Metamemory

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Metamemory refers to the set of processes responsible for governing the knowledge, the beliefs about, and the control of one's own memory. Metamemory can be considered a part of the overarching field of metacognition. There have been many theories and descriptions of the processes involved in metacognition dating as far back as Aristotle and beyond. More recently, William James wrote on the metacognitive state of knowing but not knowing, where, "The state of our consciousness is peculiar. There is a gap therein; but no mere gap. It is a gap that is intensely active" (1893, p. 251). Though there have been musings on the subject over the years, the formal examination of metacognition and metamemory remains young, relatively speaking. In fact, the state that James was alluding to in 1893 was not described in full until Brown and McNeil's (1966) seminal paper which explored this "tip of the tongue" phenomenon.

Prior to the mid-1960s, when metamemory entered into the modern study of psychology, memory research primarily considered the learner as a passive entity. John Flavell's pioneering work in the early 1970s introduced metamemory by studying the active insights and strategies that children use to memorize information. Metamemory can be influenced by different forms of self-efficacy (Bandura, 1989), and can be measured by various tests that also include predictions about performance as well as the observation and assessment of self-efficacy, goal setting, and learning mastery (Berry & West, 1993). The study of metamemory has shown that humans constantly reflect on their memory and actively make predictions about it. Often these assessments are accurate and informative, though they can at times be prone to error.

The metacognitive processes associated with memory are generally divided into two distinct categories: monitoring and control (Nelson, 1996). Metacognitive monitoring is often thought of as the learner actively checking memory and assessing the strength of his or her knowledge. It helps to think of monitoring this way, but it is not necessarily an active process. Certain features may influence our judgments about memory even when their influence is not registered. For instance, it is often the case that upon rereading a textbook chapter a student will feel as if the information is very well learned. However, the student fails to consider the impact of familiarity on his assessment: The material is more familiar on the second read, but not necessarily better learned. Monitoring has strong implications for the learning process because it informs the learner's decisions about future study. There are various ways of experimentally measuring metacognitive monitoring, including, but not limited to, feelings of knowing (FOK; see Hart, 1965), judgments of learning (see Arbuckle & Cuddy, 1969), and confidence judgments.

Metacognitive control, as opposed to monitoring, refers to decisions concerning the manipulation and regulation of memory. For instance, control encompasses the allocation of study time, the selection of study strategies, and decisions about when to optimally start or stop study. It is clear that metacognitive control is intrinsically tied to monitoring. If one were to imagine the directional flow of information, monitoring would be the flow of information from memory, and control would be the flow of information to behavior and back to memory (see Nelson, 1996). The assessment and manipulation of that information is both prospective and retrospective in nature. That

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is, a particular task can be judged by how easy it was to learn and also by how easy one expects it will be to remember at a later date.

An important understanding about metamemory is that it is inferential in nature. This is in contrast to earlier ideas on self-assessment such as those posited in Hart's (1965) foundational article on the evaluation of the FOK. The FOK is the experience of knowing a piece of information but being unable to call it to mind immediately. This is an expression of metamemory as it is the understanding that the knowledge is definitely somewhere in memory, though it is currently inaccessible. People tend to be very good at assessing FOKs and can reliably judge when they will be able to recognize an answer to a question even when they cannot recall it (e.g., Metcalfe, 1986).

Positive findings regarding metamemory accuracy seemingly suggest that there may be some direct method of assessing the specific strength of a certain memory. However, this is not the general consensus among researchers in the area. There are major problems with a direct-access model: There are circumstances in which learners give higher efficacy judgments to ineffective strategies than effective strategies, and there are instances in which assessments are inaccurate about the relative strength of a memory, as measured by later performance (see Schwartz, Benjamin, & Bjork, 1997). Moreover, these inaccuracies can be influenced by systematic manipulations. For example, when information is processed faster, predictions of future performance tend to be more optimistic than when the information takes longer to process. One highly influential view of how people make metamemory judgments is the cue-utilization approach (Koriat, 1997). This cue-utilization framework suggests that people use any cues that are readily available and highly accessible during learning, even when they do not actually influence learning. Learners can be misled by apparent cues like font size and fail to notice beneficial but more subtle cues like repetition or levels of processing (e.g., Kornell, Rhodes, Castel, & Tauber, 2011).

Despite any shortcomings, the ability to accurately assess learning is a core feature of metamemory. Without this ability it would be impossible to decide whether to continue trying to recall an elusive piece of memory or abandon the attempt. Hart's early research on FOKs showed that healthy adults tend to be very good at assessing their memory. Because the ability to assess memory has a centrality in metamemory, it seemed to be an intuitive finding that adults are well versed in it. Thus, the research turned toward the study of the development of metacognition from early childhood into adulthood.

Lifespan changes in metamemory and metacognition provide important insight regarding the process and mechanisms that give rise to the awareness of how memory works, and how it changes with age. Very young children commonly have idealistic views of their own memory and believe that, if they want to remember something badly enough, they will. However, by the age of 8–9 there is an enhanced understanding of memory span and capacity, and predictions are much more refined, if still somewhat inflated (Flavell, Friedrichs, & Hoyt, 1970). Older children tend to give more accurate retroactive estimates of test performance than do kindergarteners. While it is clear that children are capable of producing relatively accurate metacognitive judgments about their memory, they do not seem to rely on metamemory to aid in study or recall. Stronger memory performance in children is more strongly related to good use of mnemonics and larger memory capacity (DeMarie & Ferron, 2003). While this may be the case for children, it is not so for adults; increased reliance on metamemory becomes more pronounced with age.

There is now strong evidence that, despite declines in memory, older adults can monitor their memory performance as accurately as younger adults (Hertzog, Sinclair, & Dunlosky, 2010). Older adults adapt to deficits in associative memory for words and proper names (Berry, Williams, Usubalieva, & Kilb, 2013), revealing a metacognitive awareness of those deficits. Additionally, older adults may be as aware as younger adults of how much information they have forgotten when learning and recalling lists of categorized items (Halamish, McGillivray, & Castel, 2011), suggesting that certain types of monitoring of forgetting may remain relatively intact in old age.

There do appear to be age-related differences in the monitoring of semantic knowledge. Older adults will report more tip-of-the-tongues states, particularly for proper nouns, although there are not consistent age differences in terms of the resolution of these metacognitive states (Brown, 2012). While past studies found reduced accuracy with age for FOKs, recent findings suggest that these deficits may be alleviated or eliminated when using strategies that increase the quality of encoding (Sacher, Isingrini, & Tacconat, 2013). With respect to memory for general or frequently encountered knowledge, the accuracy and calibration of confidence judgments do not appear to differ by age (Dodson, Bawa, & Krueger, 2007). However, for recent episodic events, older adults tend to express greater levels of confidence, relative to younger adults, for incorrectly remembered items, even when memory accuracy is equated across age groups (Chua, Schacter, & Sperling, 2009).

Metacognitive control is very good in older adults. It necessarily takes a different form than for younger adults, as older adults need to use specific strategies to compensate for any memory declines, perceived or actual. For older adults, these strategies are generally more external in the form of written notes and social accountability (Horhota, Lineweaver, Ositelu, Summers, & Hertzog, 2012). Older adults may also approach memory tasks by attempting to focus on the most important information to remember, at the expense of less valuable information. This prioritization shows awareness of memory declines with age, and the metacognitive understanding that one needs to be selective and strategic about focusing on important information (Castel, McGillivray, & Friedman, 2012). There are changes across the lifespan in the ability to strategically remember important information, and these changes are dissociable from memory capacity (Castel et al., 2011). Specifically, while recall is best in young adulthood, younger and older adults are more selective than adolescents and children, suggesting that the metacognitive processes involved in selecting and remembering important information are likely well preserved in healthy older adults.

Conclusions

As a final consideration, the scientific study of metamemory has many important applications, such as in education and training (e.g., Bjork, 1994), and in the study of development and cognitive aging. Overconfidence (and a lack of awareness) in certain situations, and by certain individuals or populations, can have important practical implications (see Dunning, 2011). Recent work using brain imaging (functional magnetic resonance imaging) showed that the act of making metamemory judgments was associated with activity in medial prefrontal, medial parietal, and lateral parietal regions of the brain, which have previously been implicated in internally directed, and self-regulated, cognitive tasks (Chua et al., 2009). A better understanding of the complex and interactive brain mechanisms involved in metamemory, as well as how to train and enhance metamemory processes, will likely provide important insight regarding how metamemory can influence behavior.

SEE ALSO: Learning; Memory; Memory and Memory Theory; Memory Schema

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