventions that aim at enhancing memory performance. It was based on the research and theory of cognitive psychology and developed to address the problem of little structure and training in police interviewing (Fisher & Geiselman, 1992). The cognitive interview is based on four general ideas to improve retrieval (Geiselman et al., 1986): (1) mental reinstatement of the event's context (both personal and environmental), (2) encouragement to report everything, regardless of the perceived importance, (3) reporting the events in changed order, and (4) reporting the events from different perspectives. Changing of order and perspectives was designed to promote using many retrieval paths. If information cannot be accessed via one path, it is still possible that it can be accessed via another (Tulving, 1974). The incentive to report everything may be beneficial both due to the fact that some witnesses may not now which piece of information is important, and because the retrieval of details that are irrelevant may support the retrieval of other pieces of information (Geiselman et al., 1986).

As a cognitive interview was designed in the applied context, its aim is not only to boost the memory performance of a witness, but also to contribute to the witness' well-being (Fisher & Geiselman, 2010). For the present purposes, the crucial question is the influence of the method on the accuracy and quantity of a memory report.

Some studies suggest that a cognitive interview, compared to a standard interview, allows to obtain more comprehensive report, and the increase in the number of correct details is not accompanied by costs in accuracy (Geiselman et al., 1986; Dukala, Sporer, & Polczyk, 2018). Fisher and Geiselman (2017) argue that the typical finding in the studies that tested the efficacy of cognitive interview is the increase of 35–50% in the number of reported details (compared to the control, police interview), with the accuracy rate, as measured by the percentage of correct responses, being "either the same or slightly higher for the *CI* than the control, police interview" (p. 454). To our knowledge, there have been two meta-analyses on the effects of the cognitive interview procedure for the accuracy and quantity of memory reports (Kohnken, Milne, Memon, & Bull, 1999; Memon, Meissner, & Fraser, 2010). The results of the first meta-analysis (Kohnken et al., 1999) indicate that, generally, the cognitive interview procedure resulted in an increase in recall of correct details, with accompanying (considerably smaller) increase in incorrect details. The second meta-analysis (Memon et al., 2010) replicated the results that had been found a decade earlier; the increase in the amount of correct information was accompanied by a smaller increase in erroneous information reported.

Importantly, the increase in the recall of erroneous information after the cognitive interview procedure was not related to the decrease in overall accuracy: "In both the original and current meta-analysis we noted a small increase in the recall of erroneous details. The 1999 meta-analysis indicated an increase in output was not accompanied by a drop in accuracy. The current meta-analysis which included a subset of studies that reported accuracy rates concludes the same." (Memon et al., 2010, p. 357). In this way, the results of the two meta-analyses (Kohnken et al., 1999; Memon et al., 2010) are consistent with what Fisher and Geiselman (2017) report about the influence of the cognitive interview on the general accuracy and quantity of memory reports. Another important aspect of research on the cognitive interview is that its effects on memory were also found in a criminal setting (Fisher, Geiselman, & Amador, 1989).

### Mechanisms underlying the actual improvement in memory performance

#### Is it possible to enhance resolution?

The results obtained in the study by Niedzwińska (2004b) suggest that the observed improvement in memory performance may have stemmed from better monitoring resolution: the experimental manipulation resulted in the rise of both accuracy and quantity. The improvement of accuracy with no costs in quantity is the pattern of results

which Koriat and Goldsmith (1996) attribute to very good monitoring effectiveness.

More effective monitoring is also a possible explanation of the improved quantity performance in the study by Niedzwieska (2004b): items which were correctly remembered were held more confidently by the participants who had attended the course (so their monitoring accuracy was better compared to the control group), and thus were more likely to be volunteered (or volunteered at a greater level of specificity) in comparison with the answers of the participants who had not attended the course.

The improvement in quantity due to experimental manipulation was also observed in the studies with the relative retrieval fluency manipulation (Pansky & Goldsmith, 2014; Portnoy & Pansky, 2016). As described previously, participants who were given the difficult test questions at the beginning, were later more confident about their answers and thus achieved higher quantity compared to the participants who were solving the easy question test. Interestingly, this improvement in quantity was not accompanied by costs in accuracy. Portnoy and Pansky (2016) investigated possible mechanisms of this pattern of results. They found that it was not due to the difference in monitoring effectiveness between the groups whose tests differed in initial difficulty. In fact, the difference in confidence ratings for correct and incorrect answers was comparable across both groups. However, they found that monitoring resolution in the medium confidence range (confidence ratings between .5 and .8) was very poor in both groups: “confidence judgements in this range did not significantly discriminate between correct answers (.63) and incorrect answers (.60)” (Portnoy & Pansky, 2016, p. 163). Consistent with Koriat’s and Goldsmith’s reasoning (1996), in the conditions of lacking monitoring effectiveness the exercise of strategic control is not likely to enhance accuracy, but still leads to reduced quantity. Therefore, it seems that the experimental manipulation did not affect monitoring effectiveness in Portnoy and Pansky’s study.

Miller and Geraci (2014, p. 132), after reviewing a considerable set of data on the attempts to improve metacognitive accuracy (e.g. Thiede et al., 2003; Miller & Geraci, 2011), have concluded that “while a few of these attempts have been modestly successful at improving metacognitive monitoring accuracy, the general theme of this research is that metacognitive ability is highly resistant to change”. At the same time, the experimental manipulation that they used (Miller & Geraci, 2014) improved metacognitive accuracy; experiencing retrieval failure reduced overconfidence and made participants more accurate in their performance predictions compared to the group that did not experience retrieval failure. However, the fact that from some point the retrieval failure reduced participants confidence too much (made their predictions of performance less accurate) suggests that although exposure to retrieval practice failure may serve to reduce overconfidence, it is definitely not a universal tool for improving metacognitive accuracy. The possible

mechanism is perhaps more like changing temporal mind-set rather than increasing metacognitive ability.

It remains unclear whether monitoring effectiveness as such can be influenced by an experimental manipulation. The results gathered and analysed above suggest that a single experimental manipulation is not likely to improve monitoring effectiveness, but the results obtained after a long-term course (Niedzwieska, 2004b) suggest improvement in monitoring effectiveness. It seems reasonable to suggest that improving monitoring effectiveness requires more extensive, and perhaps long-term interventions, that allow the participants not only to gain metamemory knowledge, but also to change beliefs about the accuracy of their own’s recollections, especially vivid ones. It is worth noting that the improvement in monitoring resolution is inferred here only on the basis of the patterns of results and their interpretation that comes from Koriat and Goldsmith’s (1996) model. More certain knowledge concerning these mechanisms could be obtained by measuring confidence and matching it with the actual correctness for each question (see Higham, Luna, & Bloomfield, 2011, for application of this methodology in the misinformation effect paradigm). To our best knowledge, there are no studies that focused on improving memory performance and directly measured resolution in this way.

In the study by Scoboria et al. (2014b), participants’ accuracy was improved after the retrieval training related to various aspects of metacognition (participants correctly rejected more unanswerable questions). As the authors emphasize: “gains for responding to unanswerable questions occurred at no cost to the quality of responses made to answerable questions” (p. 213). The pattern of results suggests again that metacognitive accuracy was improved in the trained group. Importantly, the training was extensive and referred to various aspects of metacognition and memory.

### **Control decisions and adequacy**

As we indicated in the second section, memory performance is largely dependent on monitoring effectiveness, but also on the mechanisms of control. One of the factors influencing control processes is the knowledge whether volunteered responses will remain private or will become public. McCallum, Brewer and Weber (2016) found that when aware that their answers would not be individually identifiable, participants volunteered more fine-grain responses. The possible explanation of this relationship is that when the answers remain private there is no possibility of negative consequences (e.g. negative judgement). The authors confirmed that the possibility of negative consequences mediated the change in control processes. When monetary incentives were introduced (Experiment 2), participants who were told that they would not be penalised for inaccurate reporting were also more likely to volunteer fine-grain responses. In short, participants presented effective monitoring across both experiments, but their control decisions were affected by the potential negative consequences of providing the wrong answer.

Several examples from the literature support the idea that metamemory processes can be influenced by conditions at encoding (e.g. Pansky et al., 2009; Sauer & Hope, 2016). Encoding in the conditions of divided attention impaired monitoring processes compared to encoding in the conditions of full attention (Pansky et al., 2009). However, these results were not supported in the study by Sauer and Hope (2016). They found that encoding in the conditions of divided attention did not impair monitoring resolution; participants were less accurate in fine-grain responses, compared to the participants in the full attention condition, but rated their fine-grain responses with lower confidence. Interestingly, accuracy in the divided attention condition was reduced even though participants provided fewer fine-grain details in this condition. The authors found that the participants had enough knowledge about their accuracy, but they chose to sacrifice accuracy for quantity. Their metacognitive control-related decisions can thus account for the pattern of results obtained (for the detailed differences between the two studies see Sauer and Hope, 2016, p. 152).

The studies reviewed above indicate that metamemory processes (control processes, and presumably also monitoring processes) can be influenced by the interventions that are focused on improvement of retrieval and/or metacognitive accuracy, but also by other factors such as conditions at encoding or a possibility for negative consequences. As remembering does not occur in social vacuum, the reactions of other people (either real or implied) are also likely to influence metamemory processes. Findings on memory conformity (e.g. Wright, Mathews, & Skagerberg, 2005; Allan, Midjord, Martin, & Gabbert, 2012) demonstrate that people estimate how well certain information is remembered when deciding whether to conform to the information given by others. The term “memory conformity” is used to describe the situation in which two people witness the same event and talk about it, and the information introduced by one person influences the other person’s memory report (Gabbert, Memon, & Wright, 2006). The subject of research on memory conformity is “how information provided by other people affects the contents of a memory report” (Zawadzka, Krogulska, Button, Higham, & Hanczakowski, 2015, p. 2). If the effect of monitoring processes (“how well I remember”) influences decisions about whether to conform, another question is whether the metamemory processes (monitoring or control) can be influenced by the information that is provided by other people. The relationship between social feedback and metacognitive processes was explored by Rechdan and colleagues (Rechdan, Sauer, Hope, Sauerland, Ost, & Merckelbach, 2017; Rechdan, Hope, Sauer, Sauerland, Ost, & Merckelbach, 2018). In the first study (2017), they hypothesized that social comparative feedback (positive, negative, or none) that was presented during completing a computer task, would influence participants’ metacognitive monitoring and control processes, and, subsequently, their memory reports. Social comparative feedback was presented as the test percentile that indicated an overall accuracy of a co-witness in the test concerning

the witnessed event (a video). In fact, all scores were fabricated by the experimenter and the participants received either the information that a co-witness performed very accurately, or very poorly. However, social comparisons did not affect the metacognitive appraisals. The authors reasoned that social feedback that is indirectly encountered (i.e. via computer task) may not be as effective as direct feedback. The effect of a co-witness discussion on the grain-size and confidence of memory reports was then explored (Rechdan et al., 2018). A confederate either agreed or disagreed with participants’ answers about the video; the control group had no feedback at all. Participants in the disconfirming condition gave fewer fine-grain responses. This was not accompanied by a decrease in participants’ confidence ratings in relation to these responses, though. As the authors (Rechdan et al., 2018, p. 6) conclude, “social feedback manipulation had an effect on participants’ metacognitive control decisions (grain-size volunteering), but no effect on their metacognitive monitoring (as reflected by subjective confidence)”. None of the manipulations used (Rechdan et al., 2017; 2018) had an effect on monitoring resolution.

In sum, there are various ways of improving memory performance that are based on very different techniques and thus, presumably, underlain by different metacognitive mechanisms. We described interventions based on a single mechanism: (1) improving metacognitive accuracy via reducing overconfidence due to experiencing the retrieval practice failure, (2) getting the most of quantity-accuracy trade-off by moderating the incentive for accuracy, (3) increasing quantity with no costs for accuracy due to the enhanced relative retrieval fluency in the conditions of poor monitoring resolution (for the medium confidence range items). These interventions were successful in improving memory performance, but, as we argued above, they were not likely to generally improve monitoring resolution or control sensitivity. The underlying mechanisms, such as reducing overconfidence, changing the control criterion, and affecting relative retrieval fluency, may be best understood as changing the temporal mind-set, rather than improving metacognitive ability. To investigate this issue further, we analysed the results of the studies on the factors potentially influencing the processes of monitoring and control. What we found is that neither conditions at encoding (Sauer & Hope, 2016), nor social feedback (Rechdan et al., 2017; 2018) influenced monitoring resolution or control sensitivity. Therefore, we conclude that although the control decisions are naturally influenced by situational factors, such as incentives to be accurate (e.g. Koriat & Goldsmith, 1996), or the possibility of negative consequences (e.g. McCallum, Brewer, & Weber, 2016), the control sensitivity and monitoring resolution are not.

These data lend additional support to the idea that monitoring ability is resistant to change. It appears, though, that extensive or long-term interventions may lead to changes in metacognitive ability. As we argued above, the patterns of results of the studies by Niedzwińska (2004b) and Scoboria et al. (2014b) imply that the interventions they used did influence metacognitive ability.

However, both studies included quite complex interventions. In the first study, the subjects participated in the course on autobiographical memory (30 hours over the course of a few months), which presumably influenced their metamemorial awareness via considerable extension of their knowledge about memory. The second study used the extensive training procedure that was based on scientific research and affected various aspects of metacognition.

To conclude, various factors may lead to improved retrieval, but only some of them involve the genuine improvement of metacognitive ability. In the two studies discussed above (Niedzwieska, 2004b; Scoboria et al., 2014b), monitoring resolution was not measured directly. However, the patterns of results suggest that the change in the memory performance was due to the improved monitoring resolution. At the same time, in the real-life situations, like the eyewitness recall, we are hardly interested in anything more than whether we can obtain improved accuracy with no costs in quantity or vice versa.

### Suggestions for future research

#### Problems to solve

##### *The validation process and memory accuracy*

In the second section we discussed various metacognitive judgements (belief in the event's occurrence and the recollection's accuracy) that contribute to and influence the process of remembering. A considerable set of data confirms that the processes of recollection and belief (e.g. Scoboria et al., 2014a), and judgements of accuracy and recollection (Scoboria & Pascal, 2016) are separate and stem from distinct underlying mechanisms. Not only are these processes separate, but also the judgements of occurrence and accuracy may act as control factors that are external to the memory system but contribute to remembering in the process of validation/reality check (Blank, 2017). However, *it remains unclear, how this process of validation, i.e. transforming recollection into believed memory, influences memory accuracy*. Blank's (2017) theoretical proposal of the two validation systems, i.e. System 1-type (heuristic, automatic) versus System 2-type (elaborate), defines the system 2-type processing as more reliable, and, at the same time, consuming more resources. It may suggest that when one moves toward more elaborate processing (different strategies are not separate categories, but rather different ranges at the continuum of the possible ways of processing), memory accuracy should increase. Blank (2017) suggests that the accuracy of distinguishing recollection from other sources of information depends on considerations upon general plausibility, social information (that can be used "for the better"), and how extensive versus automatic the process of reality checking is. In contrast, the reality monitoring framework (Johnson & Raye, 1981) ties the accuracy of distinguishing recollection from other sources of information to the characteristics of mental contents. The fundamental assumption of the reality monitoring

framework is that memories from the external and internal sources differ as a class. Firstly, for those generated externally, spatial and temporal characteristics are better encoded. Secondly, externally generated memories typically have more sensory attributes. Moreover, they should also be more semantically detailed. An example of evidence for this fundamental assumption is the fact that it is easier to discriminate between the memories of external and internal events than between two memories of external origin (Raye & Johnson, 1980). As we understand Johnson and Raye's (1981) proposal, it connects the accuracy of the reality monitoring process to the proper recognition of the perceptual or other phenomenal characteristics of a mental representation.

Still, to our best knowledge, there are no studies exploring how metamemory appraisals of belief in occurrence or accuracy influence memory performance. It may stem from the fact, as Johnson and Raye (1981) suggested, that the evidence for the constructive nature of memory has sometimes been misconstrued as the evidence against reliability of memories altogether. Such a notion might have prevented thorough research on the issue of veridicality as related to various monitoring processes. However, some degree of cognitive elaboration is entangled in any memory, and acknowledging the contribution of thinking to the process of remembering does not equal "the hopeless entanglement of memories derived from perception and reasoning" (Johnson & Raye, 1981, p. 68).

##### *How to differentiate between recollection and information from other sources*

Information derived from the context is by no means necessarily harmful for accuracy (e.g. it can be used "for the better" or to provide information about the past, see the second section). Yet, there certainly are situations, when it is necessary to differentiate between the information that stems from recollection, and the information from other sources (including internal sources, as the reality monitoring framework defines them). The eyewitness testimony is an example of such situation: we want to rely on recollection only. Two important questions thus arise. Firstly, whether it is possible to enhance distinguishing between recollection and information that stems from other sources. Secondly, what metacognitive processes mediate this differentiation. Addressing these questions is vitally important not only for the applied issue of eyewitness memory, but also for understanding the nature of the metacognitive control involved in the retrieval of events.

Goldsmith (2008) proposes two lines of "defense" against reporting the unintentionally erroneous information. The first line is based on the processes of monitoring and control. The person should firstly consider "cues and heuristics to evaluate the source and likely accuracy of the information that comes to mind" (Goldsmith, 2008, p. 88) and then decide whether to report the information or not, and at what level of specificity. As we broadly discussed above, such strategic control improves the accuracy of memory reports. In addition, research on memory confor-

mity suggests that people effectively use their metamemory processes to discriminate between reliable and unreliable sources of information, based on provided feedback, and therefore conform to the reliable sources, but not to the random ones (Zawadzka et al., 2015). However, Goldsmith (2008) suggests that the first line of defense that is created by monitoring and control processes is by no means sufficient, and therefore the “second line” is needed. The proposed “second line” is related to how an investigation is carried out. It includes avoiding leading questions and leading line-ups or using the cognitive interview, but also developing various tools of “interpersonal reality monitoring” (Goldsmith, 2008, p. 98).

#### *Confidence ratings and accuracy appraisals*

As we mentioned in the second section, Scoboria et al. (2015) put together appraisals of belief in accuracy that have been analysed in the autobiographical memory research and confidence ratings that have been analysed in metamemory literature. As we presented above, Koriat and Goldsmith’s (1996) model proposes several ways of improving memory performance by influencing meta-cognitive control and monitoring processes. However, as *the nature of the relationship between confidence ratings and more general accuracy appraisals is unknown* (Scoboria, Talarico, & Pascal, 2015), translating findings from metamemory research to the field of autobiographical memory would be, for the time being, unjustified.

#### *Memory accuracy within autobiographical memory*

It is worth noting that direct testing of memory accuracy and quantity is relatively easy in research that is rooted in Koriat and Goldsmith’s model. In contrast, for autobiographical memory, to which the model of judgments of recollection, belief in occurrence and accuracy pertains, the original information is usually not available. This probably can account for lack of research focused directly on the influence of these judgments on memory performance. Developing paradigms and research procedures in the field of autobiographical memory which enable focusing on accuracy with greater reliability is desirable also for this reason. The Koriat and Goldsmith’s framework (1996) is designed to analyse the memory performance on the tasks in which the retrieved information can be compared with the original information, and therefore its accuracy can be assessed. This approach is generally possible in the field of autobiographical memory, but puts considerable restrictions on the conditions of the study and nature of the questions asked (for example, the experimenter can ask only about those details that can be verified, or they may need to record the whole situation that is later reported as someone’s personal memory and compare the details etc.).

Moreover, it is possible that the accuracy within autobiographical memory is influenced by various factors differently than outside of autobiographical memory. In our opinion, situational demands (including social pressure) play an important role in remembering all types

of information. However, autobiographical memories may be perceived as especially sensitive to the influence of various schemas that are connected to the Self. Maruszewski (2010) describes the mechanism of Working Self, which is responsible for the achievement of personal goals in autobiographical remembering and is a “main structure responsible for construction of autobiographical memories” (p. 1). These personal goals may stem from both situational demands and the relatively permanent personal hierarchy of goals and values.

#### *Existing theories and paradigms in the process of integration*

We argued that the source monitoring and reality monitoring frameworks may help to integrate autobiographical memory research and metamemory research. It seems also a promising ground for better understanding the relationship between the belief in occurrence and accuracy appraisals and memory performance. Situational characteristics and stronger incentives for accuracy are said to lead to more extensive and elaborate (System 2-type) metamemory appraisals. Similarly, one of the main ideas of the source monitoring framework (SMF) is that rememberer’s current orientation influences source discriminations: “some tasks orient rememberers to making fine source discriminations with high confidence (e.g. testifying in court) whereas others orient individuals toward some other goal (e.g. telling an amusing story) with little regard to the sources of thoughts and images that come to mind while working toward that goal” (Lindsay, 2006, p. 2). Studies on the SMF could inform research on the role of belief in autobiographical memory, and perhaps vice versa. Moving beyond noting similarities toward the integration of knowledge is likely to provide valuable insights.

Another perspective which may ultimately contribute to the research on recollection and the belief in occurrence judgments is the remember/know paradigm (e.g. Mickes, Seale-Carlisle, & Wixted, 2013). This is a paradigm used to examine one’s subjective experience that is related to retrieval. Retrieval may be associated with different states of awareness: remembering and knowing. Typically, remember judgements denote conscious recollection, while know judgements do not (McCabe & Geraci, 2009). However, some comments on the possible contribution of this paradigm may be useful. Wais, Mickes and Wixted (2008) state that the currently dominating view on remember/know judgments is that “remember” responses are based on recollection, whereas familiarity underlies “know” answers. The authors undermine this logic and argue that if “know” decisions about remembering are based on familiarity, and devoid of recollection, the source recollection accuracy for them should be at chance. The results of Wais et al.’s (2008) study proved otherwise; the accuracy of the source remembering was significantly above chance for both types of answers which suggests that “know” answers were not devoid of recollection. As such, “know” judgments are not supposed

to involve different processes compared to “remember” judgments, but to reflect “different levels of memory strength” (p. 400, Wais et al., 2008). While “remember” judgments are usually provided for strongly recollected and familiar memories, “know” judgments are associated with lower levels on dimensions of both recollection and familiarity. Some researchers (e.g. McCabe & Geraci, 2009) suggest that in order to clarify what memory-states possibly underlie participants’ responses, neutral terminology and source-specific instructions should be applied instead of the remember/know distinction that are usually used. Nonetheless, we believe that the remember/know perspective can inform research on recollection and judgments of belief in autobiographical memory. As the remember/know paradigm has been developed much longer than research on autobiographical recollection and belief in its occurrence, the findings from the former may serve as the hypotheses for the studies on autobiographical memory and thus be confirmed or rejected in a different context.

In short, it is likely that further research aimed at integration of knowledge about the role of metamemory appraisals in autobiographical memory with other perspectives will provide valuable insights in terms of both theoretical understanding and directing future research. However, it should be stressed that our review and the conclusions we draw address only some aspects of metacognitive processes in remembering, and our primary goal was to contrast a well-established perspective of strategic regulation in memory with a relatively new concept of belief appraisals in autobiographical memory. Much integration of metacognition and memory has already occurred in other areas, e.g. learning semantic material, self-regulated learning and various aspects of encoding (e.g. Dunlosky et al., 2013; Efklides, 2014; Efklides, Schwartz, & Brown, 2018).

### **Venues for future research**

When discussing mechanisms underlying the improvement, we argued that the studies which focus on single aspects of remembering, such as the relative retrieval fluency or experiencing retrieval failure, cannot serve as universal tools for improving metacognitive accuracy. The apparent scarcity of studies that have focused on the influence of various aspects of metacognition on the accuracy (and quantity) of memory reports shows the need for using experimental interventions that comprise various aspects of metacognition, similar to the intervention used by Scoboria et al. (2014b). Of particular value would be to explore if the intervention that successfully supports the correct rejection of unanswerable questions will be equally effective in other contexts, e.g. in supporting correct rejection of erroneous information coming from other source.

Furthermore, designing a series of experiments to unconfound the effects of a single manipulation from the “successful” set of manipulations that build the whole intervention, would not only enable to see which specific manipulation is the most effective in particular context,

but also how different aspects of metacognitive control mechanisms may foster or impair each other’s action. On a theoretical level, such clarification would provide valuable insights into mechanisms of improvement of memory performance that result from metacognitive manipulations.

Another important question is related to the duration and extent of the experimental intervention that aims at influencing metacognitive processes, and thus increasing memory performance. Most of the studies that we discussed used a one-session intervention. Undoubtedly, shorter interventions are easier to control, and thus less prone to be influenced by random disturbing factors. Designing an experimental intervention that lasts weeks or months requires more ingenuity and effort. As we argued above, the mechanisms underlying an improvement in the accuracy of remembering within a short time (one session) and an improvement in performance within a longer time (e.g. several months) may differ. Similarly, some changes in the metacognitive functioning may not likely to be achieved quickly, e.g. reconstructing beliefs about the accuracy of one’s own memories. What is more, the studies in which the intervention is placed immediately after remembering the material are by no means typical for remembering events. In many instances events may occur weeks or months before the time when the questions concerning them are asked.

The promising (in terms of a rise in both the quantity and accuracy of memory reports) results of the study by Niedźwieńska (2004b) suggest that long-term interventions that are focused on metacognitive knowledge and challenging the beliefs on accuracy of one’s recollections are potentially effective and worth exploring.

There are definitely many factors that are able to influence control decisions during remembering, and a considerable amount of research that has explored them (e.g. Rechdan et al., 2017; Rechdan et al., 2018; McCallum et al., 2016). Still, further research on what factors (and in what conditions) regulate participants’ control decisions may lead to building a more extensive knowledge on the nature of the control mechanisms. For example, it would be worth exploring if simple statements, similar to post-warnings in the misinformation effect studies but adapted to the type of information presented and the type of retrieval task, would prove effective (e.g. “some of the information in the paragraph may have been inaccurate”, Greene, Flynn, & Loftus, 1982; “please only report details that you remember seeing. Be sure to report only those details that you are sure about and do not attempt to guess”, Wright, Memon, Skagerberg, & Gabbert, 2008). To explore the mechanisms of this kind of intervention, it is necessary to control for the level of monitoring resolution. More specifically, if this intervention (1) did not affect monitoring resolution (measured as ability to discriminate between correct and incorrect answers), and (2) was effective in the conditions of very good monitoring but detrimental in the conditions of poor monitoring levels,

its mechanisms would probably be limited to changing the control criterion, namely changing the “threshold” of confidence required to volunteer an answer. As we argued above, of particular importance would be choosing and developing such interventions that would have a potential of improving metacognitive accuracy, instead of only moving the control criterion.

Nonetheless, building the knowledge about the factors that have a potential to regulate one’s control decisions is also important. We described several such factors: reducing overconfidence, potential for negative consequences, possibility of the answers becoming public, conditions at encoding and social feedback. The list is by no means complete and its development, as we indicated above, would inform the knowledge about the mechanisms underlying control processes. Moreover, if we have more complete knowledge about factors which affect the control criterion (and in which direction) we can predict whether introducing such a factor would be beneficial or rather detrimental in certain conditions (provided we can control the monitoring effectiveness).

### Conclusions

We presented a theoretical and empirical integration on the topic of metacognition and its influence on retrieval. As we indicated in the second section, a significant part of research that has focused on improving memory performance via metacognition is influenced by the model of strategic regulation of memory (Koriat & Goldsmith, 1996). The interventions based on this model that referred to various mechanisms, proved to be effective in improving remembering accuracy and quantity. We argued, though, that the pattern of results obtained in most of these studies suggests the regulation of control decisions, and not an increase in metacognitive ability, as the mechanism of improvement. The results of the studies on the factors potentially influencing the processes of monitoring and control (Sauer & Hope, 2016; Rechdan et al., 2017; Rechdan et al., 2018) provided further support for the notion that metacognitive ability is resistant to change. However, as the studies using more extensive interventions suggest (Niedzwińska, 2004b; Scoboria et al., 2014b), an improvement within the processes of monitoring and control is possible.

The relationship between metacognition and memory performance within the model of strategic regulation in memory is well described and has been often explored in research. However, for the second model that we focused on, a relatively new but intensively explored model of appraisals in autobiographical memory, this issue is much less clear. The question of how the validation process translates into memory accuracy is one of the main problems to address. In addition, because of the difficulty in controlling memory accuracy in the studies on autobiographical memory, we believe that the knowledge from the other perspective could bring especially valuable insights. The integration of the two perspectives: one newer

and the other relatively well established may allow to (1) use conclusions and findings from the latter as an inspiration for the hypotheses in the newer field of research (2) better understand both perspectives, thanks to connecting it to the source monitoring framework.

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