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Beyond the experience: Detection of metamemorial regularities

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ABSTRACT

We examined the mechanisms involved in the development of the easily learned, easily remembered (ELER) heuristic in three groups of young children (4–5 years, 6–7 years, and 8–9 years). A trial-to-acquisition procedure was used to evaluate how much these children's judgment of learning depended on the ELER heuristic. Moreover, a new experimental paradigm, composed of six phases—a pretest, four training phases, and a posttest—was employed to implicitly influence the validity of the ELER association that underlies this metacognitive rule. Results revealed that the ELER heuristic develops early (4–5 years), but its use is reduced after implicit training. Furthermore, executive monitoring was found to account for the smaller changes observed in older children (8–9 years) after training. From a developmental perspective, these findings present a coherent picture of children's learning of metacognitive heuristics, wherein early automatic and implicit learning is later followed by effortful control.

1. Introduction

It is commonly hypothesized that metamemory knowledge develops throughout childhood on the basis of day-to-day experience (Jacoby, Kelley, & Dywan, 1989; Olds & Westerman, 2012). Over the past decade, several studies have examined the nature of the mechanisms that underlie this experiential development (Grammer, Purtell, Coffman, & Ornstein, 2011; Hodzik & Lemaire, 2011). To date, these studies have mostly focused on explicit metacognitive knowledge—that is, late-onset knowledge that people can verbalize and purposely put into practice when they are confronted with tricky memory situations—and have generally demonstrated that high-level cognitive functions are required to acquire knowledge about memory functioning (Grammer et al., 2011).

In reality, however, metamemory is not fully explicit (Lyons & Ghetti, 2013; Paulus, Proust, & Sodian, 2013). Many metacognitive theories merely guide memory decisions at the border of awareness. For example, we use the ease with which memories of positive events come to mind as a cue to determine whether we had a good time (availability heuristic; Tversky & Kahneman, 1973); we judge the familiarity of names on the basis of the fluency with which we process them (fluency heuristic; Johnston, Hawley, & Elliott, 1991); and we are inclined to suppose that easily learned information is more likely to be remembered (memorizing-effort heuristic; Koriat, 2008). These naïve theories and the underlying heuristic rules are rarely, if ever, verbalized or deliberately employed, but their effects on memory performance are equal to those of

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explicit strategies (Dodson & Schacter, 2001; Ghetti, 2008; Howe, 2008; Meeks, Knight, Brewer, Cook, & Marsh, 2014). However, although researchers studying adult metacognition have long placed a heavy emphasis on the study of these heuristic rules, research on metacognition in children has only recently started to pay greater attention to the contribution made by these heuristic-based judgments (e.g., Koriat, Ackerman, Lockl, & Schneider, 2009a; Lockl & Schneider, 2002; Roebers, von der Linden, Schneider, & Howie, 2007). Generally, the results of these studies indicate that memory decisions are already based on some heuristics (e.g., the memorizing-effort or availability heuristic) by the age of 7–8 years. Thus far, the question of whether the same is true of younger children has mostly remained unexplored. Furthermore, to our knowledge, no previous study has examined the processes that explain the development of these metacognitive rules. The present study is an attempt to fill these gaps.

Recently, several studies have demonstrated that metacognitive heuristics in adults are more malleable and sensitive to environmental specificity than had previously been thought (e.g., Olds & Westerman, 2012; Unkelbach, 2006; Winkielman & Schwarz, 2001). Unkelbach (2006, 2007), for instance, has established that the fluency heuristic can be reversed when participants are trained to associate the subjective feeling of difficulty with familiarity, which seems to indicate that people are able to temporarily modify the metacognitive content of their heuristics when they perceive new environmental constants. For example, in one of these experiments (Unkelbach, 2006, Experiment 1), participants made recognition judgments in which processing fluency was manipulated by color contrast. This test was preceded by a learning phase specifically constructed to thwart the natural fluency-familiarity relationship: previously learned (i.e., familiar) stimuli were systematically presented in low contrast (i.e., dysfluent condition) and new (i.e., unfamiliar) stimuli were systematically presented in high contrast (fluent condition). The results revealed that participants were quickly able to learn that fluent processing indicated that the stimulus was new and to use this novel information to guide their memory decision during the recognition test. This leads us to hypothesize that children may learn the knowledge underlying metacognitive heuristics by means of a well-established implicit process involving the detection of environmental regularities. In non-metacognitive contexts, this aptitude appears early in development (Meulemans, Van der Linden, & Perruchet, 1998), sometimes as early as the age of 1 (Gomez & Gerken, 1999). We therefore hypothesized that children exposed to repeated—but not explicitly mentioned—memory contingencies should be able to detect the underlying rule and then use it as a guide to predict their future recall.

For this purpose, we chose to base our experiment on the easily learned, easily remembered (ELER) heuristic, whereby the easier it feels to learn new information, the better people judge that their ability to recall it in the future will be Koriat (2008), Koriat, Nussinson, and Ackerman (2014), Paulus, Tsalas, Proust, and Sodian (2014) and Undorf and Erdfelder (2011). This heuristic was initially examined by Koriat (2008; see also Koriat, Ma'ayan, & Nussinson, 2006). In that study, participants were required to encode a list of paired-associates using a classical trial-to-acquisition procedure (i.e., a study-test loop procedure in which pairs that participants fail to recall are presented for re-study until perfect recall is achieved; Bahrick & Phelps, 1987) followed by a judgment of learning (JOL) solicitation. The results indicated that participants' JOLs for items were negatively correlated with the number of trials needed to achieve perfect recall of those items at study. In other words, the more trials were needed to learn an item, the lower was participants' prediction of their future recall of the item. Moreover, this heuristic offers the double advantage of running counter to the observation that memory performance actually improves with repeated practice—which explains why children often have no explicit knowledge of the heuristic (Koriat & Ackerman, 2010; Koriat, Ackerman, Lockl, & Schneider, 2009b)—and of having demonstrated sensitivity to experimental manipulation (Koriat, Ackerman, Adiv, Lockl, & Schneider, 2014; Miele, Finn, & Molden, 2011).

For these reasons, we decided to use this heuristic to determine whether children are able to learn a new piece of metacognitive knowledge by detecting environmental and phenomenological regularities. Specifically, since we are not aware of any studies on the ELER heuristic before the age of 7 (Koriat et al., 2009a), we cannot rule out the possibility that this particular heuristic is at least partially established at a very young age. And in fact, if the implicit detection of environmental regularities truly underlies the learning of metacognitive heuristics, it is highly likely that even young children will be able to demonstrate them, at least in some rudimentary form. In this context, to avoid trying to "teach" our participants knowledge that they might have already mastered, we decided to use a new experimental procedure, composed of six phases—a pretest, four training phases, and a posttest—constructed to modify the traditional knowledge associated with the ELER heuristic and teach the children instead that Easily Learned = Difficult to Remember.

As mentioned above, when a trials-to-acquisition paradigm is employed, the application of the ELER heuristic typically translates into higher JOLs for items that were learned after a small number of study trials than for those that were learned after a large number of trials, as measured by a JOL procedure. In the present study, this classical ELER effect was expected at pretest. However, because the participants were taught an opposite version of the ELER heuristic in the four training phases, we expected the pattern of JOL responses at posttest to be reduced or even reversed. Moreover, for the first time, we investigated the ELER heuristic not only in school-age children, but also in preschoolers. The finding that participants in the latter group use this heuristic would be a further indication of the involvement of early implicit processes in the learning of metamemory knowledge.

Finally, a secondary aim of this study was to explore the influence of three important executive functions—inhibition, flexibility, and executive monitoring—on the use of the ELER heuristic. In the literature, it has been argued that the mature implementation of a strategic heuristic requires inferential processes (Westerman, Miller, & Lloyd, 2003) that could be subject to effortful regulation (e.g., Miller & Lloyd, 2011). Therefore, once children attain a sufficient level of cognitive maturity, it is possible that they begin to apply effortful control to their learning and use of heuristics, thus becoming less sensitive to implicit environmental contingencies.