

Metacognition – Thinking about thinking

Description

Metacognition is “cognition about cognition”, “thinking about thinking”, “knowing about knowing”, becoming “aware of one’s awareness” and in general “higher-order thinking”. Meta is a prefix used in English to indicate a concept which is an abstraction behind another concept, used to complete or add to the latter. The term is etymologically derived from Ancient Greek from ???? (*metá*, cf. metaphysics, q.v. a science of that which transcends the physical, i.e., “higher than, transcending, overarching, dealing with the most fundamental matters”; cf. metacommunication (n.) “a secondary communication that takes place with, or underlies, a more obvious communication”; cf. metalogical (n.) “beyond the sphere of logic, transcending logic” (by 1865).

Veenman, M. V. J., Van Hout-Wolters, B. H. A. M., & Afflerbach, P.. (2006). Metacognition and learning: conceptual and methodological considerations. Metacognition and Learning

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“This is the first issue of metacognition and learning, a new international journal dedicated to the study of metacognition and all its aspects within a broad context of learning processes. flavell coined the term metacognition in the seventies of the last century (flavell, 1979) and, since then, a huge amount of research has emanated from his initial efforts. do we need metacognition as a concept in learning theory? already in 1978, brown posed the question whether metacognition was an epiphenomenon. apparently, she was convinced otherwise as she has been working fruitfully for many years in the area of metacognition. moreover, a review study by wang, haertel, and walberg (1990) revealed metacognition to be a most powerful predictor of learning. metacognition matters, but there are many unresolved issues that need further investigation. this introduction will present ten such issues, which are by no means exhaustive. they merely indicate what themes might be relevant to the journal.”
Lai, E. R.. (2011). Metacognition : A Literature Review Research Report. Research Reports

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“Metacognition is defined most simply as thinking about thinking. metacognition consists of two components: knowledge and regulation. metacognitive knowledge includes knowledge about oneself as a learner and the factors that might impact performance, knowledge about strategies, and knowledge about when and why to use strategies. metacognitive regulation is the monitoring of ones cognition and includes planning activities, awareness of comprehension and task performance, and evaluation of the efficacy of monitoring processes and strategies. recent research suggests that young children are capable of rudimentary forms of metacognitive thought, particularly after the age of 3. although individual developmental models vary, most postulate massive improvements in metacognition during the first 6 years of life. metacognition also improves with appropriate instruction, with empirical evidence supporting the notion that students can be taught to reflect on their own thinking. assessment of metacognition is challenging for a number of reasons: (a) metacognition is a complex construct; (b) it is not directly observable; (c) it may be confounded with both verbal ability and working memory capacity; and (d) existing measures tend to be narrow in focus and decontextualized from in- school learning. recommendations for teaching and assessing metacognition are made.”
Baker, L.. (2010). Metacognition. In International Encyclopedia of Education

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“Metacognition is the awareness and control of one’s own cognition. the construct of metacognition has been useful to researchers and educators seeking an explanation for why some students fare better in school than others. the consistent finding in over 30 years of research is that more-successful students exhibit higher levels of metacognitive knowledge about a given domain and are more skilled at regulating their cognitive processes than less-successful students. this article addresses issues regarding definitions, origins, measurement, and intervention. it highlights prominent research findings in the academic domains of reading, writing, mathematics, and science. © 2010 elsevier ltd. all rights reserved.”
Nelson, T. O.. (1996). Consciousness and Metacognition. American Psychologist

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“This article describes the interplay between psychological and philosophical approaches to consciousness. the role of empirical evidence from psychological research on metacognition is emphasized. the metacognitive approach to subjective reports is helpful for circumventing some

fundamental shortcomings in early introspectionist approaches. a central claim of the article is that subjective reports can be useful for testing hypotheses if the way in which they are used is reformulated, and specific reformulations are offered. illustrative findings about metacognitive monitoring and metacognitive control demonstrate how research on metacognition can produce synergy between the psychological and philosophical approaches to consciousness, by furnishing constraints on the range of acceptable theories and by producing clues to inspire new theories." Fleming, S. M., & Lau, H. C.. (2014). How to measure metacognition. Frontiers in Human Neuroscience

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"The ability to recognize one's own successful cognitive processing, in e.g. perceptual or memory tasks, is often referred to as metacognition. how should we quantitatively measure such ability? here we focus on a class of measures that assess the correspondence between trial-by-trial accuracy and one's own confidence. in general, for healthy subjects endowed with metacognitive sensitivity, when one is confident, one is more likely to be correct. thus the degree of association between accuracy and confidence can be taken as a quantitative measure of metacognition. however, many studies use a statistical correlation coefficient (e.g. pearson's r) or its variant to assess this degree of association, and such measures are susceptible to undesirable influences from factors such as response biases. here we review other measures based on signal detection theory and receiver operating characteristics (roc) analysis that are 'bias free', and relate these quantities to the calibration and discrimination measures developed in the probability estimation literature. we go on to distinguish between the related concepts of metacognitive bias (a difference in subjective confidence despite basic task performance remaining constant), metacognitive sensitivity (how good one is at distinguishing between one's own correct and incorrect judgments) and metacognitive efficiency (a subject's level of metacognitive sensitivity given a certain level of task performance). finally, we discuss how these three concepts pose interesting questions for the study of metacognition and conscious awareness." Tanner, K. D.. (2012). Promoting student metacognition.. CBE Life Sciences Education

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"Learning how to learn cannot be left to students. it must be taught. (gall et al., 1990) imagine yourself as the instructor of an introductory un-dergraduate biology course. two students from your course independently visit your office the week after the first exam. both students are biology majors. both regularly attend class and submit their assignments on time. both appear to be eager, dedicated, and genuine students who want to learn bi-ology. during each of their office hours visits, you ask them to share how they prepared for the first exam. their stories are strikingly different (inspired by ertmer and newby, 1996). during office hours, josephina expresses that she was happy the exam was on a monday, because she had a lot of time to prepare the previous weekend. she shares that she started studying after work on saturday evening and did not go out with friends that night. when queried, she

also shares that she reread all of the assigned textbook material and made flashcards of the bold words in the text. she feels that she should have done well on the test, because she studied all saturday night and all day on sunday. she feels that she did everything she could do to prepare. that said, she is worried about what her grade will be, and she wants you to know that she studied really hard, so she should get a good grade on the exam. later in the week, maya visits your office. when asked how she prepared for the first exam, she explains that she has regularly reviewed the powerpoint slides each evening after class since the beginning of the term 4 weeks ago. she also read the assigned textbook pages weekly, but expresses that she spent most of her time comparing the ideas in the powerpoint slides with the information in the textbook to see how they were similar and different. she found several places in which things seemed not to agree, which confused her. she kept a running list of these confusions each week. when you ask what she did with these confusions, she shares that she"
Thompson, V. A., Prowse Turner, J. A., & Pennycook, G.. (2011). Intuition, reason, and metacognition. Cognitive Psychology

Plain numerical DOI: 10.1016/j.cogpsych.2011.06.001
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"Dual process theories (dpt) of reasoning posit that judgments are mediated by both fast, automatic processes and more deliberate, analytic ones. a critical, but unanswered question concerns the issue of monitoring and control: when do reasoners rely on the first, intuitive output and when do they engage more effortful thinking? we hypothesised that initial, intuitive answers are accompanied by a metacognitive experience, called the feeling of rightness (for), which can signal when additional analysis is needed. in separate experiments, reasoners completed one of four tasks: conditional reasoning (n=60), a three-term variant of conditional reasoning (n=48), problems used to measure base rate neglect (n=128), or a syllogistic reasoning task (n=64). for each task, participants were instructed to provide an initial, intuitive response to the problem along with an assessment of the rightness of that answer (for). they were then allowed as much time as needed to reconsider their initial answer and provide a final answer. in each experiment, we observed a robust relationship between the for and two measures of analytic thinking: low for was associated with longer rethinking times and an increased probability of answer change. in turn, for judgments were consistently predicted by the fluency with which the initial answer was produced, providing a link to the wider literature on metamemory. these data support a model in which a metacognitive judgment about a first, initial model determines the extent of analytic engagement. © 2011 elsevier inc."
Shimamura, A. P.. (2000). Toward a Cognitive Neuroscience of Metacognition. Consciousness and Cognition

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"The relationship between metacognition and executive control is explored. according to an analysis by

fernandez-duque, baird, and posner (this issue), metacognitive regulation involves attention, conflict resolution, error correction, inhibitory control, and emotional regulation. these aspects of metacognition are presumed to be mediated by a neural circuit involving midfrontal brain regions. an evaluation of the proposal by fernandez-duque et al. is made, and it is suggested that there is considerable convergence of issues associated with metacognition, executive control, working memory, and frontal lobe function. by integrating these domains and issues, significant progress could be made toward a cognitive neuroscience of metacognition. © 2000 academic press."
Fleming, S. M., & Frith, C. D.. (2014). The cognitive neuroscience of metacognition. The Cognitive Neuroscience of Metacognition

Plain numerical DOI: 10.1007/978-3-642-45190-4
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"The relationship between metacognition and executive control is explored. according to an analysis by fernandez-duque, baird, and posner (this issue), metacognitive regulation involves attention, conflict resolution, error correction, inhibitory control, and emotional regulation. these aspects of metacognition are presumed to be mediated by a neural circuit involving midfrontal brain regions. an evaluation of the proposal by fernandez-duque et al. is made, and it is suggested that there is considerable convergence of issues associated with metacognition, executive control, working memory, and frontal lobe function. by integrating these domains and issues, significant progress could be made toward a cognitive neuroscience of metacognition."
Garrison, D. R., & Akyol, Z.. (2015). Toward the development of a metacognition construct for communities of inquiry. Internet and Higher Education

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"Metacognition is a required cognitive ability to achieve deep and meaningful learning that must be viewed from both an individual and social perspective. recently, the transition from the earliest individualistic models to an acknowledgement of metacognition as socially situated and socially constructed has precipitated the study of metacognition in collaborative learning environments. this study presents the results of research to develop and validate a metacognitive construct for use in collaborative learning environments. the metacognitive construct was developed using the community of inquiry framework as a theoretical guide and tested applying qualitative research techniques in previous research and has been tested in this research by way of developing a metacognition questionnaire. the results indicate that in order to better understand the structure and dynamics of metacognition in emerging collaborative learning environments, we must go beyond individual approaches to learning and consider metacognition in terms of complementary self and co-regulation that integrates individual and shared regulation."
Georghiades, P.. (2004). From the general to the situated: Three decades of metacognition.

International Journal of Science Education

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" This paper discusses the notion of metacognition, which is usually defined as `cognitions about cognitions', or `thinking about one's own thinking'. in so doing, it reviews the literature on metacognition over the past three decades, listing different definitions of the term and identifying diverse origins of processes metacognitive. aspects of the nature of metacognition are discussed, highlighting some of its important yet problematic dimensions, and the potentially positive impact metacognition can have on the learning process is addressed. the paper also relates metacognition to the broader area of general thinking skills and discusses the appropriateness of practising metacognition with primary school children. the paper concludes with a synopsis of research in the outcomes of metacognition, in general, and in science education, in particular, highlighting recent interest in blending metacognitive thinking with science subject matter. directions for research in science education with an interest in metacognition are also proposed. "
Foote, A. L., & Crystal, J. D.. (2007). Metacognition in the Rat. Current Biology

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"The ability to reflect on one's own mental processes, termed metacognition, is a defining feature of human existence [1, 2]. consequently, a fundamental question in comparative cognition is whether nonhuman animals have knowledge of their own cognitive states [3]. recent evidence suggests that people and nonhuman primates [4-8] but not less 'cognitively sophisticated' species [3, 9, 10] are capable of metacognition. here, we demonstrate for the first time that rats are capable of metacognition-i.e., they know when they do not know the answer in a duration-discrimination test. before taking the duration test, rats were given the opportunity to decline the test. on other trials, they were not given the option to decline the test. accurate performance on the duration test yielded a large reward, whereas inaccurate performance resulted in no reward. declining a test yielded a small but guaranteed reward. if rats possess knowledge regarding whether they know the answer to the test, they would be expected to decline most frequently on difficult tests and show lowest accuracy on difficult tests that cannot be declined [4]. our data provide evidence for both predictions and suggest that a nonprimate has knowledge of its own cognitive state. © 2007 elsevier ltd. all rights reserved."
Livingston, J.. (2003). Metacognition: An Overview. Educational resources information center

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"Truth has to be repeated constantly, because Error also is being preached all the time, and not just by a few, but by the multitude. In the Press and Encyclopaedias, in Schools and Universities, everywhere Error holds sway, feeling happy and comfortable in the knowledge of having Majority on its side." ~Johann Wolfgang von Goethe

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“Metacognition is one of the buzz words in educational psychology, but it is not always clear what is meant by metacognition. metacognition refers to higher order thinking that involves active control over the cognitive processes engaged in learning. because metacognition plays a critical role in successful learning, it is important to study metacognitive activity and development to determine how students can be taught to apply their cognitive resources through metacognitive control. the term ‘metacognition’ is most often associated with john flavell (1979), who proposed that metacognition consists of both metacognitive knowledge and metacognitive experiences or regulation. flavell further divides metacognitive knowledge into knowledge of person variables, task variables, and strategy variables. most definitions of metacognition include both knowledge and strategy components. most individuals of normal intelligence engage in metacognitive regulation when confronted with an effortful cognitive task, but some are more metacognitive than others. the most effective approaches to metacognitive instruction involve providing the learner with both knowledge of cognitive processes and strategies and experience or practice in using both cognitive and metacognitive strategies. the study of metacognition has important implications for instructional intervention.”
Akyol, Z., & Garrison, D. R.. (2011). Assessing metacognition in an online community of inquiry. Internet and Higher Education

Plain numerical DOI: 10.1016/j.iheduc.2011.01.005
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“Metacognition is an important aspect of human intelligence and higher learning. there is the recognition that metacognition is not just a private internal activity but also socially situated. in this context, the purpose of this research is to develop and validate a metacognitive construct that provides the opportunity to assess metacognition in online discussions. furthermore, the community of inquiry (coi) theoretical framework provided the conceptual coherence to construct, operationalize and interpret metacognition in an online collaborative inquiry. the results provided evidence of metacognition indicators in student discussion postings and the frequency of these indicators increased over time. © 2011 elsevier inc. all rights reserved.”
Schraw, G.. (1998). Promoting general metacognitive awareness. Instructional Science

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DOI URL
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“I describe two aspects of metacognition, knowledge of cognition and regulation of cognition, and how they are related to domain-specific knowledge and cognitive abilities. i argue that metacognitive knowledge is multidimensional, domain-general in nature, and teachable. four instructional strategies are described for promoting the construction and acquisition of metacognitive awareness. these include promoting general awareness, improving self-knowledge and regulatory skills, and promoting

learning environments that are conducive to the construction and use of metacognition."
Frith, C. D.. (2012). The role of metacognition in human social interactions. Philosophical Transactions of the Royal Society B: Biological Sciences

Plain numerical DOI: 10.1098/rstb.2012.0123
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"Metacognition concerns the processes by which we monitor and control our own cognitive processes. it can also be applied to others, in which case it is known as mentalizing. both kinds of metacognition have implicit and explicit forms, where implicit means automatic and without awareness. implicit metacognition enables us to adopt a we-mode, through which we automatically take account of the knowledge and intentions of others. adoption of this mode enhances joint action. explicit metacognition enables us to reflect on and justify our behaviour to others. however, access to the underlying processes is very limited for both self and others and our reports on our own and others' intentions can be very inaccurate. on the other hand, recent experiments have shown that, through discussions of our perceptual experiences with others, we can detect sensory signals more accurately, even in the absence of objective feedback. through our willingness to discuss with others the reasons for our actions and perceptions, we overcome our lack of direct access to the underlying cognitive processes. this creates the potential for us to build more accurate accounts of the world and of ourselves. i suggest, therefore, that explicit metacognition is a uniquely human ability that has evolved through its enhancement of collaborative decision-making."
Fleming, S. M., Dolan, R. J., & Frith, C. D.. (2012). Metacognition: Computation, biology and function. Philosophical Transactions of the Royal Society B: Biological Sciences

Plain numerical DOI: 10.1098/rstb.2012.0021
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"Many complex systems maintain a self-referential check and balance. in animals, such reflective monitoring and control processes have been grouped under the rubric of metacognition. in this introductory article to a theme issue on metacognition, we review recent and rapidly progressing developments from neuroscience, cognitive psychology, computer science and philosophy of mind. while each of these areas is represented in detail by individual contributions to the volume, we take this opportunity to draw links between disciplines, and highlight areas where further integration is needed. specifically, we cover the definition, measurement, neurobiology and possible functions of metacognition, and assess the relationship between metacognition and consciousness. we propose a framework in which level of representation, order of behaviour and access consciousness are orthogonal dimensions of the conceptual landscape."
Smith, J. D.. (2009). The study of animal metacognition. Trends in Cognitive Sciences

Plain numerical DOI: 10.1016/j.tics.2009.06.009
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"Truth has to be repeated constantly, because Error also is being preached all the time, and not just by a few, but by the multitude. In the Press and Encyclopaedias, in Schools and Universities, everywhere Error holds sway, feeling happy and comfortable in the knowledge of having Majority on its side." ~Johann Wolfgang von Goethe

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“Do nonhuman animals share humans’ capacity for metacognition-that is, for monitoring or regulating their own cognitive states? comparative psychologists have approached this question by testing a dolphin, pigeons, rats, monkeys and apes using perception, memory and food-concealment paradigms. there is growing evidence that animals share functional parallels with humans’ conscious metacognition, although the field has not confirmed full experiential parallels and this remains an open question. this article reviews this new area of comparative inquiry and describes significant empirical milestones, remaining theoretical millstones and the prospects for continuing progress in a rapidly developing area. this research area opens a new window on reflective mind in animals, illuminating its phylogenetic emergence and allowing researchers to trace the antecedents of human consciousness. © 2009 elsevier ltd. all rights reserved.”
Fox, E., & Riconscente, M.. (2008). Metacognition and self-regulation in James, Piaget, and Vygotsky. Educational Psychology Review

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“This article investigates the intertwined constructs of metacognition and selfregulation as they emerge in the works and theories of james, piaget, and vygotsky. to coordinate this exploration, we use an interpretive framework based on the relation of subject and object. in this framework, james’s perspective on metacognition and selfregulation is aligned with the self, piaget’s with the other and object, and vygotsky’s with the medium or agency of language. we explore how metacognition and self-regulation function within the realm of human behavior and development as described in the works of each of these theorists. key questions or issues that emerge for current research are outlined, and the limitations and benefits of each theorist’s perspective vis-à-vis metacognition and self-regulation are discussed.”
Brown, A. L.. (1987). Metacognition, executive control, self-regulation, and other more mysterious mechanisms. In Metacognition, motivation, and understanding

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“This paper discusses the notion of metacognition, which is usually defined as `cognitions about cognitions’, or `thinking about one’s own thinking’. in so doing, it reviews the literature on metacognition over the past three decades, listing different definitions of the term and identifying diverse origins of processes metacognitive. aspects of the nature of metacognition are discussed, highlighting some of its important yet problematic dimensions, and the potentially positive impact metacognition can have

on the learning process is addressed. the paper also relates metacognition to the broader area of general thinking skills and discusses the appropriateness of practising metacognition with primary school children. the paper concludes with a synopsis of research in the outcomes of metacognition, in general, and in science education, in particular, highlighting recent interest in blending metacognitive thinking with science subject matter. directions for research in science education with an interest in metacognition are also proposed."
Terrace, H. S., & Son, L. K.. (2009). Comparative metacognition. Current Opinion in Neurobiology

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"Metacognition is knowledge about knowledge, often expressed as confidence judgments about what we know. most of the literature on metacognition in humans is based on subjects' verbal reports. investigators of animal cognition have recently described nonverbal methods for investigating metacognition in animals. in one, subjects are given the option to escape from difficult trials. in another, subjects are trained to place bets about the accuracy of their most recent response. to rule out noncognitive interpretations of purported evidence of metacognition in animals, one must ensure that escape responses do not increase the overall density of reinforcement and that they do not occur in the presence of the stimuli on which the subject was trained. the nonverbal techniques used to investigate metacognition in animals make possible two interesting lines of research: investigating the contribution of language and explicit instruction in establishing metacognition, and the investigation of the neural substrates of metacognition."Know thyself", attributed to the delphic oracle, socrates and solon. © 2009."

Category

1. Cognitive science
2. General

Tags

1. Epistemology
2. Metacognition

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