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By Charlie Huntington, M. A., Ph. D. candidateReviewed by Tchiki Davis, M.A., Ph.D. Metacognition can be defined as thinking about thinking, but there's way more to it than that. This article defines metacognition and provides useful metacognition strategies and skills. *This page may include affiliate links; that means we earn from qualifying purchases of products. If you are reading this article, you have probably tried meditating at some point in your life. So perhaps you can relate to the experience I commonly have in meditation, which is the moment when I realize that my mind has wandered. At first, I got down on myself for these moments – I was being a bad meditator, I thought – but over time, I came to recognize it as inevitable. Psychologists have a name for the process of reflection I just described – metacognition. Blame it on our big brains – we don't just think, but we are able to think about our thinking. This is one of the things that seems to distinguish us from virtually every other species on the planet. So, what exactly is metacognition, and how do we get better at using our metacognitive skills to run our lives more effectively? I hope this article can shed light on these key questions about metacognition. Before reading on, if you're a therapist, coach, or wellness entrepreneur, be sure to grab our free Wellness Business Growth eBook to get expert tips and free resources that will help you grow your business exponentially. Are You a Therapist, Coach, or Wellness Entrepreneur? ✓ Save hundreds of hours of time ✓ Earn more $ faster ✓ Boost your credibility ✓ Deliver high-impact content A simple definition of metacognition is that it is "thinking about thinking". A more scholarly definition is that metacognition is our awareness and knowledge concerning our own thinking (Flavell, 1979). You are always thinking, but how aware are you of the content and patterns of your thinking? To the extent that you are aware of what is happening in your thinking, you are practicing metacognition. Metacognition is a skill that begins to develop in childhood and continues to influence our development throughout our lives (Flavell, 1979). In fact, as I will discuss more below, our awareness of our own cognition plays a central role in how we learn. Think about it: if you had no awareness of your thinking patterns, would you be able to make the changes you need to approach a problem in a more effective way? We are engaged in metacognition all the time, because we are not complete masters of our minds and often need to redirect our attention or change the way we focus on things. In this sense, there are two processes in metacognition – monitoring our thinking and controlling our thinking (Flavell, 1979). Most efforts to control our thinking can be thought of as falling under the umbrella of executive functioning skills (Carruthers, 2014). For example, try to imagine all the "thinking about thinking" skills that it requires to effectively listen to a college lecture and write down the "important stuff." What information matters? What doesn't? How is this related to what we've already learned? Is that the sort of information that was on the last test? We can distinguish between metacognition and cognition by considering them as happening on two different levels (Nelson & Narens, 1990). I will use the example of "learning" to demonstrate these levels. When you read a text, you are decoding the words, considering how they are related to each other, and assigning meaning to the sentence based on what you've read. That is all thinking on the cognitive level. By contrast, the metacognition going on during your reading would be your processes of monitoring and controlling your reading. It's the part of your thinking that might say, "Do I have enough time to finish this chapter before dinner?" or "I don't think I really got the point of the previous paragraph – I should go back and reread it."We can also think of the difference between cognition and metacognition as being the difference between performing a task and awareness of the nature of one's performance. You cannot learn without cognition, but you cannot evaluate the effectiveness of your own learning without metacognition. When you tweak your studying process before your reading (for example, by intentionally choosing a different schedule or approach), during your reading (by noticing that you are getting distracted and choosing to take a quick break), and after your reading (by reflecting on the success of the overall process), you are engaged in metacognition. Understanding metacognition is important for several reasons, chief among them is the fact that when awake, we are almost always engaged in metacognition (Flavell, 1979). Perhaps the reason so many people find meditation relaxing is that they experience periods without metacognition – time when they are not actively observing themselves, but simply having their experience. Not only is metacognition a constant presence in our lives, but it is fundamental to making any and all adjustments in our lives. Without the ability to monitor and control our own thinking, we would have no cognitive flexibility (Dunlosky & Metcalfe, 2009). Here is a mildly embarrassing example from my own life. I have noticed (an act of metacognition) that when faced with a challenge or puzzle, there are often certain aspects of the situation that I inaccurately assume are unchangeable. For example, I recently spent a long time looking at a corner of my bedroom and wishing it was less crowded. When I shared my dilemma with a friend, she suggested I remove the ottoman that came with the chair in the corner. This was exactly the solution needed, but it had never occurred to me that I could separate the chair from its ottoman.I have come to appreciate that in problem-solving, I often have this kind of mental block. I now try to monitor my thinking in problem-solving and redirect myself to asking for help when I get stuck – these are metacognitive strategies that help me overcome my cognitive blind spot. To the extent that I am able to successfully monitor and control my thinking in such situations, I use metacognition to grow in my cognitive flexibility. The story I just shared from my own life illustrates a classic example of metacognition – the ability to recognize when uncertainty exists or when our own knowledge is limited (Smith et al., 2003). I think this is an especially important metacognitive skill for people in positions of authority; I know that when students in my psychology classes have asked me a question which I cannot answer with certainty, I am often tempted to give my best guess as a response, even when I know the answer will be incomplete. It takes metacognition to monitor my own thinking and catch that impulse – "I don't want to admit that I'm not sure, so I'm going to make something up", control that impulse, and tell the student I'll get them a full answer later.For really clear examples of metacognition that you can share with your friends, you can turn to the feeling-of-knowing (Hart, 1965) and the tip-of-the-tongue phenomenon (Brown & McNeill, 1966). These are closely related forms of metacognition. The first is that sensation you might have when you see a person with whom you graduated from high school, ten years after the fact: you know you know this person, but you can't say from where you know them. And you have probably had a tip-of-the-tongue moment yourself. For my part, I last experienced this on a hiking trip, where I spent over 36 hours wracking my brain to remember the name of a particular film that had come up in conversation but which nobody could name.Here are a few more examples of when metacognition really matters (Rhodes, 2019):When trying to decide how much to get your hopes up about receiving a particular job offer, you might ask yourself whether you are accurately remembering and interpreting everything that happened during the interview.When providing feedback to somebody you supervise, you might consider whether there are any extenuating factors that influenced their behavior that you haven't taken into account.When a therapist meets with a client for the first time, they will typically monitor their approach to information-gathering, and likely change their style if they observe that the client is shutting down or giving minimal responses. While metacognition has been a topic of discussion in scholarly work since the time of Plato and Aristotle, it is only in the last seventy-five years that more systematic and in-depth theorizing about it has taken place (Flavell, 1979). It was in this period of time that some of the aspects of metacognition we have already covered became formally accepted, such as how it is different from cognition and how it consists of both monitoring our cognitions and controlling our cognitions. When we are consciously using metacognition to be more effective out in the world, we are engaging in the use of metacognitive strategies (Efklides, 2011).One essential metacognitive strategy – at least in the eyes of therapists like me – is the ability to monitor the relationship between one's cognitions and one's emotions and then intervene successfully to change one's cognitions (Nelson et al., 1999). In fact, this kind of metacognitive strategy forms the backbone of much of modern psychotherapy.Let's look at an example of this metacognitive strategy in action. Again, I'm going to draw on my own slightly embarrassing patterns of thinking and feeling. When I watch somebody else play the guitar, my brain often fills with negative, judgmental thoughts about that person. Why is that? It took me a while to recognize that those thoughts were related to feeling jealous: jealous because the other person was performing and I was merely a spectator, because they were more talented than me, because I saw how much positive attention they were receiving, etc. Once I could identify this link between judgmental thoughts and jealous feelings, I became able to intervene on my thinking in those moments. Now, when I watch somebody else play guitar, I direct myself to remember that we are different people with different backgrounds and skills.We can look at most metacognitive strategies as falling into one of three categories (Dirkes, 1985):Connecting new information to things we already know—like when we put a friend's recent grumpiness in the context of his having gotten a bad performance review at work.Selecting thinking strategies—like when I choose to apply a growth mindset instead of a fixed mindset to my experience of learning a new instrument.Planning, monitoring, and evaluating thinking—like when I watch another guitarist perform having chosen to monitor myself for judgmental thoughts, then I reflect after the fact on how well my efforts to reframe went. Here are a few questions you can ask yourself to practice metacognition:"What might I not be considering right now?""What is my usual response in a situation like this? Could I do something different?""What information do I not have that would help me make this decision?""How do I know what I think I know right now? Can I be truly certain about this?" Since learning always involves new information or change, metacognition is central to all experiences in education (Flavell, 1979), whether the learning at hand involves active listening, reading, problem-solving, or social interactions. Learning how to harness one's metacognition can help learners become more effective over time (Mahdavi, 2014); the more effectively they learn how to handle moments when their usual cognitive patterns won't solve the problem, the better they will be at adjusting and growing. Metacognitive strategies in education include preparing to learn, picking strategies for learning, monitoring learning, adjusting strategies, and evaluating one's process (Anderson, 2008). This video offers some additional metacognitive strategies for effective learning: Want to learn more? Check out these articles: If you'd like to keep learning more, here are a few books that you might be interested in. Metacognition is a critical component of self-awareness. We have all developed metacognitive skills with time, and we will hopefully continue to grow in these abilities with time. In fact, I think that one of the biggest determinants in personal growth is our willingness to examine our personal patterns of thinking and feeling. Only through metacognition do we realize how to change our patterns to become more effective problem-solvers.It can be very humbling to catch ourselves going through the same cognitive motions again and again; I hope that you can be gentle with yourself when you notice yourself stuck in a pattern of thought or at a loss for what to do next. Those moments are the perfect opportunities to engage in metacognitive strategies. There is no learning without stepping outside our usual patterns and pre-existing ways of thinking. Brown, R., & McNeill, D. 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Department & Whole-School Plans include access to in-house teaching resources. Whole-School Plans also grant all of your school's teachers access to our online teacher-training course focused on metacognition and self-regulated learning.Meditation, Deep-Metacognition - Cover [Meditation, Deep-Metacognition - Cover [Motivational Reflection Sessions - CoverMeditation, Deep-Metacognition - Cover [Have you ever stopped to think about how you think? That is metacognition — reflecting on our own mental processes. This ability is a key competency for both personal and academic development. It also plays a role in society by encouraging individuals to be more autonomous, analytical, and strategy-oriented. In this article, we explain what metacognition is, its true meaning, its components, and how to apply it in daily life and the classroom. We'll also explore tools and strategies of metacognition to incorporate conscious learning into educational programs. Metacognition is the human ability to reflect on one's own cognition (thinking and learning), including cognitive processes, strategies, and outcomes. In short, it is about learning how to learn by becoming aware of the knowledge acquisition process. It involves understanding the cognitive tasks we engage in and how we monitor, regulate, and organize them. These include memory, calculation, and attention to achieve a specific goal. Thus, metacognition involves: Analyzing the starting point for a given topic Setting and coordinating the necessary tasks Choosing the right strategy to complete the tasks Evaluating the result and making adjustments. This awareness helps people comprehend, manage, and evaluate their learning in a holistic way. It supports active learning built on previous experiences, closely tied to constructivism. As you can see, the process is crucial for acquiring knowledge, developing competencies, and enabling conscious, autonomous, and meaningful learning. The term was introduced in the 1970s by cognitive psychologist John Flavell. He was the first to suggest that humans not only think, but also have the ability to reflect on and regulate their own cognitive processes. In his work Metacognition and Cognitive Monitoring: A New Area of Cognitive-Developmental Inquiry, Flavell formally introduced this concept. He identified four key interacting components in this process: metacognitive knowledge, metacognitive experiences, cognitive goals, and both cognitive and metacognitive strategies. He also defined two major dimensions: Metacognitive knowledge: Understanding one's cognitive strengths and weaknesses, recognizing learning strategies, and knowing how to tackle tasks. Metacognitive control: Planning, monitoring, and evaluating mental actions. Yes, metacognition and scaffolding are closely linked. Both guide students toward autonomy. Scaffolding in education is based on Lev Vygotsky's Zone of Proximal Development (ZPD). It consists of temporary support until the student can complete tasks independently. Through various techniques like tutoring and questioning, students gradually build confidence and strategic skills. This progression activates metacognitive processes such as planning, regulation, and self-assessment, reinforcing transferable, conscious learning. Metacognition comprises skills and attitudes that help individuals regulate their thinking and learning. Regarding the different types, we can distinguish three main components that work in a related way: metacognitive knowledge, metacognitive regulation, and metacognitive experience. Each of these includes its own subtypes, which you'll explore below. Metacognitive knowledge leads individuals to question what they know about their own thinking. In other words, it focuses on understanding their own cognitive processes and how they work. While this may seem difficult at first, it can be developed through three key questions: What strategies can you apply? (Declarative knowledge) How will you apply them? (Procedural knowledge) When and why will you use a specific strategy? (Conditional knowledge) Do you want to stay on top of the latest trends in eLearning, EdTech, and Human Resources? Fill out the form to receive our weekly newsletter with industry insights from our experts. These three questions imply three categories of knowledge: About the person (understanding how one learns best) About the task (recognizing its difficulty and nature) About strategies (identifying which techniques will improve learning) For example, the process might look like this: imagine you need to study a history topic. You could use several strategies, such as identifying key elements to better understand the content. Once you've picked out the main ideas, you decide to create a diagram to help organize and visualize them. You then realize that a timeline is the most effective format for learning sequences of historical events. Each of these steps reflects awareness of one's own thinking and involves concepts like metamemory (both understanding it and applying strategies to improve it) and metalanguage (using language as a thinking tool). Here, the function is to manage thinking in real time through planning, monitoring, and self-assessment, which can be guided by the following questions: Planning: How will you approach the topic and what resources do you need? Monitoring: Are you understanding the topic well or completing the task properly? Self-assessment: Did the strategy you chose and applied work, or do you need to try a different one to be more effective? This dimension includes meta-attention (self-regulation of attention to avoid distractions) and metacomprehension (the ability to improve one's own understanding). As you can see, this self-regulation is essential for achieving educational and professional goals. Metacognitive experience refers to subjective evaluations such as perceptions, emotions, and judgments that accompany thinking. For example, it includes the feeling of not making progress, the perception of difficulty, or the ability to judge whether an answer is correct without needing to verify it. It also involves aspects like transfer, which is the application of acquired knowledge to new contexts, and cognitive bridges, which allow connections between prior knowledge and new learning, helping to consolidate information in long-term memory. Metacognition is present throughout all areas of human life, including daily routines, education, and professional development. It is essential for learning in a conscious and strategic way, and it helps individuals reflect on how to improve their performance in any field. This is why models like competency-based learning often include it. You'll understand it better by looking at its benefits: Increases the effectiveness of the task being performed. Promotes critical thinking and problem-solving skills. Enhances adaptability in complex situations. Supports the development of self-regulation skills and encourages the efficient use of working memory. Improves long-term understanding and retention of information, as learners identify which strategies work best in each situation. Optimizes knowledge transfer by connecting strategies with outcomes and applying acquired skills in new contexts. Reduces stress and anxiety, since individuals know how to approach a task to achieve a specific result. Boosts the autonomy of students and professionals by improving informed decision-making through active engagement in their own learning. The metacognitive ladder is an educational tool designed to encourage students to reflect on their learning. This process helps them develop the ability to self-regulate by moving up a series of question-based steps. In the end, the student should become aware of what they have learned, how they learned it, and how they can apply it in other contexts. The ladder includes the following four basic steps or questions that each student should answer: What have I learned from the activity? How did I learn it and what skills did I develop in the process? What was it useful for? In what other situations can I use it? There are variations of this tool, like the one below, which is more detailed. Ideally, the steps should be adapted to the level and needs of your students: I don't know what I don't know: The student is unaware that they need to learn, or of the mistakes and difficulties they face. I know what I don't know: The student begins to reflect on their thinking. I know what I need to know: At this stage, they can identify their goals and what is needed to move forward. I know how I can learn it: The student becomes aware of the strategies and resources needed to reach their goals, such as creating outlines or asking questions. This is where self-regulation begins. I understand that I'm learning actively: This involves monitoring the learning process, allowing the student to adjust methods and assess their progress. I'm able to teach or apply what I've learned to other contexts: At this final step, the student has developed the ability to transfer knowledge and self-regulate independently. This strategy is not only helpful for students to identify their current level of awareness or how they can keep progressing, but it is also valuable for teachers because it facilitates the teaching of metacognitive skills and instructional design. Metacognition is also highly valuable in a professional context, as it promotes strategic thinking within teams and fosters a culture of continuous learning and improvement. Understanding the levels of the metacognition ladder will help you design concrete pedagogical interventions so your students can progress toward self-regulated learning. To develop metacognitive skills in the classroom, you can combine two approaches: 1. Thinking routines These naturally and contextually activate mental processes by acting as simple, repeatable guides that allow students to explore ideas and make thinking visible. They are brief, repeatable, and flexible formulas for organizing tasks before, during, and after an activity, mainly developed in Harvard's Project Zero research. Some examples of these structures include: I see – I think – I wonder; explain – support – question; or I think – I'm interested – I investigate. 2. Thinking skills In this case, the procedures are more complex and, according to Robert Swartz's classification, focus on generating, classifying, and evaluating ideas. For example, brainstorming sessions can be organized into tables listing pros and cons to support decision-making. Specific evaluation criteria are applied to select the best option. We have gathered other practical examples of these metacognitive techniques that you can draw inspiration from: Metacognitive log or learning journals: You can invite your students to engage in cognitive reflection through a sort of "thinking diary" about what they have learned, how the process went, and how they felt. This also helps develop socio-emotional education, as highlighted by UNESCO in its study on contributions to teaching socio-emotional skills. Checklists: These are very useful tools for creating lists of requirements that students must meet to progress in their learning. Verbalizing learning: This involves students expressing aloud what they are doing and feeling while completing a task. This method can also be enriching for other students if shared in class, encouraging peer participation. Guided self-assessments: When students finish a task or project, invite them to ask themselves questions like what they did well, where they faced challenges, what they could improve, and what they learned. Peer assessment: Promoting feedback among classmates helps students become aware of how others perceive their actions. This dynamic also encourages assertiveness and inclusion, and provides invaluable information that helps teachers create more constructive assessments. Concept maps: These are very useful tools that make thinking visible, encourage planning and data organization, allow clear self-assessment of the process, and stimulate meaningful learning. Developing metacognition in the classroom is essential to strengthen your students' ability to reflect on, regulate, and improve their learning, reduce frustration, and achieve better outcomes. The result for the teacher is clear: greater student engagement and improved evaluations of their classes. To help you get started with the metacognitive method, we have prepared a simple roadmap that you can adapt according to your own criteria: Steps to apply the metacognitive method in the classroomExplicit instructionExplain in detail the metacognitive strategies you will use. You can apply cognitive modeling by verbalizing the process so students understand it through observation.Guided practiceThe student begins to apply the proposed strategies. Your role as a teacher is to accompany or facilitate, encouraging reflective dialogue and providing ongoing feedback.Cooperative practiceStudents form small groups and work collaboratively, reflecting together. This type of activity helps create a team metacognitive awareness.Individual practiceStudents tackle individual tasks, following the roadmap you have explained. A metacognitive journal can be very useful here.Self-assessmentInvite students to evaluate the process: what they've learned, what they need to improve, whether they met their expectations, and so on.EvaluationAssess the development of the practice and invite your students to a final joint reflection. You can schedule tutoring sessions to personalize feedback. If you want to add more meaning to the activity, consider creating a digital wall or a collaborative mural poster where each student can share their final reflections. Encourage them to answer three questions: What have I learned? Which strategy worked best for me? What would I change if I had to do this task again? You could title it: "What we've learned about how we learn" to highlight the importance of learning how to learn. The digital transformation of society — and education along with it — has greatly expanded opportunities to integrate metacognition into virtual environments. Adaptive learning platforms, whether standalone systems or integrated within Learning Management Systems (LMS), are designed to adjust to each student's performance level. However, they also offer great potential by promoting metacognition through continuous, reflective interaction with the learning process. By detecting patterns of correct and incorrect answers, response times, and the user's strategic choices, these platforms provide tools that can suggest when a student should review concepts or move forward. It's a kind of simulation of the metacognitive process, encouraging students to reflect on their own progress and self-regulate, even if "guided" by these systems. Another example of the connection between metacognition and educational technologies is online proctoring systems — technologies designed to monitor remote assessments using artificial intelligence, biometrics, and user behavior tracking. While the primary goal of these solutions is to ensure the authenticity of evaluations, they can also offer benefits related to metacognition. So, how does this connection work? Since these online monitoring systems analyze behavioral patterns, navigation between questions, and time management, they can help identify the level of self-regulation and application of cognitive processes during an assessment. Beyond their monitoring function, this data can support formative feedback and strengthen your learning planning and assessment strategies. At Smowltech, we offer our clients proctoring plans that integrate AI solutions to maximize their formative strategies. If you want to experience how it works firsthand, feel free to request a free demo. Metacognition is often described as "thinking about thinking." It is a crucial cognitive process that allows individuals to regulate and improve their learning, problem-solving, and decision-making abilities. Metacognition plays a fundamental role in education, self-development, and professional settings, as it helps individuals reflect on their thought processes and make strategic adjustments to enhance their understanding and performance.Metacognition is not a single skill but a combination of multiple cognitive processes that work together to optimize learning and critical thinking. By understanding the different types of metacognition, individuals can develop strategies to become more effective learners and thinkers. Key InsightsMetacognition and Learning: Metacognition consists of multiple components that influence learning and cognitive development, helping individuals regulate their thinking processes.Types of Metacognition: Understanding different types of metacognition enhances self-awareness, critical thinking, and problem-solving skills, allowing learners to assess and refine their strategies effectively.Real-World Applications: Metacognitive skills are essential in both academic and professional settings, fostering better decision-making, adaptability, and lifelong learning.What is Metacognition?Metacognition is often described as "thinking about thinking"—a crucial skill that allows individuals to be aware of, regulate, and refine their cognitive processes. It plays a vital role in learning, problem-solving, and decision-making, enabling individuals to assess their own understanding, recognize when they need to change strategies, and develop better approaches to tackling complex tasks. Whether in an academic setting, a professional environment, or everyday life, metacognition empowers individuals to become more self-sufficient, independent learners.The concept of metacognition has been widely studied in cognitive psychology, education, and neuroscience, with research showing that students who develop strong metacognitive skills tend to perform better academically, retain information more effectively, and demonstrate greater resilience when faced with challenges. Beyond the classroom, metacognition is linked to intellectual growth, as it fosters adaptability, creativity, and problem-solving skills—traits that are essential for success in an increasingly complex and fast-paced world.Metacognition is generally divided into three core components:Metacognitive Knowledge: This refers to an individual's understanding of their own cognitive abilities, the learning strategies available to them, and when to apply specific strategies for optimal results. For example, a student who knows they learn best through visual aids may prioritize diagrams and charts when studying.Metacognitive Regulation: This involves the ability to control, monitor, and adapt one's learning processes in response to different situations. It includes setting goals, selecting strategies, tracking progress, and making adjustments when necessary. A professional preparing for an important presentation, for instance, may evaluate their speaking style and adjust their approach based on audience engagement.Metacognitive Experiences: These are the reflections and insights gained from previous learning experiences that inform future decision-making and problem-solving. For example, if someone struggled to understand a concept using one approach, they may recognize the need to try a different method next time.Each of these components plays a crucial role in cognitive development and self-improvement. By actively engaging in metacognitive thinking, individuals enhance their ability to think critically, solve problems efficiently, and develop a more profound understanding of complex topics. As a result, metacognition is not just a learning tool—it is a lifelong skill that fosters continuous growth and success.The 3 Types of MetacognitionMetacognition is a multi-faceted concept that goes beyond simple self-awareness, encompassing different types that shape how individuals think, learn, and problem-solve. By understanding the various types of metacognition, individuals can develop more effective learning strategies, improve decision-making, and enhance their overall cognitive flexibility.1. Metacognitive KnowledgeMetacognitive knowledge involves being aware of one's cognitive processes and understanding how different strategies can enhance learning. It includes three subtypes:Declarative Knowledge: Awareness of factual information and cognitive processes (e.g., knowing that rereading notes helps with memorization).Procedural Knowledge: Understanding how to apply different learning techniques (e.g., using a mind map to structure ideas).Conditional Knowledge: Recognizing when and why to apply specific strategies (e.g., knowing that summarization works well for history but not for solving math problems).Example: A student preparing for an exam recognizes that they struggle with memorization, so they decide to use flashcards as an effective recall strategy.2. Metacognitive RegulationMetacognitive regulation refers to the ability to plan, monitor, and evaluate one's learning and cognitive processes. It consists of three stages:Planning: Setting learning goals and selecting appropriate strategies.Monitoring: Tracking progress and adjusting approaches based on effectiveness.Evaluating: Reviewing outcomes and refining learning strategies for future use.Example: A student notices that they struggle with understanding a textbook chapter, so they switch to watching an educational video on the topic and take notes.3. Metacognitive ExperiencesMetacognitive experiences involve reflecting on past learning situations and using those reflections to inform future decisions. It includes recognizing moments of confusion, confidence, or realization during learning.Example: A person solving a difficult math problem recalls a similar question they encountered before and applies the same problem-solving strategy.Why is Metacognition Important?Metacognition enhances learning efficiency by allowing individuals to adapt their approaches to different challenges. It is particularly beneficial in:Education: Helps students develop independent learning habits and improve academic performance.Problem-Solving: Enables individuals to evaluate potential solutions and choose the most effective one.Decision-Making: Encourages self-reflection, reducing impulsive choices and fostering strategic thinking.Professional Development: Supports educators in improving their skills and adapting to workplace challenges.Studies have shown that students who practice metacognitive strategies perform significantly better in academics compared to those who do not actively monitor their learning.How to Improve Metacognitive SkillsEnhancing metacognition requires conscious effort and practice. Here are some effective ways to develop metacognitive skills:Encourage Self-Questioning: Ask reflective questions such as "What do I already know about this topic?" and "What strategies can I use to understand this better?"Practice Reflection: Keep a learning journal to document experiences, challenges, and strategies that worked.Use Effective Learning Strategies: Implement active reading techniques, summarization, and self-explanation.Seek Feedback: Learn from mistakes and make adjustments to improve performance.The Bottom LineMetacognition is a powerful cognitive tool that enhances learning, problem-solving, and decision-making. By understanding the different types of metacognition—metacognitive knowledge, regulation, and experiences—individuals can take control of their cognitive processes and optimize their performance in academic, professional, and personal settings. Whether applied in education, business, or daily life, metacognition fosters adaptability, strategic thinking, and continuous self-improvement.FAQs1. How does metacognition help students? Metacognition helps students regulate their learning, improve retention, and become more independent learners by encouraging self-awareness and strategic thinking.2. What are the three components of metacognition?The three components are metacognitive knowledge (understanding one's learning strategies), metacognitive regulation (planning and monitoring learning processes), and metacognitive experiences (reflecting on past learning experiences).3. Can metacognition be taught?Yes, teachers can integrate metacognitive strategies such as self-reflection, goal-setting, and active monitoring into lessons to help students develop these skills.4. How does metacognition differ from cognition? Cognition refers to thinking and processing information, while metacognition involves being aware of and regulating those cognitive processes.5. What role does metacognition play in problem-solving?Metacognition allows individuals to assess their understanding, adjust strategies, and reflect on past experiences to improve future problem-solving efforts. Dunlosky, J. & Metcalfe, J. Metacognition (SAGE Publications, 2008).Pintrich, P. R. The role of metacognitive knowledge in learning, teaching, and assessing. Theory Into Pract. 41, 219–225 (2002).Article Google Scholar Zimmerman, B. J. Self-regulated learning and academic achievement: an overview. Educ. Psychol. 25, 3–17 (1990).Article Google Scholar Zimmerman, B. J. & Schunk, D. H. Self-Regulated Learning and Academic Achievement: Theoretical Perspectives (Routledge, 2001).Baker, L. & Brown, A. L. Metacognitive Skills and Reading. In Handbook of Reading Research Vol. 1 (ed. Pearson, P. D.) 353–395 (Longman, 1984).Mckeown, M. 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Brain Mapp. 41, 4562–4573 (2020).Article PubMed PubMed Central Google Scholar Page 2Meta-knowledge Metacognitive judgementsJOLXXFOKXX2-AFC + confidenceX Self-evaluationMAI XInterviews XAwareness of learningLearning journals XSelf-monitoringThinking-aloud XMeta-control Strategy selectionMAI XMSLQ XLASSI XLearning journals XUse of strategiesInterviews XThinking-aloud XConflict monitoring Motion discrimination + additional evidenceX Flanker taskXX Stroop taskXXEffort regulation 2-AFC + Cognitive offloadingX Demand-selection taskX BRIEF XInhibition BRIEF X Flanker taskXXShifting Stroop taskXXEmotional control BRIEF X PlanningMAI XMSLQ XLASSI XBRIEF X Cognitive offloadingGo/no-go + setting remindersX Go/no-go + desire for reminderX Metacognitive Theory is a theory of knowledge that is interested in how humans can actively monitor and regulate their own thought processes. According to Flavell, the theory’s founder, some people are more capable of control over their minds than others. It differs from cognition in the following ways: Cognition: Thinking skills, such as the skills we develop to store (remember) and retrieve (recall) information in our minds. Metacognition: The ability to control our own cognition For example, the capacity to reflect on which cognitive skills we use to succeed in a given task. Metacognition means thinking about thinking. The concept was created by John Flavell in the 1970s. It includes all the processes involved in regulating how we think. Examples include planning out our work, tracking our progress, and assessing our own knowledge. Metacognitive strategies are useful to help us study smarter (not harder) and achieve self-control. Here’s my video mini-lecture on metacognitive theory: The theory was first proposed by John H. Flavell, an American professor and child psychologist, in the 1970s. His theory was developed over a series of years: 1971: Metamemory. Flavell proposes the term ‘metamemory’ to explain thinking about how we store and recall information. This term was later changed to ‘metacognition’. 1976: Metacognitive skill development in childhood. Flavell discusses the importance of regulation of cognition and identifies three stages of meta skill development in early childhood. 1979: Four classes of metacognition. Flavell proposes four classes or types ‘thinking about thinking’ in order to explain the theory. Those four classes are outlined below. In 1971, Flavell proposed the term ‘metamemory’ to explain a process of thinking about how we store and recall information in our minds (Flavell, 1971). For Flavell, metamemory was: Intentional: Thinking about how we think can’t be stumbled upon. It needs to be strategic and based on specific techniques, such as self-questioning. Foresighted: We need to plan our thinking before conducting a task but coming up with a ‘plan of attack’ for our studies. Used to accomplish a goal: We should be using meta strategies to be better at learning or working. Flavell (1976) identified three stages of metacognition in early childhood: Stage 1: Storage. Young children begin to intentionally and consciously They use basic strategies such as repetition and focus to ensure information is stored in their minds for future use. Stage 2: Recall. Children learn strategies that help them store information in their working memory to recall it in the near future. They can recall information when they predict it will be useful, such as in a game of ‘memory’. Stage 3: Systematic Strategies. Children use systematic strategies to recall information even when they did not predict that it would be required. They use active recall strategies such as self-questioning, thinking aloud and mnemonic aids so that information can be recalled from longer-term memory. In 1979, Flavell proposed 4 different classes of metacognition. These categories act as a framework for thinking about the theory. Metacognitive knowledge (MK) is a person’s beliefs about how they can affect their own cognition. A person who believes they have the ability to control their own cognitive processes may be understood to have an ‘internal locus of control’. This person is likely more motivated to try to control their thought processes than someone who does not believe in their own ability to control their thoughts. The person who does not believe they can control their own cognitive processes has an ‘external locus of control’, meaning they believe control over their thinking is outside of their grasp. Flavell identified three factors that impact our MK: Person Variables: Some people believe they have an inherent ability to control their thoughts. Others may not. Task Variables: When we are given scarce information about a task to complete, we will have a harder time identifying cognitive strategies to use for the task. If we have better grasp on the task, we’re more capable of using our meta-thought to come up with appropriate cognitive strategies to complete the task. Strategy Variables: Some people have developed more strategies to manage their cognition than others. The goal is to have as many great strategies for regulating your thinking as possible (for example, aim to be skilled at reflecting on and monitoring your thoughts regularly throughout the day). Also see below: ‘Strategies or Activities’. Metacognitive experiences (ME) are a person’s own ‘in the moment’ subjective applications of their meta-thinking to achieve tasks. Flavell suggested that this is a “stream of consciousness” process. Examples include: Connecting one current event to a past event. Providing personal feedback throughout a task to ensure you are using the right thought processes to succeed. Measuring progress or likelihood of success at any one time. ME differs from MK because your experiences are the ways you apply meta strategies, while knowledge is your awareness of your ability to control your cognition. Your tasks or goals are the outcomes you want to achieve when thinking about your own thinking. Examples include: Comprehension, Memorization, Creating something, Solving a problem. Writing a paragraph, Improving your own knowledge. You use your goals to shape which cognitive strategies you plan to use to achieve success. ‘Metacognitive strategies’ are all the strategies you can use to achieve your cognitive goals. These can include: Self-questioning (internal talk): The ability to ask yourself questions when going throughout your work to ensure you’re doing it to the best of your ability. Meditation: Through pausing and clearing your mind, you can flush out all the extra chatter and focus more on the task. Reflection: As you work, you reflect on what you’re doing and think about ways to do it better. Schon called this ‘reflection-in-action’. Awareness of Strengths and Weaknesses: Being able to know what tasks you’re good at, and what tasks you struggle at. Awareness of Learning Styles: Knowing which ways of learning best suit your skills. Learning styles are also known as ‘learning modalities’ and include verbal, aural, kinesthetic and tactile. Use of Mnemonic Aids: Ability to use rhymes, patterns and associations to remember things. For example, when you meet someone new, you bank the knowledge in your mind by cognitively linking that person to another person with the same name. Study Skills: Using study aides such as flash cards, spaced repetition, and other study strategies to remember. I have a full article on examples of metacognitive strategies that you can check out for more details. Strengths of the theory include: It is widely accepted as a useful way of explaining a type of thinking that is considered very advanced. Few other animals have achieved this level of thinking, with the exception of some apes, dolphins and rhesus monkeys. It highlights the flaws of behaviorist approaches to education, which fail to encourage higher order meta-thinking. Educators and psychologists can use the theory in their practice. Educators should provide meta-thinking strategies to students to help them study and self-assess. The theory is widely accepted in educational psychology. However, some minor criticisms and critiques include: It is hard to measure meta-thought. By its very nature, it is an internal process rather than externally observable ‘thing’. Therefore, the phenomenon is difficult to directly observe. It’s not clear whether meta-thought is entirely conscious or unconscious. Flavell argues that it can be both conscious (when we are learning a task) and unconscious (when we are at a higher and more competent stage of learning). However, others believe it is only a conscious process. The theory is closely connected to cognitive and social constructivist learning theories including: Vygotsky’s Sociocultural Theory: Vygotsky argues the strategy of private speech is central to development. Children learn by talking through issues in their mind. Teachers encourage children to ‘think about’ this ‘thinking strategy’ when they are stuck on a task. Piaget’s Cognitive Theory: Piaget argues that learning develops in stages and children develop cognitive strategies as they move through those stages. In higher stages, children should use meta-thinking strategies to achieve abstract thought and reach conclusion on difficult topics. Jonassen’s Cognitive Tools Theory: Jonassen proposes that computers can help students to think about their thinking, and achieve higher-order cognition. Such computers are labelled ‘cognitive tools’. Metacommentary: This concept refers to reflecting on our own written texts to provide insights into how to achieve self-improvement. The metacognitive theory is widely popular among educational and developmental psychologists. It can effectively explain how people regulate their own thinking to improve their efficiency in learning and work. The theory has been widely used by educators and psychologists to help people gain control over how they think and act, particularly in regards to learning. By applying meta-thinking strategies in education, learners can be more aware of their own control over their success at tasks. They can also adjust their thinking strategies as they go about their tasks to ensure optimum outcomes. All references are in APA style: Brown, A. (1978). Knowing when, where and how to remember: A problem of MC. In: Glaser, R. (Ed.), Advances in Instructional Psychology. New Jersey: Erlbaum Associates. Duell, O.K. (1986). MC skills. In: Phye, G. & Andre, T. (Eds.), Cognitive classroom learning. Orlando Florida: Academic Press. Flavell, J. (1976). MC aspects of problem-solving. In: Resnick, L. (Ed.), The nature of intelligence (pp. 231 – 235). Hillsdale, NJ: Erlbaum Assoc. Flavell, J. H. (1985). Cognitive development. Englewood Cliffs, NJ: Prentice Hall. Flavell, J. H. (1992). Cognitive development: Past, present, and future. Developmental psychology, 28(6), 998-1012. Forrest-Pressly, D., MacKinnon, G., & Waller, T. (1985). MC, cognition, and human performance. Orlando Florida: Academic Press. Garner, R. (1987). MC and reading comprehension. New Jersey: Ablex Press. Livingston, J. A. (2003). Metacognition: An overview. Retrieved from: Martinez, M. E. (2006). What is metacognition?. Phi delta kappan, 87(9): 696-699. Metacognition is the process of thinking about your own thinking. It is an awareness of your thought processes that allows you to observe and analyze how you learn and solve problems. This capacity is about taking a step back to manage your thoughts, similar to a CEO overseeing their mind’s operations. By developing this skill, you can direct your cognitive functions and consciously select effective strategies. Key Components of Metacognition Metacognition has two primary components: metacognitive knowledge and metacognitive regulation. These elements provide the foundation for guiding your learning and problem-solving efforts. Metacognitive knowledge is what you understand about yourself as a learner and the factors that influence your performance. This includes recognizing your cognitive strengths and weaknesses, like knowing you remember information better when it’s presented visually. It also encompasses understanding different learning strategies and knowing which are most effective for particular tasks. The other component, metacognitive regulation, involves the active management of your learning. This includes planning your approach to a task, monitoring your understanding and progress as you go, and evaluating the outcomes of your efforts. An example would be noticing a particular study method isn’t working and deciding to switch to a different one to improve comprehension. The Cycle of Metacognitive Thinking Effective metacognition operates as a continuous, cyclical process with three distinct phases: planning, monitoring, and evaluating. This cycle transforms abstract knowledge about your thinking into a deliberate, active process. The cycle begins with the planning phase, before a task is started. This stage involves setting clear goals and selecting appropriate strategies. For example, when preparing for a work presentation, planning would involve outlining content, deciding on visual aids, and scheduling practice time. Once the task is underway, the monitoring phase begins. This involves actively checking your progress and assessing your understanding in real-time. During a practice run for a presentation, you might notice that a section is confusing or that you are speaking too quickly, which allows for immediate adjustments. The final phase is evaluating, which takes place after the task is completed. This involves reflecting on the outcome and the effectiveness of the strategies you used. After giving the presentation, you would think about what went well and what could be improved, informing how you approach similar tasks in the future. Strategies for Improving Metacognition Developing metacognitive skills requires intentional practice. Several strategies can help cultivate this awareness and control over your thinking by making your internal thought processes more explicit and open to analysis. Self-questioning involves pausing to ask yourself pointed questions before, during, and after a task. Before reading a chapter, you might ask, “What do I already know about this topic?” This habit encourages active engagement and helps you recognize errors and adjust your approach. The think-aloud protocol is where you verbalize your thought process as you perform a task. Speaking your thoughts out loud forces you to slow down and clarify your reasoning, making it easier to identify where you might be making assumptions or getting stuck. Reflective journaling promotes deeper understanding of your learning habits over time. After completing a project, you can write about what you did, what worked well, and what you struggled with. This helps you recognize patterns and make more informed decisions for future challenges. Source: Siphotography/Deposit Photos Metacognition is a high order thinking skill that is emerging from the shadows of academia to take its rightful place in classrooms around the world. As online classrooms extend into homes, this is an important time for parents and teachers to understand metacognition and how metacognitive strategies affect learning. These skills enable children to become better thinkers and decision-makers. Metacognition: The Neglected Skill Set for Empowering Students is a new research-based book by educational consultants Dr. Robin Fogarty and Brian Pete that not only gets to the heart of why metacognition is important but gives teachers and parents insightful strategies for teaching metacognition to children from kindergarten through high school. This article summarizes several concepts from their book and shares three of their thirty strategies to strengthen metacognition. What Is Metacognition? Metacognition is the practice of being aware of one’s own thinking. Some scholars refer to it as “thinking about thinking.” Fogarty and Pete give a great everyday example of metacognition: Think about the last time you reached the bottom of a page and thought to yourself, “I’m not sure what I just read.” Your brain just became aware of something you did not know, so instinctively you might reread the last sentence or rescan the paragraphs of the page. Maybe you will read the page again. In whatever ways you decide to capture the missing information, this momentary awareness of knowing what you know or do not know is called metacognition. When we notice ourselves having an inner dialogue about our thinking and it prompts us to evaluate our learning or problem-solving processes, we are experiencing metacognition at work. This skill helps us think better, make sound decisions, and solve problems more effectively. In fact, research suggests that as a young person’s metacognitive abilities increase, they achieve at higher levels. Fogarty and Pete outline three aspects of metacognition that are vital for children to learn: planning, monitoring, and evaluation. They convincingly argue that metacognition is best when it is infused in teaching strategies rather than taught directly. The key is to encourage students to explore and question their own metacognitive strategies in ways that become spontaneous and seemingly unconscious. Metacognitive skills provide a basis for broader, psychological self-awareness, including how children gain a deeper understanding of themselves and the world around them. Metacognitive Strategies to Use at Home or School Fogarty and Pete successfully demystify metacognition and provide simple ways teachers and parents can strengthen children’s abilities to use these higher-order thinking skills. Below is a summary of metacognitive strategies from the three areas of planning, monitoring, and evaluation. 1. Planning Strategies As students learn to plan, they learn to anticipate the strengths and weaknesses of their ideas. Planning strategies used to strengthen metacognition help students scrutinize plans at a time when they can most easily be changed. One of ten metacognitive strategies outlined in the book is called “Inking Your Thinking.” It is a simple writing log that requires students to reflect on a lesson they are about to begin. Sample starters may include: “I predict…” “A question I have is…” or “A picture I have of this is…” Writing logs are also helpful in the middle or end of assignments. For example, “The homework problem that puzzles me is…” “The way I will solve this problem is to…” or “I’m choosing this strategy because…” 2. Monitoring Strategies Monitoring strategies used to strengthen metacognition help students check their progress and review their thinking at various stages. Different from scrutinizing, this strategy is reflective in nature. It also allows for adjustments while the plan, activity, or assignment is in motion. Monitoring strategies encourage recovery of learning, as in the example cited above when we are reading a book and notice that we forgot what we just read. We can recover our memory by scanning or re-reading. One of many metacognitive strategies shared by Fogarty and Pete, called the “Alarm Clock,” is used to recover or rethink an idea once the student realizes something is amiss. The idea is to develop internal signals that sound an alarm. This signal prompts the student to recover a thought, rework a math problem, or capture an idea in a chart or picture. Metacognitive reflection involves thinking about “What I did,” then reviewing the pluses and minuses of one’s action. Finally, it means asking, “What other thoughts do I have” moving forward? Teachers can easily build monitoring strategies into student assignments. Parents can reinforce these strategies too. Remember, the idea is not to tell children what they did correctly or incorrectly. Rather, help children monitor and think about their own learning. These are formative skills that last a lifetime. 3. Evaluation Strategies According to Fogarty and Pete, the evaluation strategies of metacognition “are much like the mirror in a powder compact. Both serve to magnify the image, allow for careful scrutiny, and provide an up-close and personal view. When one opens the compact and looks in the mirror, only a small portion of the face is reflected back, but that particular part is magnified so that every nuance, every flaw, and every bump is blatantly in view.” Having this enlarged view makes inspection much easier. When students inspect parts of their work, they learn about the nuances of their thinking processes. They learn to refine their work. They grow in their ability to apply their learning to new situations. “Connecting Elephants” is one of many metacognitive strategies to help students self-evaluate and apply their learning. In this exercise, the metaphor of three imaginary elephants is used. The elephants are walking together in a circle, connected by the trunk and tail of another elephant. The three elephants represent three vital questions: 1) What is the big idea? 2) How does this connect to other big ideas? 3) How can I use this big idea? Using the image of a “big idea” helps students magnify and synthesize their learning. It encourages them to think about big ways their learning can be applied to new situations. Metacognition and Self-Reflection Reflective thinking is at the heart of metacognition. In today’s world of constant chatter, technology and reflective thinking can be at odds. In fact, mobile devices can prevent young people from seeing what is right before their eyes. John Dewey, a renowned psychologist and education reformer, claimed that experiences alone were not enough. What is critical is an ability to perceive and then weave meaning from the threads of our experiences. The function of metacognition and self-reflection is to make meaning. The creation of meaning is at the heart of what it means to be human. Everyone can help foster self-reflection in young people. The term metacognition refers to a broad set of skills that enable people to plan their cognitive efforts, identify their errors, revise their strategies, and accept or reject their conclusions. In other words, metacognition predicts the feasibility and regulates the performance of cognitive actions, i.e., actions with an informational purpose. For example, metacognition helps you determine whether items from your memory can be swiftly retrieved, whether a given problem is within your reach, or whether your solution is likely to be true.HistoryThe Greek prefix “meta” means “about.” Metacognition then, literally means “cognition about cognition,” i.e., it refers to a set of abilities for knowing what one thinks and how one thinks. Metacognition, however, also refers to the mere ability to regulate one’s own cognition. The first attempt at understanding the mechanisms underlying metacognition dealt with the regulation of memory, at a time when the word metacognition had not yet been used.Figure 1Two definitions of metacognition.The control of one’s memoryHow do people predict, in a given case, whether they will remember a name that currently escapes them? In 1965, Josef T. Hart demonstrated experimentally that feelings of knowing are used to reliably assess one’s ability to remember. It was not until the following decade that child psychologist John H. Flavell (1979) coined the terms metamemory and metacognition “by analogy with ‘metalanguage.’” Metamemory, Flavell writes, refers to “the individual’s knowledge and awareness of his memory.” Metacognition, by analogy, is claimed to refer to “knowledge and cognition of cognitive phenomena,” including “attention, memory, problem-solving, social cognition and various types of self-control and self-instruction.” The two definitions are based on two conflicting hypotheses.The mindreading hypothesisIn a 1975 paper, John Flavell and Henry Wellman claimed that all the forms of metacognition involve “generalizations about people and their actions in relation to objects.” For them, metacognition is “naturally a form of social cognition.” At the time, young children were considered nonmetacognitive because they easily attributed to themselves skills they did not have, believed themselves capable of solving a problem they failed at, and attributed to themselves knowledge they could not retrieve. Metacognitive skills were not supposed to appear until the end of the preschool period, i.e., until children could attribute mental states to themselves—a capacity called mindreading that emerges around the age of 5 years.The feedback loop hypothesisIn an influential 1960 book entitled Plans and the Structure of Behavior, however, George A. Miller, Eugene Galanter, and Karl A. Pribram explored the mechanisms that enable the mind to control its activity (Miller et al., 1986). They analyzed the crucial role of feedback loops known as test-operate-test-exit (TOTE) units (see Figure 2). In the first test phase, the current state is compared with the desired end state, and discrepancies are identified. This is known as the incongruity-sensitive mechanism. Feedback from this test guides action, triggering an operation to resolve the discrepancies. Once the operation has been completed, a new test is required to compare the feedback with the expected final state. If there are no discrepancies, the action is completed and control is transferred to another TOTE unit. On the other hand, if there are discrepancies, a new action is triggered to achieve the final state. These TOTE units act as feedback loops, monitoring the successive states of a system.Figure 2Following this analysis of behavior control, Thomas O. Nelson and Louis Narens (1992) provided a convincing definition of metacognitive processing in terms of feedback loops. They hypothesized that it involved three principles:Cognitive processes are divided into a meta level and an object level.The meta level contains a dynamic model (a mental simulation) of the object level.“Control” and “monitoring” are defined in terms of these levels, with an object level collecting feedback from current activity and a meta level sending new commands in the light of feedback.The dual-processing hypothesisThis point of view reconciles the two ways in which metacognition can be “about cognition.” Asher Koriat and his colleagues have shown that metacognitive regulation can be based on both experience and concepts (Koriat & Levy-Sadot, 1999).Experience-based monitoring depends on the noetic feelings generated by processing an ongoing task, such as the feeling of knowing, the feeling of ease of processing, or the tip-of-the-tongue phenomenon. Research has shown that these feelings depend directly on the representational vehicle (underlying neural dynamics), rather than on the semantic content of the cognitive tasks being monitored. Thus, the reliability of these feelings is based on their having been previously associated with a specific task outcome, such as success or failure. In some cases, however, feelings may be elicited by cues that are either irrelevant to the task at hand or actually interfere with it. For example, the perceived ease with which information is processed (fluency) often correlates with correct memory retrieval or correct perceptual discrimination. In hurried reasoning, however, agents overlook aspects relevant to problem-solving; the perceived fluency of their own responses creates an illusion of correctness (Ackerman & Thompson, 2017). Experience-based metacognition is also referred to as procedural or implicit in that the underlying cues that generate conscious predictions of likely success are selected unconsciously.Concept-based monitoring, on the other hand, depends on forming beliefs about one’s own likely success or error, based on one’s perceived abilities in a task. Theories and verbal feedback from others often play a major role in shaping students’ confidence in their own learning abilities; this is notably the case for sociocognitive stereotypes and related conceptions, such as “men are better at math” or “women are better at literature.” Concept-based metacognition is also referred to as analytic or explicit because it generates conscious, reportable reasons for one’s evaluations about the ongoing cognitive activity.Core conceptsComparative studies over the past three decades have contributed significantly to the debate on the structure and function of metacognition (Smith, J. D., Shields, W. E., & Washburn, D. A., 2003). They brought evidence that nonlinguistic animals, such as monkeys, dolphins, rodents, and corvids, are able to monitor and control their perceptual discrimination and memory retrieval even though they lack mindreading abilities (Beran, 2019).However, the experimental paradigms involved were initially criticized because they allowed animals’ decisions to be conditioned by the receipt of trial-by-trial rewards. A series of computer simulations further suggested that the response profiles observed in these behavioral experiments could be explained equally well by a metacognitive strategy, an associative strategy (when each response is rewarded), and a stimulus avoidance strategy (difficult items followed by time-out punishment; Le Pelley, 2012).To address these objections, experimental paradigms carefully operationalized the distinction between a primary task involving trials of variable difficulty, in which animals’ responses can be assessed for accuracy, and a secondary behavior in which animals are able to regulate their primary responses (Hampton, 2009). In light of these new tests, there is now a stronger consensus that the performance seen in many tests of animal metacognition are evidence for procedural metacognition, i.e., evaluative skills based on past outcomes rather than beliefs or theories (as is the case for explicit metacognition in humans).Behavioral studies of animal metacognition within comparative psychology were first conducted independently from the study of neural correlates of metacognition in animal species. The situation dramatically changed when neuroscientists realized that behavioral measures can be used to study confidence assessments by animals trained in cognitive decision-making.Following the lead of comparative psychologists of metacognition, the rate of decline responses (where animals reject trials that are likely to be failed) and rate of post-decision wagering (where animals place a bet on the anticipated value of their response after their choice is made) were used as indexes for confidence in rats and rhesus monkeys. Firing rates measured in the orbitofrontal cortex while the animals performed an olfactory categorization task were shown to reliably assess confidence, i.e., decision (un)certainty. Furthermore, these measures were shown to be unrelated to recent reward history (Kepecs & Mainen, 2012). This evidence contradicted earlier hypotheses that animals were merely conditioned to accept or reject a task as a function of prior rewards. Studies of patients’ deficits in various clinical conditions suggest that, in humans, the right ventromedial prefrontal cortex and the dorsal anterior cingulate cortex support predictive confidence assessments (such as the feeling of knowing), whereas rostro-lateral prefrontal regions support retrospective confidence judgments (Fleming & Dolan, 2012).The comparative literature has also prompted developmental researchers to explore the procedural dimension of metacognition. Some researchers hypothesized that young children should be able to monitor their confidence in a perceptual or memory task as well as rhesus monkeys do, in order to guide their cognitive decisions long before they can reason about their states of mind. In these instances of procedural metacognition, the predictive feedback from processing a cognitive task manifests as specific emotions, such as a feeling of knowing, ease of processing, or understanding.Experimental evidence supported this hypothesis using a nonverbal opting-out memory task with 3-year-old children similar to one used in primatology to test nonhuman metacognition (Balcomb & Gerken, 2008). In this study, children performed better on trials they chose to accept than those they opted out of, as demonstrated by subsequent forced-choice recognition responses. This suggests that even young children can make reliable confidence judgments about what they can remember before they can identify and reason about their mental states (i.e., before developing mindreading abilities).However, there is debate among developmental psychologists about the procedural character of the process through which children express their confidence. For example, 3-, 4-, and 5-year-olds exhibit parallel opting-out responses and verbal confidence reports (Lyons & Ghetti, 2013). This is interpreted as evidence that children’s confidence evaluations are based on a self-attribution process, where children report their own mental states. This particular study, however, included a pretest phase where children were trained to link their feelings of uncertainty with verbal reports. Another study demonstrated that, without such training, 3-year-olds are able to adaptively accept or skip trials even if they fail false-belief tests (Bernard et al., 2014).A critical test of the independence between control-and-monitoring (procedural metacognition) and verbal self-attribution of mental states involves demonstrating metacognitive sensitivity in nonverbal children. A distinction between the two basic metacognitive processes—confidence-based decision and error monitoring—are present in infants as young as 12 and 18 months (Goupil & Kouider, 2016). Although toddlers do not talk about their mental states until their third year of life, another study showed that 20-month-olds can strategically seek help from caregivers by selectively turning to them when they cannot remember the location of a toy (Goupil et al., 2016). These findings clearly demonstrate that procedural metacognition operates independently of verbal self-attribution of mental states.Cognitive actions To clarify the role of metacognition in cognitive actions, it is helpful to consider it in light of the following definition of an action: A behavior qualifies as an action “when its course is subject to adjustments that compensate for the effects of forces that would otherwise interfere with it” (Frankfurt, 1978, p. 160). Cognitive actions are actions whose goal is to acquire information (based on perception, memory, inference, testimony, etc., termed informational goals). Metacognition compensates for interference in the case of cognitive actions: This is why it is part and parcel of cognitive actions. While pragmatic goals are pursued for their instrumental value (e.g., food shopping), informational goals are often pursued on the basis of intrinsic motivations (i.e., motivations that do not depend on having further ends), such as learning or understanding.Cognitive controlCognitive control designates the mechanisms responsible for flexibly adapting information processing to the demands of present goals. In spite of its name, it applies to all kinds of action, not only cognitive actions. A main function of cognitive control is to prevent goal conflicts due to competition between different tasks. For example, cognitive control is needed to perform the “Stroop test” where participants must filter out what a color word says (“RED”) to report its ink color (blue). Cognitive control (aka executive control) ensures that agents keep focused on their goal until it is reached and only switch attention to other tasks when it is adaptive to do so.Metacognitive control serves functions similar to the control of pragmatic actions: selecting a goal, keeping it active in working memory, updating and redirecting it, and assessing the final outcome. As shown in Table 1, this control structure also applies to metacognition. Metacognition, however, is a specialized form of cognitive control. Rather than simply stabilizing agents’ attention toward a current goal, its role is to optimize the accomplishment of informational goals as a function of time and cognitive resources. As defended by the dual-processing hypothesis, metacognitive control depends on affective and conceptual monitoring.Affective monitoring is related to information conveyed by feelings that signal opportunities and risks. Felt valence (perceived probability of success or error) elicits a desire to engage or disengage from the current cognitive action. The intensity of a feeling has an arousal value in that it determines the resources to be allocated to a response. In addition, valence and intensity play roles at different stages of the action (see Table 1). Before action, feelings help assess the importance and likely success of a cognitive goal. Curiosity, for example, stimulates agents’ motivation to learn target content that is perceived as currently lacking but learnable. During action, metacognitive feelings signal unexpected difficulties, errors, inadequacies or unexpected progress to the goal. At the end of a cognitive action, feelings assess the outputs for their validity or interest. Their function is to accept correct results and store them in memory for further use.Table 1. Taxonomy of metacognitive feelings based on action stages (from Goupil & Proust, 2023).Table 1Goal-related predictive feelings (examples)Process-related evaluative feelings (examples)Result-related evaluative feelings (examples)Feelings of curiosityFeelings of errorFeelings of being right/wrongFeelings of familiarityFeelings of incomprehensionFeelings that one learnedFeelings of knowingFeelings of incoherenceEureka feelingsFeelings of prospective confidenceFeelings of interest/boredomFeelings of retrospective confidenceTip-of-the tongueFeelings of confusionExplicit metacognition enables people to revise decisions made on the basis of metacognitive feelings in light of their background knowledge. For example, even if something seems hard to understand, you can tell yourself that it is worth concentrating on it. Concept-based metacognition also helps to convince others: Verbal assertions must be justified, explanations provided, and the subjectively felt level of certainty reported. Interestingly, there are cases where explicit metacognition cannot overcome the influence of metacognitive feelings. For example, when participants’ attention is divided (they have to do two things simultaneously), they can no longer filter out anagrams whose solutions they know from those they predict will be easy for naive subjects (Nussinson & Koriat, 2008).Questions, controversies, and new developmentsThe controversy between monists and dualists is focused on three issues (see Table 2). First, there is debate about whether uncertainty monitoring (as well as other forms of metacognitive control) needs to engage beliefs about one’s own mind. Monists consider that subjective uncertainty only qualifies as metacognitive if it is explicitly represented by a judgment of one’s own uncertainty—a metarepresentation (Carruthers, 2009). Consistent with this view, developmental evidence suggests that metacognition only becomes efficient when children become able to read their own minds (Lyons & Ghetti, 2011; Perner, 2012). In contrast, dualists propose that uncertainty can also be implicitly represented by metacognitive feelings. Nonhuman animals and infants rely on them when they manifest curiosity or realize that they cannot remember an object’s location (Kornell et al., 2007; Goupil & Kouider, 2016).A second, related point of contention is whether metacognitive monitoring is involved in nonhuman and infant decision-making, such as seeking information, trying to remember, etc. Monists take these behaviors to be directly controlled by the corresponding basic functions (memory, perception, etc.). A more economical account, for them, is that infant and nonhuman responses are based on simple learning processes based on the probability of reward (Carruthers, 2017). Dualists, on the other hand, point to neural and behavioral evidence demonstrating that the probability of success and probability of reward compete to influence behavior (Kepecs & Mainen, 2012; Nussinson & Koriat, 2008).A third topic of controversy has to do with the potential ubiquity of metacognition throughout brain activity. If experience-based control depends on nonconscious predictive processes, monists argue, then it is unclear why the process of keeping one’s balance should not qualify as metacognitive—which might be viewed as an absurd consequence (Nagel, 2014). Dualists respond by differentiating levels of control. Metacognition is specialized in assessing the informational quality of cognitive activities, such as categorizing, remembering, or problem-solving. Furthermore, in contrast to subpersonal homeostatic processes, metacognitive feelings involve conscious subjective experience (Koriat, 2000).Table 2. The main points of controversy about metacognitive architecture.Table 2ArgumentsMetacognition theoryMonistDualistSource of metacognitive uncertaintyJudgments of uncertaintyMetacognitive feelings and judgments of uncertaintySource of controlSimple learning processesSpecialized predictions concerning probability of success and rewardSpecializationMetacognition should not apply to subpersonal control (e.g., control of balance)Control is level-specific. Metacognitive control is conscious.What feelings of confidence trackA classic assumption in metacognitive studies is that confidence judgments track the distance of a given response to an objective world property (which only the experimenter is in a position to identify). On this assumption, confidence is supposed to refer to the posterior probability that a decision is correct, given the evidence. The function of confidence, from this perspective, is to help agents detect true properties or objective states of the world.An alternative construct takes confidence to refer instead to self-consistency, i.e., the reproducibility of a decision. Experiments on perceptual decision-making suggests that observers’ perceptual confidence tracks the subjective reliability (i.e., self-consistency) of internal representations (Caziot & Mamassian, 2021). Similar evidence has been found when studying participants’ confidence in their general knowledge, social beliefs, and personal preferences (Koriat, 2024). A related puzzling finding is that the confidence and speed with which an answer is given to a two-alternative forced-choice question predicts the likelihood that the same choice will be made by a majority of other participants, whether correct or not. Far from being an indicator of likely accuracy, the distribution of high and low confidence correlates with the degree of the consensus of specific responses (right and wrong alike) and the speed at which they are provided. This seems to be an unanticipated effect of participants’ sharing common wisdomware (background knowledge).Wisdom of crowds These results contribute to the understanding of the “wisdom of the crowd” phenomenon. This expression derives from the finding that aggregated opinions within a group tend to be more accurate than the opinion of the best single expert within the group. Group decisions have also been found to be more accurate when more decision weight is given to the most confident persons. However, if self-consistency rather than accuracy determines confidence, group reasoning might be predicted to be subject to false consensus. To address this structural difficulty, it has been suggested that participants be encouraged to actively think differently. For example, they could be asked to try to contradict themselves (in order to experience internal disagreement) in order to blind themselves to their previous judgments. Another method is to increase interpersonal diversity in group composition (Herzog & Hertwig, 2014).Broader connectionsEvidence from biology, psychology, anthropology, and linguistics is needed to identify the role of metacognition in the evolution of communication. Three types of hypotheses have been considered.First, according to dual-inheritance theories, culture and biology are considered parts of one interacting system, with feedback going both ways (Jablonka & Lamb, 2007). From this viewpoint, cultural traditions may influence, as well as be influenced by, the genes controlling linguistic communication.Second, according to the cultural epidemiology view, cultural processes have their own nongenetic selection mechanisms, based on copying and social learning, either through high-fidelity replicators (Blackmore, 2000) or creative reconstruction of target inputs (Sperber & Hirschfeld, 2004).Finally, according to the suprapersonal hypothesis, explicit metacognition is singled out as the thing that allows humans (unlike other primates) to reliably select who to copy or learn from (Heyes et al., 2020). It was selected to allow higher efficiency in the cognitive control of epistemic cooperation in hominin groups. On this view, explicit metacognition used for intrapersonal control is a side effect of suprapersonal forms of control applied to coordinated cognitive actions (Shea et al., 2014).The regulation of communication If explicit metacognition involves sharing one’s own uncertainty with other members of the group, then could the normative rules that apply to communication have been generated with explicit metacognition? In support of a positive answer, accuracy, informativeness, ease of processing, economy, and relevance—the central informational standards targeted by Paul Grice’s maxims of conversation—appear to involve higher-order communicative intentions (i.e., metarepresentations of speakers’ intentions). The study of animal signaling, on the other hand, suggests that procedural metacognition may have shaped nonhuman communicators’ sensitivity to trade-offs between informativity and clarity or between cognitive effort and survival significance (Proust, 2023). This hypothesis sheds new light on human communication. The pragmatic rules governing it could be based in part on metacognitive compromises inherited from biology. This view is reflected in the distinction between basic and mentalistic forms of communication (Sperber & Wilson, 2024).AcknowledgmentsThe diagrams were drawn by Frédéric Guilleray.Further reading Beran, M. J. (2019). Animal metacognition: A decade of progress, problems, and the development of new prospects. Animal Behavior and Cognition, 6(4), 223–229. A. (2000). The feeling of knowing: Some metatheoretical implications for consciousness and control. Consciousness and Cognition, 9(2), 149–171. J. (2010). Metacognition. Philosophy Compass, 5(11), 989–998. Self-awareness about thinking, higher-order thinking skills Metacognition and self directed learning Metacognition is an awareness of one's thought processes and an understanding of the patterns behind them. The term comes from the root word meta, meaning "beyond", or "on top of".[1] Metacognition can take many forms, such as reflecting on one's ways of thinking, and knowing when and how oneself and others use particular strategies for problem-solving.[1][2] There are generally two components of metacognition: (1) cognitive conceptions and (2) a cognitive regulation system.[3][4] Research has shown that both components of metacognition play key roles in metaconceptual knowledge and learning.[5][6][4] Metamemory, defined as knowing about memory and mnemonic strategies, is an important aspect of metacognition.[7] Writings on metacognition date back at least as far as two works by the Greek philosopher Aristotle (384–322 BC): On the Soul and the Parva Naturalia.[8] Cognitive psychology Perception Visual Object recognition Face recognition Pattern recognition Attention Memory Aging Emotional Learning Long-term Metacognition Language Metalanguage Thinking Cognition Concept Reasoning Decision making Problem solving Numerical cognition Number sense in animals Numerosity adaptation effect Approximate number system Parallel individuation system vte This higher-level cognition was given the label metacognition by American developmental psychologist John H. Flavell (1976).[9] The term metacognition literally means 'above cognition', and is used to indicate cognition about cognition, or more informally, thinking about thinking. Flavell defined metacognition as knowledge about cognition and control of cognition. For example, a person is engaging in metacognition if they notice that they are having more trouble learning A than B, or if it strikes them that they should double-check C before accepting it as fact. J. H. Flavell (1976, p. 232). Andreas Demetriou's theory (one of the neo-Piagetian theories of cognitive development) used the term hyper-cognition to refer to self-monitoring, self-representation, and self-regulation processes, which are regarded as integral components of the human mind.[10] Moreover, with his colleagues, he showed that these processes participate in general intelligence, together with processing efficiency and reasoning, which have traditionally been considered to compose fluid intelligence.[11][12] Metacognition also involves thinking about one's own thinking process such as study skills, memory capabilities, and the ability to monitor learning.[citation needed] This concept needs to be explicitly taught along with content instruction.[13] A pithy statement from M.D. Gall et al. is often cited in this respect: "Learning how to learn cannot be left to students. It must be taught."[14] Metacognition is a general term encompassing the study of memory-monitoring and self-regulation, meta-reasoning, consciousness/awareness and autonoetic consciousness/self-awareness. In practice these capacities are used to regulate one's own cognition, to maximize one's potential to think, learn and to the evaluation of proper ethical/moral rules. It can also lead to a reduction in response time for a given situation as a result of heightened awareness, and potentially reduce the time to complete problems or tasks. In the context of student metacognition, D. N. Perkins and Gavriel Salomon observe that metacognition concerns students' ability to monitor their progress. During this process, students ask questions like “What am I doing now?”, “Is it getting me anywhere?", and “What else could I be doing instead?”. Perkins and Salomon argue that such metacognitive practices help students to avoid unproductive approaches.[15] In the domain of experimental psychology, an influential distinction in metacognition (proposed by T. O. Nelson & L. Narens) is between Monitoring—making judgments about the strength of one's memories—and Control—using those judgments to guide behavior (in particular, to guide study choices). Dunlosky, Serra, and Baker (2007) covered this distinction in a review of metamemory research that focused on how findings from this domain can be applied to other areas of applied research. In the domain of cognitive neuroscience, metacognitive monitoring and control has been viewed as a function of the prefrontal cortex, which receives (monitors) sensory signals from other cortical regions and implements control using feedback loops (see chapters by Schwartz & Bacon and Shimamura, in Dunlosky & Bjork, 2008).[7] Metacognition is studied in the domain of artificial intelligence and modelling.[16] Therefore, it is the domain of interest of emergent systemics. Metacognition has two interacting phenomena guided by a person's cognitive regulation:[2] Metacognitive knowledge (also called metacognitive awareness) is what individuals know about themselves and others like beliefs about thinking and such, as cognitive processors. Metacognitive experiences are those experiences that have something to do with the current, on-going cognitive endeavor. Metacognition refers to a level of thinking and metacognitive regulation, the regulation of cognition and subsequent learning experiences that help people enhance their learning through a set of activities. It involves active metacognitive control or attention over the process in learning situations. The skills that aid in regulation involve planning the way to approach a learning task, monitoring comprehension, and evaluating progress towards the completion of a task. Metacognition includes at least three different types of metacognitive awareness when considering metacognitive knowledge:[17] Declarative knowledge: refers to knowledge about oneself as a learner and about what factors can influence one's performance.[3] Declarative knowledge can also be referred to as "world knowledge".[18] Procedural knowledge: refers to knowledge about doing things. This type of knowledge is displayed as heuristics and strategies.[3] A high degree of procedural knowledge can allow individuals to perform tasks more automatically. This is achieved through a large variety of strategies that can be accessed more efficiently.[19] Conditional knowledge: refers to knowing when and why to use declarative and procedural knowledge.[20] It allows students to allocate their resources when using strategies. This in turn allows the strategies to become more effective.[21] These types of metacognitive knowledge also include: Content knowledge (declarative knowledge), which involves understanding of one's own capabilities, such as a student evaluating their own knowledge of a subject in a class. It is notable that not all metacognition is accurate. Studies have shown that students often mistake lack of effort with understanding in evaluating themselves and their overall knowledge of a concept.[22] Also, greater confidence in having performed well is associated with less accurate metacognitive judgment of the performance.[23] Task knowledge (procedural knowledge), which is how one perceives the difficulty of a task which is the content, length, and the type of assignment. The study mentioned in Content knowledge also deals with a person's ability to evaluate the difficulty of a task related to their overall performance on the task. Again, the accuracy of this knowledge was skewed as students who thought their way was better/easier also seemed to perform worse on evaluations, while students who were rigorously and continually evaluated reported to not be as confident but still did better on initial evaluations. Strategic knowledge (conditional knowledge) is one's own capability for using strategies to learn information. Young children are not particularly good at this; it is not until students are in upper elementary school that they begin to develop an understanding of effective strategies. In short, strategic knowledge involves knowing what (factual or declarative knowledge), knowing when and why (conditional or contextual knowledge) and knowing how (procedural or methodological knowledge). Similar to metacognitive knowledge, metacognitive regulation or "regulation of cognition" contains three skills that are essential.[3][24] Planning: refers to the appropriate selection of strategies and the correct allocation of resources that affect task performance. Monitoring: refers to one's awareness of comprehension and task performance Evaluating: refers to appraising the final product of a task and the efficiency at which the task was performed. This can include re-evaluating strategies that were used. Metacognitive control is an important skill in cognitive regulation, it is about focusing cognitive resources on relevant information.[25] Similarly, maintaining motivation to see a task to completion is also a metacognitive skill that is closely associated with the attentional control. The ability to become aware of distracting stimuli – both internal and external – and sustain effort over time also involves metacognitive or executive functions. Swanson (1990) found that metacognitive knowledge can compensate for IQ and lack of prior knowledge when comparing fifth and sixth grade students' problem solving. Students with a better metacognition were reported to have used fewer strategies, but solved problems more effectively than students with poor metacognition, regardless of IQ or prior knowledge.[26] A lack of awareness of one's own knowledge, thoughts, feelings, and adaptive strategies leads to inefficient control over them. Hence, metacognition is a necessary life skill that needs nurturing to improve one's quality of life. Maladaptive use of metacognitive skills in response to stress can strengthen negative psychological states and social responses, potentially leading to psychosocial dysfunction. Examples of maladaptive metacognitive skills include worry based on inaccurate cognitive conceptions, rumination, and hypervigilance. Continuous cycles of negative cognitive conceptions and the associated emotional burden often lead to negative coping strategies such as avoidance and suppression. These can foster pervasive learned helplessness and impair the formation of executive functions, negatively affecting an individual's quality of life.[27] The theory of metacognition plays a critical role in successful learning, and it's important for both students and teachers to demonstrate understanding of it. Students who underwent metacognitive training including pretesting, self evaluation, and creating study plans performed better on exams.[28] They are self-regulated learners who utilize the "right tool for the job" and modify learning strategies and skills based on their awareness of effectiveness. Individuals with a high level of metacognitive knowledge and skill identify blocks to learning as early as possible and change "tools" or strategies to ensure goal attainment. A broader repertoire of "tools" also assists in goal attainment. When "tools" are general, generic, and context independent, they are more likely to be useful in different types of learning needs. In one study examining students who received text messages during college lectures, it was suggested that students with higher metacognitive self-regulation were less likely than other students to have their learning affected by keeping mobile phones switched on in classes.[29] Finally, there is no distinction between domain-general and domain-specific metacognitive skills. This means that metacognitive skills are domain-general in nature and there are no specific skills for certain subject areas. The metacognitive skills that are used to review an essay are the same as those that are used to verify an answer to a math question.[30] A number of theorists have proposed a common mechanism behind theory of mind, the ability to model and understand the mental states of others, and metacognition, which involves a theory of one's own mind's function. Direct evidence for this link is limited.[31] Several researchers have related mindfulness to metacognition. Mindfulness includes at least two mental processes: a stream of mental events and a higher level awareness of the flow of events.[32] Mindfulness can be distinguished from some metacognition processes in that it is a conscious process.[33]:137 Although metacognition has thus far been discussed in relation to the self, recent research in the field has suggested that this view is overly restrictive.[34] Instead, it is argued that metacognition research should also include beliefs about others' mental processes, the influence of culture on those beliefs, and on beliefs about ourselves. This "expansionist view" proposes that it is impossible to fully understand metacognition without considering the situational norms and cultural expectations that influence those same conceptions. This combination of social psychology and metacognition is referred to as social metacognition. Social metacognition can include ideas and perceptions that relate to social cognition. Additionally, social metacognition can include judging the cognition of others, such as judging the perceptions and emotional states of others.[34] This is in part because the process of judging others is similar to judging the self.[34] However, individuals have less information about the people they are judging; therefore, judging others tends to be more inaccurate; an effect called the fundamental attribution error.[34][35] Having similar cognitions can buffer against this inaccuracy and can be helpful for teams or organizations, as well as interpersonal relationships. An example of the interaction between social metacognition and self-concept can be found in examining implicit theories about the self. Implicit theories can cover a wide range of constructs about how the self operates, but two are especially relevant here; entity theory and incrementalist theory.[36] Entity theory proposes that an individual's self-attributes and abilities are fixed and stable, while incrementalist theory proposes that these same constructs can be changed through effort and experience. Entity theorists are susceptible to learned helplessness because they may feel that circumstances are outside their control (i.e. there's nothing that could have been done to make things better), thus they may give up easily. Incremental theorists react differently when faced with failure: they desire to master challenges, and therefore adopt a mastery-oriented pattern. They immediately began to consider various ways that they could approach the task differently, and they increase their efforts. Cultural beliefs can act on this as well. For example, a person who has accepted a cultural belief that memory loss is an unavoidable consequence of old age may avoid cognitively demanding tasks as they age, thus accelerating cognitive decline.[37] Similarly, a woman who is aware of the stereotype that purports that women are not good at mathematics may perform worse on tests of mathematical ability or avoid mathematics altogether.[38] These examples demonstrate that the metacognitive beliefs people hold about the self - which may be socially or culturally transmitted - can have important effects on persistence, performance, and motivation. The way that individuals think about attitude greatly affects the way that they behave. Metacognitions about attitudes influence how individuals act, and especially how they interact with others.[39] Some metacognitive characteristics of attitudes include importance, certainty, and perceived knowledge, and they influence behavior in different ways.[39] Attitude importance is the strongest predictor of behavior and can predict information seeking behaviors in individuals. Attitude importance is also more likely to influence behavior than certainty of the attitude.[39] When considering a social behavior like voting a person may hold high importance but low certainty. This means that they will likely vote, even if they are unsure whom to vote for. Meanwhile, a person who is very certain of who they want to vote for, may not actually vote if it is of low importance to them. This also applies to interpersonal relationships. A person might hold a lot of favorable knowledge about their family, but they may not maintain close relations with their family if it is of low importance. Metacognitive characteristics of attitudes may be key to understanding how attitudes change. Research shows that the frequency of positive or negative thoughts is the biggest factor in attitude change.[40] A person may believe that climate change is occurring but have negative thoughts toward it such as "If I accept the responsibilities of climate change, I must change my lifestyle". These individuals would not likely change their behavior compared to someone that thinks positively about the same issue such as "By using less electricity, I will be helping the planet". Another way to increase the likelihood of behavior change is by influencing the source of the attitude. An individual's personal thoughts and ideas have a much greater impact on the attitude compared to ideas of others.[40] Therefore, when people view lifestyle changes as coming from themselves, the effects are more powerful than if the changes were coming from a friend or family member. These thoughts can be re-framed in a way that emphasizes personal importance, such as "I want to stop smoking because it is important to me" rather than "quitting smoking is important to my family". More research needs to be conducted on culture differences and importance of group ideology, which may alter these results. People have secondary cognitions about the appropriateness, justifiability, and social judgability of their own stereotypic beliefs.[41] People know that it is typically unacceptable to make stereotypical judgments and make conscious efforts not to do so. Subtle social cues can influence these conscious efforts. For example, when given a false sense of confidence about their ability to judge others, people will return to relying on social stereotypes.[42] Cultural backgrounds influence social metacognitive assumptions, including stereotypes. For example, cultures without the stereotype that memory declines with old age display no age differences in memory performance.[37] When it comes to making judgments about other people, implicit theories about the stability versus malleability of human characteristics predict differences in social stereotyping as well. Holding an entity theory of traits increases the tendency for people to see similarity among group members and utilize stereotyped judgments. For example, compared to those holding incremental beliefs, people who hold entity beliefs of traits use more stereotypical trait judgments of ethnic and occupational groups as well as form more extreme trait judgments of new groups.[43] When an individual's assumptions about a group combine with their implicit theories, more stereotypical judgments may be formed.[44] Stereotypes that one believes others hold about them are called metastereotypes. Beran, Smith, and Perdue (2013) found that chimpanzees showed metacognitive monitoring in the information-seeking task.[45] In their studies, three language-trained chimpanzees were asked to use the keyboard to name the food item in order to get the food. The food in the container was either visible to them or they had to move toward the container to see its contents. Studies shown that chimpanzees more often checked what was in the container first if the food in the container was hidden. But when the food was visible to them, the chimpanzees were more likely to directly approach the keyboard and reported the identity of the food without looking again in the container. Their results suggested that chimpanzees know what they have seen and show effective information-seeking behavior when information is incomplete. Morgan et al. (2014) investigated whether rhesus macaques can make both retrospective and prospective metacognitive judgments on the same memory task.[46] Risk choices were introduced to assess the monkey's confidence about their memories. Two male rhesus monkeys (Macaca mulatta) were trained in a computerized token economy task first in which they can accumulate tokens to exchange food rewards. Monkeys were presented with multiple images of common objects simultaneously and then a moving border appearing on the screen indicating the target. Immediately following the presentation, the target images and some distractors were shown in the test. During the training phase, monkeys received immediate feedback after they made responses. They can earn two tokens if they make correct choices but lost two tokens if they were wrong. In Experiment 1, the confidence rating was introduced after they completed their responses in order to test the retrospective metamemory judgments. After each response, a high-risk and a low-risk choice were provided to the monkeys. They could earn one token regardless of their accuracy if they choose the low-risk option. When they chose high-risk, they were rewarded with three tokens if their memory response was correct on that trial but lost three tokens if they made incorrect responses. Morgan and colleagues (2014) found a significant positive correlation between memory accuracy and risk choice in two rhesus monkeys. That is, they were more likely to select the high-risk option if they answered correctly in the working memory task but select the low-risk option if they were failed in the memory task. Then Morgan et al. (2014) examine monkeys’ prospective metacognitive monitoring skills in Experiment 2. This study employed the same design except that two monkeys were asked to make low-risk or high-risk confidence judgment before they make actual responses to measure their judgments about future events. Similarly, the monkeys were more often to choose high-risk confidence judgment before answering correctly in working memory task and tended to choose the low-risk option before providing an incorrect response. These two studies indicated that rhesus monkeys can accurately monitor their performance and provided evidence of metacognitive abilities in monkeys. In addition to nonhuman primates, other animals are also shown metacognition. Foote and Crystal (2007) provided the first evidence that rats have the knowledge of what they know in a perceptual discrimination task.[47] Rats were required to classify brief noises as short or long. Some noises with intermediate durations were difficult to discriminate as short or long. Rats were provided with an option to decline to take the test on some trials but were forced to make responses on other trials. If they chose to take the test and respond correctly, they would receive a high reward but no reward if their classification of noises was incorrect. But if the rats decline to take the test, they would be guaranteed a smaller reward. The results showed that rats were more likely to decline to take the test when the difficulty of noise discrimination increased, suggesting rats knew they do not have the correct answers and declined to take the test to receive the reward. Another finding is that the performance was better when they had chosen to take the test compared with if the rats were forced to make responses, proving that some uncertain trials were declined to improve the accuracy. These responses pattern might be attributed to actively monitor their own mental states. Alternatively, external cues such as environmental cue associations could be used to explain their behaviors in the discrimination task. Rats might have learned the association between intermediate stimuli and the decline option over time. Longer response latencies or some features inherent to stimuli can serve as discriminative cues to decline tests. Therefore, Templer, Lee, and Preston (2017) utilized an olfactory-based delayed match to sample (DMTS) memory task to assess whether rats were capable of metacognitive responding adaptively.[48] Rats were exposed to sample odor first and chose to either decline or take the four-choice memory test after a delay. The correct choices of odor were associated with high reward and incorrect choices have no reward. The decline options were accompanied by a small reward. In experiment 2, some “no-sample” trials were added in the memory test in which no odor was provided before the test. They hypothesized that rats would decline more often when there was no sample odor presented compared with odor presented if rats could internally assess the memory strength. Alternatively, if the decline option was motivated by external environmental cues, the rats would be less likely to decline the test because no available external cues were presented. The results showed that rats were more likely to decline the test in no-sample trials relative to normal sample trials, supporting the notion that rats can track their internal memory strength. To rule out other potential possibilities, they also manipulated memory strength by providing the sampled odor twice and varying the retention interval between the learning and the test. Templer and colleagues (2017) found rats were less likely to decline the test if they had been exposed to the sample twice, suggesting that their memory strength for these samples was increased. Longer delayed sample test was more often declined than short delayed test because their memory was better after the short delay. Overall, their series of studies demonstrated that rats could distinguish between remembering and forgetting and rule out the possibilities that decline use was modulated by the external cues such as environmental cue associations. Research on metacognition of pigeons has shown limited success. Inman and Shettleworth (1999) employed the delayed match to sample (DMTS) procedure to test pigeons' metacognition.[49] Pigeons were presented with one of three sample shapes (a triangle, a square, or a star) and then they were required to peck the matched sample when three stimuli simultaneously appeared on the screen at the end of the retention interval. A safe key was also presented in some trials next to three sample stimuli which allow them to decline that trial. Pigeons received a high reward for pecking correct stimuli, a middle-level reward for pecking the safe key, and nothing if they pecked the wrong stimuli. Inman and Shettleworth's first experiment found that pigeons' accuracies were lower and they were more likely to choose the safe key as the retention interval between presentation of stimuli and test increased. However, in Experiment 2, when pigeons were presented with the option to escape or take the test before the test phase, there was no relationship between choosing the safe key and longer retention interval. Adams and Santi (2011) also employed the DMTS procedure in a perceptual discrimination task during which pigeons were trained to discriminate between durations of illumination.[50] Pigeons did not choose the escape option more often as the retention interval increased during initial testing. After extended training, they learned to escape the difficult trials. However, these patterns might be attributed to the possibility that pigeons learned the association between escape responses and longer retention delay.[51] In addition to DMTS paradigm, Castro and Wasserman (2013) proved that pigeons can exhibit adaptive and efficient information-seeking behavior in the same-different discrimination task.[52] Two arrays of items were presented simultaneously in which the two sets of items were either identical or different from one another. Pigeons were required to distinguish between the two arrays of items in which the level of difficulty was varied. Pigeons were provided with an "Information" button and a "Go" button on some trials that they could increase the number of items in the arrays to make the discrimination easier or they can prompt to make responses by pecking the Go button. Castro and Wasserman found that the more difficult the task, the more often pigeons chose the information button to solve the discrimination task. This behavioral pattern indicated that pigeons could evaluate the difficulty of the task internally and actively search for information when is necessary. Dogs have shown a certain level of metacognition that they are sensitive to information they have acquired or not. Belger & Bräuer (2018) examined whether dogs could seek additional information when facing uncertain situations.[53] The experimenter put the reward behind one of the two fences in which dogs can see or cannot see where the reward was hidden. After that, dogs were encouraged to find the reward by walking around one fence. The dogs checked more frequently before selecting the fence when they did not see the baiting process compared with when they saw where the reward was hidden. However, contrary to apes,[54] dogs did not show more checking behaviors when the delay between baiting the reward and selecting the fence was longer. Their findings suggested that dogs have some aspect of information-searching behaviors but less flexibly compared to apes. Smith et al. (1995) evaluated whether dolphins have the ability of metacognitive monitoring in an auditory threshold paradigm.[55] A bottlenosed dolphin was trained to discriminate between high-frequency tones and low-frequency tones. An escape option was available on some trials associated with a small reward. Their studies showed that dolphins could appropriately use the uncertain response when the trials were difficult to discriminate. There is consensus that nonhuman primates, especially great apes and rhesus monkeys, exhibit metacognitive control and monitoring behaviors.[56] But less convergent evidence was found in other animals such as rats and pigeons.[57] Some researchers criticized these methods and posited that these performances might be accounted for by low-level conditioning mechanisms.[58] Animals learned the association between reward and external stimuli through simple reinforcement models. However, many studies have demonstrated that the reinforcement model alone cannot explain animals' behavioral patterns. Animals have shown adaptive metacognitive behavior even with the absence of concrete reward.[59][60] Metacognitive-like processes are especially ubiquitous when it comes to the discussion of self-regulated learning. Self-regulation requires metacognition by looking at one's awareness of their learning and planning further learning methodology.[61] Attentive metacognition is a salient feature of good self-regulated learners, but does not guarantee automatic application.[62] Reinforcing collective discussion of metacognition is a salient feature of self-critical and self-regulating social groups.[62] The activities of strategy selection and application include those concerned with an ongoing attempt to plan, check, monitor, select, revise, evaluate, etc. Metacognition is 'stable' in that learners' initial decisions derive from the pertinent facts about their cognition through years of learning experience. Simultaneously, it is also 'situated' in the sense that it depends on learners' familiarity with the task, motivation, emotion, and so forth. Individuals need to regulate their thoughts about the strategy they are using and adjust it based on the situation to which the strategy is being applied. At a professional level, this has led to emphasis on the development of reflective practice, particularly in the education and health-care professions. Recently, the notion has been applied to the study of second language learners in the field of TESOL and applied linguistics in general (e.g., Wenden, 1987; Zhang, 2001, 2010). This new development has been much related to Flavell (1979), where the notion of metacognition is elaborated within a tripartite theoretical framework. Learner metacognition is defined and investigated by examining their person knowledge, task knowledge and strategy knowledge. Wenden (1991) has proposed and used this framework and Zhang (2001) has adopted this approach and investigated second language learners' metacognition or metacognitive knowledge. In addition to exploring the relationships between learner metacognition and performance, researchers are also interested in the effects of metacognitively-oriented strategic instruction on reading comprehension (e.g., Garner, 1994, in first language contexts, and Chamot, 2005; Zhang, 2010). The efforts are aimed at developing learner autonomy, interdependence and self-regulation. Metacognition helps people to perform many cognitive tasks more effectively.[1] Strategies for promoting metacognition include self-questioning (e.g. "What do I already know about this topic? How have I solved problems like this before?"), thinking aloud while performing a task, and making graphic representations (e.g. concept maps, flow charts, semantic webs) of one's thoughts and knowledge. Carr, 2002, argues that the physical act of writing plays a large part in the development of metacognitive skills.[63] Strategy Evaluation matrices (SEM) can help to improve the knowledge of cognition component of metacognition. The SEM works by identifying the declarative (Column 1), procedural (Column 2) and conditional (Column 3 and 4) knowledge about specific strategies. The SEM can help individuals identify the strength and weaknesses about certain strategies as well as introduce them to new strategies that they can add to their repertoire.[64] A regulation checklist (RC) is a useful strategy for improving the regulation of cognition aspect of one's metacognition. RCs help individuals to implement a sequence of thoughts that allow them to go over their own metacognition.[64] King (1991) found that fifth-grade students who used a regulation checklist outperformed control students when looking at a variety of questions including written problem solving, asking strategic questions, and elaborating information.[65] Examples of strategies that can be taught to students are word analysis skills, active reading strategies, listening skills, organizational skills and creating mnemonic devices.[66] Walker and Walker have developed a model of metacognition in school learning termed Steering Cognition, which describes the capacity of the mind to exert conscious control over its reasoning and processing strategies in relation to the external learning task. Studies have shown that pupils with an ability to exert metacognitive regulation over their attentional and reasoning strategies used when engaged in maths, and then shift those strategies when engaged in science or then English literature learning, associate with higher academic outcomes at secondary school. "Metastrategic knowledge" (MSK) is a sub-component of metacognition that is defined as general knowledge about higher order thinking strategies. MSK had been defined as "general knowledge about the cognitive procedures that are being manipulated". The knowledge involved in MSK consists of "making generalizations and drawing rules regarding a thinking strategy" and of "naming" the thinking strategy.[67] The important conscious act of a metastrategic strategy is the "conscious" awareness that one is performing a form of higher order thinking. MSK is an awareness of the type of thinking strategies being used in specific instances and it consists of the following abilities: making generalizations and drawing rules regarding a thinking strategy, naming the thinking strategy, explaining when, why and how such a thinking strategy should be used, when it should not be used, what are the disadvantages of not using appropriate strategies, and what task characteristics call for the use of the strategy.[68] MSK deals with the broader picture of the conceptual problem. It creates rules to describe and understand the physical world around the people who utilize these processes called higher-order thinking. This is the capability of the individual to take apart complex problems in order to understand the components in problem. These are the building blocks to understanding the "big picture" (of the main problem) through reflection and problem solving.[69] Both social and cognitive dimensions of sporting expertise can be adequately explained from a metacognitive perspective according to recent research. The potential of metacognitive inferences and domain-general skills including psychological skills training are integral to the genesis of expert performance. Moreover, the contribution of both mental imagery (e.g., mental practice) and attentional strategies (e.g., routines) to our understanding of expertise and metacognition is noteworthy.[70] The potential of metacognition to illuminate our understanding of action was first highlighted by Aidan Moran who discussed the role of meta-attention in 1996.[71] A recent research initiative, a research seminar series called META funded by the BPS, is exploring the role of the related constructs of meta-motivation, meta-emotion, and thinking and action (metacognition). In the context of mental health, metacognition can be loosely defined as the process that "reinforces one's subjective sense of being a self and allows for becoming aware that some of one's thoughts and feelings are symptoms of an illness".[72] The interest in metacognition emerged from a concern for an individual's ability to understand their own mental status compared to others as well as the ability to cope with the source of their distress.[73] These insights into an individual's mental health status can have a profound effect on overall prognosis and recovery. Metacognition brings many unique insights into the normal daily functioning of a human being. It also demonstrates that a lack of these insights compromises 'normal' functioning. This leads to less healthy functioning. In the autism spectrum, it is speculated that there is a profound deficit in theory of mind.[74] In people who identify as alcoholics, there is a belief that the need to control cognition is an independent predictor of alcohol use over anxiety. Alcohol may be used as a coping strategy for controlling unwanted thoughts and emotions formed by negative perceptions.[75] This is sometimes referred to as self medication. Adrian Wells' and Gerald Matthews' theory proposes that when faced with an undesired choice, an individual can operate in two distinct modes: "object" and "metacognitive".[76] Object mode interprets perceived stimuli as truth, where metacognitive mode understands thoughts as cues that have to be weighted and evaluated. They are not as easily trusted. There are targeted interventions unique of each patient, that gives rise to the belief that assistance in increasing metacognition in people diagnosed with schizophrenia is possible through tailored psychotherapy. With a customized therapy in place, clients then have the potential to develop greater ability to engage in complex self-reflection.[77] This can ultimately be pivotal in the patient's recovery process. In the obsessive–compulsive spectrum, cognitive formulations have greater attention to intrusive thoughts related to the disorder. "Cognitive self-consciousness" are the tendencies to focus attention on thought. Patients with OCD exemplify varying degrees of these "intrusive thoughts". Patients also with generalized anxiety disorder also show negative thought process in their cognition.[78] Cognitive-attentional syndrome (CAS) characterizes a metacognitive model of emotion disorder (CAS is consistent with the attention strategy of excessively focusing on the source of a threat).[79][80] This ultimately develops through the client's own beliefs. Metacognitive therapy attempts to correct this change in the CAS. One of the techniques in this model is called attention training (ATT).[81][82] It was designed to diminish the worry and anxiety by a sense of control and cognitive awareness. ATT also trains clients to detect threats and test how controllable reality appears to be.[83] Following the work of Asher Koriat,[84] who regards confidence as central aspect of metacognition, metacognitive training for psychosis aims at decreasing overconfidence in patients with schizophrenia and raising awareness of cognitive biases. According to a meta-analysis,[85] this type of intervention improves delusions and hallucinations. The concept of metacognition has also been applied to reader-response criticism. Narrative works of art, including novels, movies and musical compositions, can be characterized as metacognitive artifacts which are designed by the artist to anticipate and regulate the beliefs and cognitive processes of the recipient,[86] for instance, how and in which order events and their causes and identities are revealed to the reader of a detective story. As Menakhem Perry has pointed out, mere order has profound effects on the aesthetical meaning of a text.[87] Narrative works of art contain a representation of their own ideal reception process. They are something of a tool with which the creators of the work wish to attain certain aesthetical and even moral effects.[88] There is an intimate, dynamic interplay between mind wandering and metacognition. Metacognition serves to correct the wandering mind, suppressing spontaneous thoughts and bringing attention back to more "worthwhile" tasks.[32][89] Philosophy portalPsychology portal The concept of metacognition has also been applied to collective teams and organizations in general, termed organizational metacognition. Educational psychology – Branch of psychology concerned with the scientific study of human learning Educational technology – Use of technology in education to improve learning and teaching Epistemology – Philosophical study of knowledge Goal orientation – Social-cognitive motivational disposition Introspection – Examining one's own thoughts and feelings Learning styles – Largely debunked theories that aim to account for differences in individuals' learning Meta-emotion – Emotions, and thoughts, about emotion Metaknowledge – Knowledge about knowledge Metaphilosophy – Investigation of the nature of philosophy Münchhausen trilemma – Thought experiment used to demonstrate the impossibility of proving any truth Metatheory – Theory whose subject matter is itself a theory Mentalization – Ability to understand mental state that underlies behavior Mindstream – Buddhist concept of continuity of mind Mirror test – Animal self-awareness test Phenomenology (philosophy) – Philosophical method and schools of philosophy Phenomenology (psychology) – Sub-discipline of psychology Psychological effects of Internet use Second-order cybernetics – Application of cybernetics to itself ^ a b c Metcalfe, Janet; Shimamura, Arthur P. 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