Metacognition and learning: conceptual and methodological considerations

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This is the first issue of *Metacognition and Learning*, a new international journal dedicated to the study of metacognition and all its aspects within a broad context of learning processes. Flavell coined the term metacognition in the seventies of the last century (Flavell, 1979) and, since then, a huge amount of research has emanated from his initial efforts. Do we need metacognition as a concept in learning theory? Already in 1978, Brown posed the question whether metacognition was an epiphenomenon. Apparently, she was convinced otherwise as she has been working fruitfully for many years in the area of metacognition. Moreover, a review study by Wang, Haertel, and Walberg (1990) revealed metacognition to be a most powerful predictor of learning. Metacognition matters, but there are many unresolved issues that need further investigation. This introduction will present ten such issues, which are by no means exhaustive. They merely indicate what themes might be relevant to the journal.

Definitions of Metacognition

Metacognition was originally referred to as the knowledge about and regulation of one's cognitive activities in learning processes (Flavell, 1979; Brown, 1978). Under

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the umbrella of this inclusive definition a proliferation of metacognitive terms has unfolded through the years. Metacognitive beliefs, metacognitive awareness, metacognitive experiences, metacognitive knowledge, feeling of knowing, judgment of learning, theory of mind, metamemory, metacognitive skills, executive skills, higher-order skills, metacomponents, comprehension monitoring, learning strategies, heuristic strategies, and self-regulation are several of the terms we commonly associate with metacognition. While these terms emanated from and helped to focus research, the domain of metacognition is one that lacks coherence. Some terms refer to more general knowledge and skills in metacognition, whereas others address rather specific ones for certain age groups or types of tasks. Some of them relate to both cognitive and metacognitive processes (for instance, learning strategies and heuristic strategies), whereas others are purely metacognitive by nature. Moreover, the relation of some specific terms with the overall concept of metacognition is not unequivocally defined. Take self-regulation as an example. Some researchers consider self-regulation to be a subordinate component of metacognition (e.g., Brown & DeLoache, 1978; Kluwe, 1987), whereas others regard self-regulation as a concept superordinate to metacognition (e.g., Winne, 1996; Zimmerman, 1995). According to the latter social-cognitive perspective, self-regulation also involves motivational and social-emotional processes. Thus, while there is consistent acknowledgement of the importance of metacognition, inconsistency marks the conceptualization of the construct.

Apparently, more theoretical work needs to be done for attaining a unified definition of metacognition and its components (see Winne, 1996). Nelson (1996) gave an initial impetus to such a unified theory. Basically, he distinguished an "object-level," at which level cognitive activity takes place, from a "meta-level" which governs the object-level. Two general flows of information between both levels are postulated. Information about the state of the object-level is conveyed to the meta-level through monitoring processes, while instructions from the meta-level are transmitted to the object-level through control processes. Thus, if errors occur on the object-level, monitoring processes will give notice of it to the meta-level and control processes will be activated to resolve the problem. This seems an elegant and simple model, including both metacognitive knowledge and skills. However, research based on Nelson's theory has been limited primarily to metamemory and the phenomena of Feeling-of-Knowing and Judgment-of-Learning (Metcalfe & Shimamura, 1994; Dunlosky & Nelson, 1992).

Components of Metacognition

The most common distinction in metacognition separates metacognitive knowledge from skills. The former refers to a person's declarative knowledge about the interactions between person, task, and strategy characteristics (Flavell, 1979), whilst the latter refers to a person's procedural knowledge for regulating one's problem-solving and learning activities (Brown & DeLoache, 1978; Veenman, 2005). Metacognitive knowledge about our learning processes can be correct or incorrect, and this self-knowledge may be quite resistant to change. For instance, a student may incorrectly think that (s)he invested enough time in preparation for math exams, despite repeated failure ("but the teacher made the exams so hard to pass..."). Such misattributions prevent students from amending their self-knowledge.

Metacognitive skills, on the other hand, have a feedback mechanism built-in. Either you are capable of planning your actions ahead and task performance progresses smoothly, or you don't and your actions go astray. Or, you may be unsure of task performance status as metacognitive skills are developing. Failing metacognitive skills may render new metacognitive knowledge, but the process of skill acquisition takes time and effort.

Researchers have distinguished many more specific components of metacognition, but they seem to disagree about the nature of those components. For instance, Metamemory is often merely studied from a declarative-knowledge perspective, while monitoring processes are heavily involved in generating this knowledge (cf. Lockl & Schneider, this issue). Similarly, Feeling of Knowing and Judgment of Learning have been investigated as metacognitive processes (driven by metacognitive experiences; Efklides & Vauras, 1999), or rather as product measures (i.e., the knowledge generated). Finally, conditional knowledge about 'what to do when' is sometimes considered as metacognitive awareness and declarative knowledge (Alexander, Schallert & Hare, 1991; Desoete & Roeyers, 2003; Schraw & Moshman, 1995), or as being intrinsically part of metacognitive skills (in line with the cognitive phase of Anderson's ACT-R model; cf. Veenman, 1998). Obviously, more precise taxonomies of metacognitive knowledge and skills are needed. Such extensive descriptions of metacognitive activities have been made for text studying by Pressley and Afflerbach (1995; Pressley, 2000). In the same vein, Meijer, Veenman, and Van Hout-Wolters (in press) developed a hierarchical model of metacognitive activities for both text-studying and problem-solving tasks in different domains. Additional to these taxonomies of components and subcomponents of metacognition, the relations amongst those components need further clarification. For instance, the work of Lockl and Schneider (this issue) shows that advanced Theory of Mind leads to improved metamemory at a later stage. We endorse further research into the intricate relations between Theory of Mind, metamemory, metacognitive experiences and awareness, metacognitive knowledge, and metacognitive skills (cf. Thorpe & Satterly, 1990). We view this state of affairs as healthy and inevitable, with the dynamic evolution of scientific knowledge fueled by diverse, related traditions of research inquiry.

Complex Relation between Metacognition and Cognition

Most conceptualizations of metacognition have in common that they take the perspective of "higher-order cognition about cognition." There is a higher-order agent overlooking and governing the cognitive system, while simultaneously being part of it. This is the classical homunculus problem or Comte's paradox: One cannot split one's self in two, of whom one thinks whilst the other observes him thinking. The issue whether cognition and metacognition can be disentangled is not merely an academic one. In fact, metacognition draws on cognition. It is very hard to have adequate metacognitive knowledge of one's competencies in a domain without substantial (cognitive) domain-specific knowledge, such as knowledge about relevant concepts and theories in a domain, about intrinsic difficulties of a domain, and about what is irrelevant (cf. Pressley, this issue). In terms of metacognitive skills, one cannot engage in planning without carrying out cognitive activities, such as generating problem-solving steps and sequencing those steps. Similarly, one cannot check one's outcome of a calculation without comparing the outcome with an estimation of it, or recalculating the outcome in another way.

If metacognition is conceived as (knowledge of) a set of self-instructions for regulating task performance, then cognition is the vehicle of those self-instructions. These cognitive activities in turn are subject to metacognition, for instance, to ongoing monitoring and evaluation processes. This circular process of metacognitive and cognitive activities makes it hard to disentangle them in the assessment of metacognition. Occasionally, metacognition can be observed in students' verbalized self-instructions, such as "this is difficult for me, let's do it step-by-step" or "wait, I don't know what this word means." Metacognition, however, is not always explicitly heard or seen during task performance. Instead, it has often to be inferred from certain cognitive activities. For instance, doing things step-by-step may be indicative of planned behavior, although self-instructions for planning are not explicitly verbalized. Future research has to differentiate far more precisely between explicitly verbalized metacognitive knowledge and self-instructions, cognitive activities that are indicative of metacognition, and purely cognitive activity.

Despite their intertwined relation with cognitive processes, metacognitive skills cannot be equated with intellectual ability (cf. Sternberg, 1990). There is ample evidence that metacognitive skills, although moderately correlated to intelligence, contribute to learning performance on top of intellectual ability. On the average intellectual ability uniquely accounts for 10 percent of variance in learning, metacognitive skills uniquely account for 17 percent of variance in learning, whereas both predictors share another 20 percent of variance in learning for students of different ages and background, for different types of tasks, and for different domains (for an overview, see Veenman, Wilhelm & Beishuizen, 2004; Veenman & Spaans, 2005). The implication is that an adequate level of metacognition may compensate for students' cognitive limitations.

Conscious vs. Automatic Metacognitive Processes

Does metacognition by definition require conscious processing, or may metacognitive activities also appear on a less conscious level? Some researchers (e.g., Nelson, 1996; Schnotz, 1992) claim that metacognition must be conscious in order to represent higher-order processing. Others (e.g., Baker, 1994; Reder, 1996; Veenman, Prins & Elshout, 2002) allow less conscious processing to be metacognitive by nature, for instance, if ideas about oneself have been firmly established or if the activity of checking yourself has become a regulatory 'good' habit. Many evaluation and self-monitoring processes run in the 'background' of the cognitive processes that are being executed. Only after an error is detected, rightfully or not, the system becomes alerted. To take this issue one step further, Bandura (1989) assumed that such behavior is modeled after the effective behavior of models (teachers, parents, peers) through observation and vicarious learning. That is, without much conscious processing of the modeled behavior. Would the automated self-instructions of checking oneself be less metacognitive or self-regulatory by nature relative to a metacognitive activity consciously decided upon? This question relates to the philosophical contrast between self-determination versus externally controlled behavior. Further, there is the perennial issue of what constitutes a skill and what constitutes a strategy. Respectively, they may be distinguished by their automaticity or intentionality. Clear and consistent conceptualizations of metacognitive skill and metacognitive strategy are needed (Afflerbach, Pearson & Paris, in preparation).

General vs. Domain-Specificity of Metacognition

An issue of particular importance to educators is whether metacognition is general by nature, or rather task and domain specific. General metacognition may be instructed concurrently in different learning situations and may be expected to transfer to new ones, whereas specific metacognition has to be taught for each task or domain separately. Much research on metacognition only pertains to one specific task or domain, such as reading and text studying (Afflerbach, 1990; Leutner & Leopold, 2000; Nist, Simpson & Olejnik, 1991; Otero, Campanario & Hopkins, 1992; Van Kraayenoord & Schneider, 1999; Veenman & Beishuizen, 2004; Zhang, 2001), writing, math problem solving (Desoete & Roeyers, 2003; Kramarski & Mevarech, 2003), science classes (Thomas, 2003), and economy lessons (Masui & De Corte, 1999). Although these studies provide detailed information of how metacognition operates in specific tasks and domains, we need to compare metacognition across tasks and domains. So far, studies with multiple tasks or domains yielded inconclusive results. Research by Schraw et al. (Schraw, Dunkle, Bendixen & Roedel, 1995; Schraw & Nietfeld, 1998) revealed that monitoring skills are general by nature, whereas Kelemen, Frost and Weaver (2000) provided evidence against such a general skill. In the same vein, Glaser, Schauble, Raghavan and Zeitz (1992) observed many differences in metacognitive activity between different tasks, whereas Veenman et al. (Veenman, Elshout & Meijer, 1997; Veenman & Verheij, 2003; Veenman et al., 2004) obtained strong support for the generality of metacognitive skills.

One of the reasons for these equivocal results may be found in the grain of analysis used by researchers. At first glance, metacognitive activities may differ from one task to the other, say text studying vs. problem solving. Orienting activities for text studying include reading the title and subheadings, scanning the text to get an overview, activating prior knowledge, and getting hold of test expectations. Orientation during problem solving, on the other hand, encompasses reading the problem statement, activating prior knowledge, and establishing what is given and what is asked for. Although specific overt activities are evoked by different learning tasks, these divergent activities may spring from similar metacognitive grounds and their occurrence and quality may still be correlated across tasks and domains. In conclusion, we need to identify the grain of analysis in our metacognitive assessments and to bring statistical analyses in line with it. Apart from testing for differences in frequencies of metacognitive activity, also correlational analyses, PCA, or Lisrel should be applied (see Veenman et al., 1997). Moreover, we need to systematically vary the tasks and domains involved in such research (see e.g., a taxonomy of task types by Elshout-Mohr, Van Hout-Wolters & Broekkamp, 1999).

Developmental Processes in Metacognition

From the literature on metacognition development (e.g., Brown, 1978; Flavell & Wellman, 1977; Kuhn, 1999), the following picture emerges. Theory-of-Mind develops somewhere between the age of 3 to 5 years (Flavell, 2004; Lockl & Schneider, this issue). In the years thereafter, metamemory and metacognitive knowledge develop, but continue to do so during life span (Alexander, Carr &

Schwanenflugel, 1995). Metacognitive skills emerge at the age of 8 to 10 years, and expand during the years thereafter (Berk, 2003; Veenman & Spaans, 2005; Veenman et al., 2004). Moreover, certain metacognitive skills, such as monitoring and evaluation, appear to mature later on than others (e.g., planning). Research by Whitebread (1999; EARLI conference in Cyprus, 2005), however, has shown that the behavior of very young children (say, 5 yr. olds) may reveal elementary forms of orientation, planning and reflection if the task is appropriated to their interests and level of understanding. This means that our model of metacognitive development needs some revision. Most likely, metacognitive knowledge and skills already develop during preschool or early-school years at a very basic level, but become more sophisticated and academically oriented whenever formal educational requires the explicit utilization of a metacognitive repertoire.

Evidently, we need to know more about what components of metacognition develop when and under what conditions (cf. Thorpe & Satterly, 1990). Moreover, we need to know how the development of a metacognitive component contributes to the subsequent development of other ones. For instance, longitudinal research by Lockl and Schneider (this issue) reveals that a higher level of Theory-of-Mind leads to improved metamemory in the following years, even when confounding factors are controlled for. Similar research for sequential developmental effects in other components of metacognition is needed.

Alexander et al. (1995; this issue) showed that metacognitive knowledge develops along a monotonic incremental line throughout the school years, parallel to the development of intellectual ability of students. The impact of intelligence neither increases, nor diminishes over the years. Similarly, Veenman et al. (2004) obtained similar results for the development of metacognitive skills in relation to intellectual ability. In other word, intelligence only gives students a head start in metacognition, but it does not further affect its developmental course.

It seems that metacognitive skills initially develop in separate domains, and later on become generalized across domains (Veenman & Spaans, 2005). We need to determine the processes that are responsible for this transfer across domains along the developmental trajectory. These processes include, amongst others, high road transfer (Salomon & Perkins, 1989), and linking metacognition through instruction and feedback provided by teachers (see below). Additionally, examination of the connection of metacognitive development in formal educational settings and other settings is needed.

Assessment of Metacognition

The evolution in understanding metacognition is paralleled by an evolution in our understanding of assessments that are suitable for measuring and describing metacognition (Pellegrino, Chudowsky, & Glaser, 2002). Many methods for the assessment of metacognition are being used, such as questionnaires (Pintrich & de Groot, 1990; Thomas, 2003), interviews (Zimmerman & Martinez-Pons, 1990), the analysis of thinking-aloud protocols (Afflerbach, 2000; Veenman, Elshout & Groen, 1993), observations (Veenman & Spaans, 2005), stimulated recall (cf. Van Hout-Wolters, 2000), on-line computer-logfile registration (Veenman et al., 2004), and eye-movement registration (Kinnunen & Vauras, 1995). All these assessment methods have their pros and cons. For instance, questionnaires are easy to

administer to large groups, whereas thinking-aloud protocols require individual assessments. Furthermore, some assessment methods may be more intrusive than others. We need, however, to determine far more precisely what metacognitive knowledge or skill component can be assessed successfully by which method. For instance, too often it is taken for granted that metacognitive activity or strategy use can be assessed by means of questionnaires, while scores on these questionnaires hardly correspond to actual behavioral measures during task performance (Veenman, 2005; Veenman, Prins & Verheij, 2003).

One clear distinction in assessment methods pertains to off-line versus on-line methods (Van Hout-Wolters, 2000; Veenman, 2005). Off-line methods are presented either *before* or *after* task performance, whereas on-line assessments are obtained *during* task performance. On-line methods appear to be more predictive of learning performance relative to off-line methods, even when the latter are administered retrospectively to task performance (Veenman, 2005). In order to understand this disparity between various assessment methods, we need research with multi-method designs, which at present is scarcely available in the literature on metacognition.

Conditions for the Acquisition and Instruction of Metacognition

The vast majority of students spontaneously pick up metacognitive knowledge and skills to a certain extent from their parents, their peers, and especially their teachers. Students, however, show a considerable variation in their metacognitive adequacy. Some student grow up under favorable conditions with ample opportunities for acquiring metacognitive knowledge and skills, while others successfully profit from the sparse opportunities they get. Still, a substantial group cannot spontaneously acquire a metacognitive repertoire, either because the opportunity to do so is missing or they do not see the relevance of investing effort in building up such a repertoire. Metacognitive instruction appears to enhance metacognition and learning in a broad range of students (Veenman, Elshout & Busato, 1994), but obviously it is of particular relevance to poor students (see Pressley, this issue). Three fundamental principles are known from the literature for successful metacognitive instruction: a) embedding metacognitive instruction in the content matter to ensure connectivity, b) informing learners about the usefulness of metacognitive activities to make them exert the initial extra effort, and c) prolonged training to guarantee the smooth and maintained application of metacognitive activity. Veenman (1998) referred to these principles as the *WWW&H rule* (What to do, When, Why, and How). Any successful instructional program (e.g., reciprocal teaching by Brown & Palincsar, 1987; but also Masui & De Corte, 1999; Kramarski & Mevarech, 2003; Pressley, this issue; Veenman et al., 1994; Volet, 1991), abides with these three principles. Research on metacognitive instruction often merely reports product measures (i.e., the effects on learning outcomes). In order to establish causal relations between metacognitive instruction and learning outcomes, however, also process measures of metacognition need to be assessed in a pretest-posttest design.

A distinction must be made between students suffering from either an availability or a production deficiency of metacognition (Veenman, Kerseboom & Imthorn, 2000; Winne, 1996). Students with an availability deficiency do not have sufficient

metacognitive knowledge and skills at their disposition, and metacognitive instruction has to start from scratch on. Students with a production deficiency, on the other hand, have a certain level of metacognitive knowledge and skills at their disposition, but fail to use their metacognition due to task difficulty, test anxiety, lack of motivation, or their inability to see the appropriateness of metacognition in a particular situation. Instruction, then, could be limited to cueing metacognitive activities during task performance (Veenman, Kok & Blöte, 2005). This shows that the individual conditions of students have to be taken into account when deciding upon what to train and how to instruct metacognition.

Little is known about the role of the teacher as a model, that is, as setting the example for students and providing them with feedback. In fact, many teachers lack sufficient knowledge about metacognition: When we interviewed teachers about metacognition their incidental responses did not go beyond "independent learning...," while a further query about how they applied metacognition in their lessons only resulted in blanks (Veenman, Kok & Kuilenburg, 2001; but see also Zohar, 1999). Teachers are absolutely willing to invest effort in the instruction of metacognition within their lessons, but they need the 'tools' for implementing metacognition as an integral part of their lessons, and for making students aware of their metacognitive activities and the utility of those activities. Generalized metacognitive instruction is not only a matter of individual teachers, but also of school organisation (Pressley, this issue; Veenman et al., 2004). Many teachers, however, experience difficulties in crossing the borders of their own field of expertise. Math teachers find it hard to come to terms with, for instance, teachers in geography or history, and visa versa.

Relation of Metacognition with other Individual Differences

Metacognition need not be studied in splendid isolation. A large group of researchers is involved in determining the complex relations between metacognitive experiences, epistemological beliefs, metacognitive knowledge, and self-regulation on the one hand, and motivational processes, self-efficacy, and study interests on the other (Boekaerts, 1997; Efklides & Vauras, 1999; Mason & Scrivani, 2004; Pintrich & De Groot, 1990; Pintrich & Schunk, 2002; Zimmerman & Martinez-Pons, 1990). Others are interested in the relationship between metacognition and affective variables, such as test anxiety (Tobias & Everson, 1997; Veenman et al, 2000). Some focus on the role of metacognition in learning disorders or disabilities (Borkowski, 1992; Harris, Reed, & Graham, 2004; Swanson, Christie & Rubadeau, 1993). Learning does not take place in a void, and neither does metacognition. We need to know a lot more about how individual differences and contextual factors interact with metacognition and its various components.

Neuropsychological Research

So far, neuropsychological research on metacognition has been limited to highly specific metacognitive processes (e.g., Feeling of Knowing, Metcalfe & Shimamura, 1994; Pinon, Allain, Kefi, Dubas & Le Gall, 2005). We would like to see this kind of research extended to other components of metacognitive functioning, such as

planning or reflection, from a developmental perspective, from a diagnostic perspective, as well as from an instructional perspective.

Conclusion

We believe that the preceding overview of issues in need of further research creates a compelling case for a new journal specializing on metacognition and learning. There are, however, separated groups of metacognition researchers with different backgrounds: Developmental psychologists studying Theory-of-Mind; metamemory researchers; educational researchers investigating the relation between motivation, metacognitive knowledge, and self-regulation; educational researchers focusing on the role of metacognitive skills and the training of those skills; and cognitive psychologists scrutinizing Feeling-of-Knowing and Judgment-of-Learning phenomena. Despite occasional interactions between research groups with different research orientations, they tend to publish in their own journals and books. It is like fishermen in their private boats on a foggy lake. All bring their valuable catch ashore, but there is different fish delivered at different harbors. *Metacognition and Learning* intends to bridge this gap and we endorse papers that cross the boundaries of various orientations on metacognition. For instance, by addressing several components of metacognition, multiple tasks and domains, and multi-method designs in both the theoretical discussion and the empirical study of metacognition.

This first issue of *Metacognition and Learning* provides a kaleidoscopic view on research into metacognition. Lockl and Schneider present a longitudinal study on whether Theory-of-Mind precedes the development of metacognitive vocabulary and metamemory knowledge. Efklides, Kourkoulou, Mitsiou and Ziliaskopoulou address the metacognitive processes underlying effort exertion. Alexander et al. investigate the effect of verbal intelligence on the development of metaconceptual knowledge. Butterfield and Metcalfe provide a theoretical discussion of the hyper-correction effect, complemented with empirical results from two studies. Their paper explains why we learn from errors that startle us. Mevarech and Fridkin examine the effects of a metacognitive instructional program on students' self-reports of metacognition, their math knowledge and math reasoning. Finally, Pressley tells a success story of a metacognitive school intervention for students suffering from problems with reading proficiency. Most important, he describes in detail what array of factors contributed to the effectiveness of this intervention program.

The Editorial team of *Metacognition and Learning* appreciates the submission of papers on metacognition, which papers are reviewed double-blind on theoretical relevance, methodological thoroughness, and appeal to an international audience. The journal aims for a high academic standard with relevance to the field of educational practices. One restriction, therefore, is that papers should pertain to the role of metacognition in *educational settings*. Self-regulation in clinical settings, such as coping with phobia or anxiety outside learning situations, is beyond the journal's scope.

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