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Contributions of metacognitive and self-regulated learning theories to investigations of calibration of comprehension

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Abstract

In this paper we examine the contributions of metacognitive and self-regulated learning theories to research on students' calibration of comprehension. Historically, cognitive psychologists have studied calibration of comprehension within a purely metacognitive framework, with an emphasis on the role of text and task factors but little consideration of factors of self. There has been a recent trend, however, towards incorporating a social cognitive perspective to the study of calibration of comprehension, with factors of self such as motivation and affect being examined more often. Among the factors of self that have been examined, self-efficacy has played a major role as it may be all but impossible to disentangle its influence on students' calibration of comprehension. Other variables of self that have been examined include ability, familiarity, ego and goal-orientation, goal setting, personality traits and susceptibility to social and cultural influences. Broadening the context in which calibration of comprehension is assessed allows a more complete examination of the rich set of interrelated processes that affect students' performance.

Keywords: Calibration, Metacognition, Self-Regulated Learning

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Introduction

Over the last several years psychologists have become increasingly interested in students' metacognition or awareness of cognitive processes (Veenman, Van Hout-Wolters, & Afflerbach, 2006) and its role in learning. In an early and influential paper on the topic of metacognition, Flavell (1979) suggested that awareness of cognitive processes consisted of both metacognitive knowledge and metacognitive experiences. Flavell's early conceptualization of metacognition proved to be quite durable and influential and remains the most commonly used one today. And, importantly, students' metacognition has been linked to increased learning, improved performance and greater achievement of educational goals (Dunlosky & Lipko, 2007; Lunderberg, Fox, Brown, & Elbedour, 2000; Miesner & Maki, 2007; Moore, Zabrucky, & Commander, 1997; Pintrich, 2002; Rickey & Stacey, 2000; Thiede, Anderson, & Therriault, 2003; Tobias & Everson, 2002-2003; Wiley, Griffin, & Thiede, 2005; Zabrucky & Moore, 1994).

Metacognitive knowledge refers to the general knowledge students have about their own or others' cognitive processes. This knowledge is typically acquired incrementally through experience and is relatively stable. For example, students are likely to continuously know that a simpler text is easier to comprehend than a more complex text and that certain strategies, such as rereading, can assist in clarifying difficult to understand passages. Metacognive experiences include the processes of evaluating and regulating one's ongoing cognition and are not necessarily stable. For example, when students ask themselves questions during reading, they are evaluating their understanding**.** If students opt to reread one or more sentences or paragraphs because they are having difficulty understanding, then students are regulating their understanding**.** As teachers are all too aware, students may not always correctly identify the extent of their comprehension or consistently use the most appropriate strategies (or, indeed, any strategies) to overcome comprehension failures. Thus, although metacognitive knowledge can lead to enhanced metacognitive experiences and improved performance, it need not necessarily do so. Knowing that a difficult passage needs to be reread does not guarantee that it will be. Intuitively, students must also possess the necessary motivation to engage in and successfully complete a task.

In the present paper we examine students' calibration of comprehension. Traditionally, the calibration paradigm has been used to measure students' ability to evaluate their level of text understanding and is, as such, a particularly critical component of students' metacognitive experiences (see Lin & Zabrucky, 1998, for a review). Calibration of comprehension is a measure of the relationship between students' perceived competence and their actual performance. Traditionally, calibration skills have been assessed in a controlled environment in which students are asked to read a series of texts and then predict how well they expect to perform on

a comprehension test to follow (Glenberg & Epstein, 1985; Glenberg, Sanocki, Epstein & Morris, 1987; Glenberg, Wilkinson, & Epstein, 1982; Lin, Zabrucky, & Moore, 2002; Maki & Berry, 1984; Maki & Serra, 1992a, 1992b; Weaver, 1990). Students' calibration accuracy is then determined by comparing their predicted performance to their actual performance. The term calibration of comprehension was first coined by Glenberg and Epstein (1985) who found that students' predictions were generally unrelated to their performance.

Students' post-hoc predictions of confidence have been termed calibration performance or postdiction (Glenberg et al. 1987). These confidence judgments differ from calibration of comprehension judgments in that they are assessed after students have read a text and completed a comprehension test. Research suggests that students are generally more accurate at postdictions than predictions, presumably because the additional feedback obtained from taking a test is useful in later assessments (Glenberg & Epstein, 1985; Hacker, Bol, Horgan & Rakow, 2000; Maki, Jonas, & Kallod, 1994; Zabrucky, Lin, & Moore, 2009).

More recently, students' calibration skills have been studied in a classroom setting by examining their calibration accuracy for classroom tests (Hacker et al., 2000; Lin-Agler, Moore, & Zabrucky, 2004) or for course grades (Finney & Schraw, 2003; Garavalia & Gredler, 2002; Zimmerman, Bandura & Martinez-Pons, 1992). Recent findings have been more optimistic than earlier ones suggesting that students' perceived and actual performances were unrelated (Glenberg & Epstein, 1985, 1987; Glenberg et al., 1982). Still, current findings suggest that students are, at best, only moderately able to calibrate their comprehension (Hacker et al., 2000; Lin, Moore & Zabrucky, 2001; Lin & Zabrucky, 1998; Magliano, Little, & Graesser, 1993; Maki, Foley, Kajer, Thompson & Willert, 1990; Maki & Serra, 1992a, 1992b; Weaver, 1990; Weaver & Bryant, 1995) although performance can be improved under certain conditions (Rawson, Dunlosky, & Thiede, 2000; Thiede & Anderson, 2003).

Traditionally, the calibration paradigm has been used to measure students' metacognitive skills for comprehension. Evidence suggests that high achieving students, who, intuitively, should be the most aware of what they do and do not know, are more accurately calibrated than their lower achieving peers (Bol & Hacker, 2001**;** Glover, 1989**;** Hacker et al., 2000; Maki & Berry, 1984**;** Pajares & Kranzler, 1995). On the other hand, it has been suggested that poor calibrators either lack knowledge about cognition, or ability to regulate cognition, or both (Schraw & Graham, 1997). Of course, it is also possible that poor calibrators possess the necessary metacognitive knowledge or skills, but lack the motivation to consistently or effectively use them (Borkowski & Cavanaugh, 1979).

In an interesting series of studies that extend the findings on calibration discussed so far, Kruger and Dunning (1999) attempted to

explore the underlying mechanisms involved in individuals' poor calibration skills. Across four studies, Kruger and Dunning found that participants who scored at the bottom quartile on tests of various domains (e.g., ability to recognize humor, knowledge of grammar and logical reasoning skills) were not only more likely to overestimate their abilities but also incorrectly assume that they were above average in skill levels. On the other hand, participants who scored at the top quartile on the same tests underestimated their abilities and overestimated the abilities of others. Across studies Kruger and Dunning demonstrated that students with less knowledge not only lacked the necessary skills to calibrate successfully but also lacked the ability to recognize that their performance was poor. Further, unlike high performing students, students who performed poorly failed to adjust their perceptions of their own competence by observing the behavior of others (see, also, Kruger and Dunning, 2002).

In the present paper we examine variables of self that have been found to impact the accuracy of students' calibration of comprehension. Traditionally, cognitive psychologists have studied calibration of comprehension with little consideration of factors of self. However, there has been a recent trend towards incorporating a more social cognitive perspective within investigations, with factors of self such as motivation and affect being examined more often (Chen, 2003; Finney & Schraw, 2003; Pajares, 1996; Pajares & Kranzler, 1995; Zimmerman et al. 1992). Thus, we examine the calibration literature emerging from *both* a cognitive and a social cognitive perspective. Theories of self-regulated learning will be discussed from a social cognitive perspective with a special emphasis on the construct of self-efficacy, as it may be all but impossible to disentangle its role on students' calibration of comprehension. In addition to self-efficacy beliefs, we examine ability, familiarity, ego and goal-orientation, goal-setting, personality traits, and susceptibility to social and cultural influences.

Calibration of comprehension within a self-regulated learning context

According to Zimmerman (1990), researchers need to abandon the practice of examining metacognition *solely* as the reflection of one's cognitive abilities. Rather, he suggests that metacognition must also include the complex interactions among the social psychological variables of motivation, emotion, and behaviour. Furthermore, he proposes that these variables can not be eliminated from the equation because they account for the necessary humanistic nature of metacognition. For instance, by excluding these variables it is rather difficult to explain why a typically high performing student may inaccurately evaluate his or her comprehension or neglect to regulate his or her learning, especially when knowing it is advantageous to do so. However, by allowing for these additional factors, it is easier to comprehend how an upcoming soccer match, a fear of appearing ill-prepared, an unlikable course or professor, or an unusually poor score on a previous quiz may affect a student's ability to effectively monitor learning.

Any one of these everyday situations can affect a student's monitoring by acting as a competing goal or by altering affective states by producing anxiety or despondency. Thus, the motivational or affective states of students should not be ignored. By examining metacognition with consideration of such factors as motivation, behaviour, and affect, researchers shift their focus from a cognitive to a social cognitive perspective. According to Jost, Kruglanski, and Nelson (1998), social cognitive psychologists have long contributed to the research of metacognition but have yet to receive the proper acknowledgment for their contributions.

Self-regulated learning is a process that involves setting goals, implementing strategies to achieve goals, monitoring performance towards reaching goals, and, finally, an evaluation of the task (Butler & Winne, 1995). Ultimately metacognitive and self-regulated learning theories are both mechanistic approaches to understanding how one most effectively learns. Metacognitive and self-regulated learning theories both explore the acquisition, evaluation and regulation of knowledge (Puustinen & Pulkkinen, 2001). An assumption shared by both models regarding cognition is that the acquisition of new knowledge in an unfamiliar domain requires extra cognitive effort, so that very few cognitive resources remain to be spent on monitoring (Puustinen & Pulkkinen, 2001). Metacognitive and self-regulated learning theories share consonant views of the learner as being capable of monitoring his or her own learning. Similarly, both agree that the learner benefits from such tasks as setting goals, and evaluating and regulating one's progress. However, self-regulated learning models *also* incorporate one's ability to control aspects of personal agency, such as motivation and affect.

Boekaerts (1995) suggests that metacognitive awareness should not be studied without a consideration of the learner's self-referenced thoughts and affective states within a specific domain because these variables of self can assist in explaining how metacognition and self-regulated learning develop and why they fail to develop. Efklides (2008) has also discussed the need for a more inclusive and comprehensive approach to the study of metacognition, suggesting that the critical role played by metacognition in self- and co-regulation of behaviour "make it necessary to reconsider the notion of metacognition and, particularly, its facets and their interrelationships, as well as the relationship of metacognition with cognition at the individual and social level, and the relationships of metacognition with affect" (p. 277). Efklides (2008; 2009) notes the need to understand affective as well as cognitive factors that play a role in metacognition and has developed a multifaceted model that outlines the role of cognitive and emotional regulation at a nonconscious level as well as the role of metacognitive knowledge, metacognitive experiences and metacognitive feelings (largely ignored by others) at the personal and social levels. Her ideas stress that metacognition is an important and multi-faceted component of self-

regulated learning. Similarly, Bandura (1982) suggests that the concept of self-referent thoughts helps us understand how and why a student takes acquired knowledge and, in turn, translates that knowledge into action, because self-referent thoughts mediate the relationship of knowledge to action through motivation, behaviour and affect. By bridging the gap between cognitive and social cognitive research, researchers are better equipped to understand the full range of influences on calibration.

According to Zimmerman (1990), self-regulated learners are aware of what they do and do not know, which intuitively suggests that they are more accurate calibrators. Furthermore, evidence suggests that self-regulated learners are typically high achieving students (Butler & Winne, 1995; Pintrich & de Groot, 1990; Zimmerman, et al., 1992), as are accurate calibrators (Bol & Hacker, 2001; Hacker et al., 2000; Maki & Berry, 1984). The distinction between the two constructs is that self-regulation is a process of learning, whereas calibration is the result, or measurement of the learning process. During the process of self-regulated learning, critical errors can occur that may affect calibration accuracy. For example, evaluation errors can occur when students become over or under confident in their comprehension. Such errors can affect students' motivation to persist on tasks and ultimately can deter students from reaching their intended goals (Butler & Winne, 1995). Self-efficacy beliefs, goal setting, and goal orientation are among the most common variables of self to be studied in conjunction with self-regulated learning (Stone, 2000). In addition to the role of affect, each of these variables has been found to influence the processes of self-regulated learning (Bandura, 1986; Zimmerman, 1990).

Currently there is not an agreed upon cohesive definition of self-regulation. This is largely due to the fact that the two most basic components of self-regulated learning, metacognition and motivation, have traditionally been studied in isolation from one another (Puustinen & Pulkkinen, 2001). Although there is a general consensus among self-regulated learning theorists that metacognition is composed of both metacognitive and motivational components, there are also a few who argue that metacognition contains a metamotivational component. In fact, Wolters (2003) proposes that a metamotivational component, which he refers to as the regulation of motivation, must be present in order for effective learning to occur. He suggests that, conceptually, the regulation of motivation and the regulation of cognition are alike yet they work towards different goals. While the regulation of cognition is primarily responsible for students' effective use of strategies, the regulation of motivation is mostly responsible for ensuring that students maintain the necessary motivation to complete a task, or to construct meaning. Furthermore, Wolters posits that these processes most often work simultaneously, making it difficult to discriminate one from the other. The distinguishing feature between motivation and metamotivation is students' awareness and purposeful

control of the latter. In other words, the regulation of motivation is concerned with the deliberate thoughts and actions of students to control their motivation. Students may avoid or disengage from learning activities because the activities do not invoke efficacious feelings. Although students' self-efficacy beliefs may affect such decisions as choice, effort and persistence, students may not consciously understand or control these decisions. Thus, the influences of self-efficacy beliefs are considered motivational, unless students intentionally managed some part of their actions, in which case the processes would be considered the regulation of motivation.

Similarly, Boekaerts' (1995) adaptable learning model suggests that metamotivational skills are similar to, and just as important as, metacognitive skills in the process of self-regulated learning. According to her model, metamotivation is divided into two components: motivation control and action control. Boekaerts refers to motivation control as the ability to conjure up positive self-referent cognitions, or positive feelings of affect, which assist in setting goals. In other words, it is during the process of motivation control that goal selections are made. She refers to action control as the ability to maintain control over the learning environment, such as blocking competing interferences, in order to reach the established goals. Boekaerts refers to this latter component as a volitional process in assisting students in protecting and pursing their goals. According to her model, students must possess both the necessary metacognitive and metamotivational self-regulatory skills in order to be effective learners.

Self-efficacy beliefs

By examining students' self-efficacy beliefs, researchers have been able to study the impact of self-referenced thoughts on calibration accuracy (Chen, 2003; Finney & Schraw, 2003; Pajares, 1996; Pajares & Kranzler, 1995; Pajares & Miller, 1995; Schunk, 1990; Zimmerman, 1990, 1995, 2000). Students' self-efficacy beliefs are judgments of their capability to organize and execute their actions to accomplish specific tasks (Bandura, 1982). Research suggests that self-regulated learners typically possess more efficacious beliefs and set more challenging goals than others (Pintrich & de Groot, 1990; Zimmerman, 1990; Zimmerman et al., 1992). It has been suggested that, when students meet their goals, their self-efficacy beliefs increase, which, in turn, sustains their motivation and use of strategies (Bandura, 1986; Schunk, 1990). By setting goals and by routinely re-examining success or failure in meeting these goals, students create a learning environment in which they are more likely to monitor their own comprehension. Self-efficacy beliefs have also been reported to increase effort expenditure, persistence and academic achievement (Bandura, 1986; Pajares, 1996; Pintrich & De Groot, 1990; Pajares & Miller, 1995; Zimmerman & Bandura, 1994; Zimmerman et al., 1992). Still, overconfident self-efficacy beliefs may result in a false sense of preparedness which can have a negative affect on performance. On the other hand, it has been

suggested that under confident self-efficacy beliefs can also hinder performance by generating motivational deficits (Bandura, 1986). Regardless, it is reasonable to assume that not all students with low self-efficacy beliefs have within them the requisite knowledge or skills necessary to perform a particular task.

According to Bandura (1986), self-referent thoughts mediate the relationship of knowledge to action through *motivation, behaviour and affect*. In fact, Bandura suggests that self-efficacy beliefs are a better predictor of achievement than ability because self-efficacy beliefs determine how students use their skills and knowledge. Studies using path analyses have revealed that ability and self-efficacy beliefs make independent and direct contributions to performance (Chen, 2003; Pajares & Kranzler, 1995; Zimmerman & Bandura, 1994; Zimmerman et al., 1992). Thus, self-efficacy beliefs have been found to contribute to performance beyond the contributions of ability, skill level, and prior experiences. Sources of self-efficacy beliefs include mastery experiences (past performance), vicarious experiences (watching others), social/verbal persuasion, and physiological or emotional states (Bandura, 1986). Although it is possible to access students' self-efficacy beliefs at any specific moment in time (e.g. in the calibration paradigm), it is much more difficult to access the origins and on-going sources of these beliefs (Klassen, 2004).

Self-efficacy is not a global construct, such as academic self-concept, but is instead uniquely related to specific tasks (Bandura, 1986; Finney & Schraw, 2003; Pajares, 1996; Zimmerman, 1990). Thus, when students make performance predictions they are assessing their self-efficacy beliefs or making judgments about their specific capabilities for performing a precise task (Finney & Schraw, 2003; Klassen, 2002; Pajares, 1996; Pajares & Kranzler, 1995; Pajares & Miller, 1995). For example, students may perceive themselves as being generally good students, while simultaneously maintaining low efficaciousness in their ability to perform specific algebraic equations. Thus, although these students have high academic self-concepts, they still maintain low self-efficacy beliefs for specific algebraic tasks.

Similarly, metacognitive skills are recognized as being domain-specific rather than domain-general (Boekaerts, 1996; Schraw, 1997). According to the domain-specific hypothesis, students' confidence judgments will be related to performance on a specific test but not to predictions or performance on unrelated tests (Schraw, 1997). Per this perspective, students' regulatory skills increase as their knowledge increases within a domain. In other words, regulatory skills originate within a specific domain and will be at best mildly useful in unrelated domains. In contrast, the domain-general hypothesis suggests that regulatory skills such as knowing to reread a chapter, creating a good study environment, or asking inference questions are skills which can be accessed independently of domain-specific knowledge (Schraw, 1997). Thus, regardless of how familiar students are with any domain, their regulatory skills should not be any better or any

worse in any other domain. Similarly, regardless of domain, students' confidence judgments should not vary much from one test to another.

In order to accurately measure self-efficacy beliefs, two essential precepts must be met. First, students must assess their capabilities for performing specific tasks (Pajares, 1996). These tasks must be similar but not identical to the actual tasks on the criterion test. Second, the criterion test should be administered immediately after students have completed their self-assessments (Bandura, 1986). In order to test the validity of these precepts, Finney and Schraw (2003) examined the task specific and variable nature of self-efficacy beliefs. In their study, two scales were developed to measure students' self-efficacy for statistics beliefs over the course of a semester. Both scales identified students' self- perceived competencies for task specific skills (i.e. distinguish between a population parameter and a sample statistic) and were administered along with a third measure of self-efficacy for general mathematics, immediately prior to the criterion test. The first scale, current statistics self-efficacy (CSSE), measured students' confidence in their ability to perform specific statistical tasks, while the second, self-efficacy to learn statistics (SELS), measured students' perceived competence for learning specific statistical tasks. As predicted, performance was more closely related to students' current statistics self-efficacy (CSSE) beliefs than to their self-efficacy for general mathematics beliefs. The researchers suggest that although there are overlapping skills associated with both statistics and general math abilities, self-efficacy beliefs are more predictive of performance when they assess competency for the specific tasks that are to appear on the criterion test. The relationship between performance and current statistics self-efficacy (CSSE) was also found to be greater than that between performance and self-efficacy to learn statistics (SELS). Thus, students' self-perceived judgments of their current competencies for specific tasks were more predictive of performance than were their judgments about their future competencies to learn. Over the course of the semester, self-efficacy beliefs for statistics scores were found to significantly increase. This finding suggests that self-efficacy beliefs are not static and are subject to change over time. Due to the variable nature of efficacy beliefs, students' self- evaluations should be assessed in as proximal time as possible to the administration of the criterion test.

Prior to the research findings of Glenberg and colleagues (1982) psychologists largely assumed that older students (e.g., those in college) were quite capable of monitoring their own comprehension. As researchers began to examine variables that might influence students' calibration accuracy, they first turned to factors of text (Commander & Stanwyck, 1997; Maki & Swett, 1987; Weaver & Bryant, 1985) and task (Glenberg et al., 1987; Maki & Berry, 1984; Maki, Foley, Kajer, Thompson & Willert, 1990; Lin et al., 2002; Maki & Serra, 1992a; Weaver, 1990) for insight into students' calibration skills). Later, the role of self was examined (Bouffard-Bouchard, 1991; Glenberg & Epstein, 1987; Karabenick, 1996; Kroll & Ford,

1992; Lin, Moore & Zabrucky, 2001; Lin-Agler et al., 2004; Zabrucky et al., 2009), a trend we would like to see continue.

Prior knowledge is probably the most obvious variable of self to impact calibration accuracy because students' prior experiences within any given domain vary so greatly. It seems logical to assume that as students become more familiar with a domain the ease at which they process information should increase, making it easier for them to acknowledge what they do and do not know. Interestingly, research suggests that students' domain familiarity is positively related to confidence judgments but not necessarily to performance (Glenberg et al. 1987). Thus, possessing a subjective sense of knowing may be all that is needed to generate feelings of confidence. In fact, overconfidence may stem from false feelings of knowing that occur in response to a familiar cue (Jost, et. al., 1998). Students' overconfidence has been termed "illusion of knowing" by Glenberg et al., (1982).

As familiarity increases, students are more likely to have, and to view themselves as having, greater domain expertise. In a study conducted by Glenberg and Epstein (1987) the role of expertise and its effect on calibration was studied using students majoring in either music or physics. Students were asked to read a series of texts, which included a text sample from their major area of concentration (music or physics), and to rate their confidence in being able to infer the gist of each text before answering inference questions. As expected, both music and physics majors' predicted better comprehension and performed at higher achieving levels within their respective areas of expertise. Although confidence and performance were found to increase within each groups' domain of expertise, students were actually better calibrated across domains. Thus, students were least accurate at calibrating within their domain of expertise.

Glenberg et al. (1987) argued that students' predictions are based on their prior experiences with a domain rather than on their comprehension of a text. If this is so, then students' predictions should not improve after reading a text because they do not use the specific information gained from reading a text when making comprehension evaluations. Rather, students' predictions are based on their assessments of how familiar they are with a domain topic, termed the domain familiarity hypothesis. In fact, Glenberg and colleagues suggested that students' predictions may be nothing more than reflections of their sense of familiarity with the title or the main principle of a passage.

In an attempt to test the domain familiarity hypothesis, Maki and Serra (1992a) had students read the titles and a one summary sentence about each text, from a series of texts, prior to predicting performance on inference tests. Students were then asked to predict their performance again but this time after reading each text entirely. According to results, following exposure to full texts, students' performance predictions improved,

which suggests that students actually used the knowledge gained from the texts when making comprehension evaluations.

Some research suggests that students are generally better calibrated towards the end of a semester (Finney & Schraw 2003; Hacker et al., 2000; Lin-Agler et al., 2004). Students' improved calibration accuracy over the course of a semester may reflect their increased knowledge, increased use of monitoring skills, or increased self-efficacy beliefs (Finney & Schraw, 2003; Schraw, 1997). According to Pfeifer (1994), as domain familiarity increases, so does domain knowledge, which is reflected in students' ability to more accurately calibrate comprehension. Still, as mentioned earlier, clearly not all research supports a positive relationship between familiarity and improved calibration accuracy (Glenberg & Epstein, 1987; Glenberg et al., 1987).

It is possible that studies on familiarity and calibration accuracy yield different results depending on the circumstances under which they are conducted. For example, in a laboratory setting, where students read as many as 16 texts from varying domains, students may assign higher confidence judgments to passages with which they are more familiar in comparison to those with which they have had little or no exposure, because it may be easier to assess familiarity than comprehension (Glenberg et al., 1987). In contrast, research conducted in the naturalistic setting of a classroom may reduce such problems, thus, reflecting students' metacognitive judgments more accurately. Because students have more time in which to build a richer knowledge base, their judgments may reflect more accurate or experience-based judgments than judgments based on feelings of competency or familiarity. Also, it has been suggested that laboratory studies do not offer a strong enough incentive to motivate students to make accurate judgments (Hacker, et al, 2000). This may be especially critical if motivation is a necessary component of the process of self-regulated learning (Boekearts, 1995; Schunk, 2003; Wolters, 2003; Zimmerman, 1990). In fact, it has been suggested that without the proper motivation, students will not engage in using strategies to monitor their learning (Zimmerman, 2000). Thus, it is possible that concerns of ecological validity may be warranted regarding laboratory studies.

Although task difficulty can be considered a variable of text or task, it can also be considered a variable of self because students do not share similar exposure or experiences within a domain, making certain tasks more challenging for some than others. According to Bandura (1986), students' self-evaluations should be most accurate when the task is challenging yet attainable. Research findings suggest that students tend to be overconfident when approaching new and difficult tasks, while under confident when tackling easier ones (Bjorkman, 1992). Interestingly, the highest achieving students have been found to experience only slight overconfidence on difficult tasks, while for the same task, the lowest achieving students have been found to experience overconfidence. Similarly, on the easiest of tasks,

the highest achieving students have been found to report under confidence while the lowest achieving students report only slight under confidence (Ferrell, 1995, Hacker et al., 2000).

According to Bandura (1986), overconfidence is a normal reaction to the exposure of difficult material. This overconfidence benefits students by motivating them to persist through challenging tasks. Likewise, it seems logical that students do not require the same motivation in order to engage and persist on easier tasks. Still, these assumptions do not explain the proclivity of students to report perceptions of under confidence for the easiest of tasks. One possible explanation is that on easy tasks, students can generate better answers than the given choices by relying on their previously learned knowledge (Stone, 2000). If so, then students may feel conflicted by being able to generate better answers than the ones which were to be inferred from a passage or the ones offered on a multiple choice test. Such confusion can lead to feelings of self-doubt. Of course another possible conclusion is that students may fear the social repercussions of answering an easy problem incorrectly. Instead, they may want to protect their self-image by appearing humble or cautious by reporting under confidence for easy tasks while simultaneously appearing highly motivated to tackle the more difficult ones.

According to Kroll and Ford (1992) students have either ego-oriented or task-oriented motivational constructs. Kroll and Ford hypothesized that the orientation style of students is related to their calibration abilities. Ego-oriented students tend to place a heavy emphasis on demonstrating their abilities while exerting as little energy as possible on any given task. These students feel a sense of accomplishment by comparing their abilities to others. Success for ego-oriented students means having others notice how little effort is required of them to succeed. In contrast, students who are task-oriented tend to place less importance on managing their self-image in favor of achieving a mastery of task. Task-oriented students feel a sense of accomplishment when learning for learning's sake. In support of their hypothesis, Kroll and Ford found that ego-oriented students were less accurate at calibrating performance than were task-oriented students.

It is possible that ego-oriented students are less successful at evaluating their comprehension because of interfering goal priorities. By prioritizing control of their self-image, ego-oriented students may devalue the importance of comprehension goals. For example, Butler (1993) has noted that students pay greater attention to different sorts of information, such as comparing their performance to the performance of others rather than to the demands of the task, depending on their goal orientations. Another possibility is that goal orientation relates to students' use of strategies. In fact, according to Bouffard, Boisvert, Vezeau and Larouche (1995), students who posses a mastery of task orientation are more likely to engage in a variety of self-regulated learning strategies. Similarly Archer

(1994) found that goal orientation was related to the effective use of strategies, independent of perceived abilities.

The role of ego-involvement was further investigated by Lin and colleagues (2001), who examined students' self-image presentations and monitoring accuracy. The researchers used two scales to determine students' image orientations. The first, the Marlowe-Crowne Social Desirability Scale, designed by Crowne and Marlowe (1960), established how likely students were to deny their failures or inadequacies in order to preserve a socially desirable appearance. The second, the Self-Monitoring Scale, designed by Snyder (1987), established how likely students were to pay attention to the environmental cues around them and to adjust their behaviours, in order to maintain a favourable self-image presentation.

According to results, students who rated themselves high on either scale were also likely to report high levels of self-perceived calibration ability, although only the relationship between social desirability and self-perceived calibration ability was found to be significant. As for actual calibration ability, high self-monitors were able to accurately predict their performance calibration (post-diction), while no relationship was found between social desirability and performance calibration. This finding supports Snyder's (1987) claim that self-monitors are astute at picking up environmental cues or feedback. Feedback is important to these students because it assists them in making accurate comprehension judgments in order to preserve a favourable self-image. As further evidence of Snyder's claim, without the assistance of feedback, self-monitors were not able to make accurate calibration of comprehension predictions (pre-diction) nor were students who rated themselves high on a measure of social desirability. Thus, self-image orientation may be related to students' ability to use feedback. Overall, students' self-perceived calibration ability was related to performance but not to actual calibration ability. In other words, students who perceived themselves as being the most accurate calibrators were generally better performers although they were generally not better calibrators. The researchers suggested that perceived calibration ability may be related to judgments of comprehension competency rather than reflections of metacognitive skill.

In a later experiment, Lin-Agler and colleagues (2004) found that on the first test of a semester, students' metacognitive self-evaluations and reported study times were not related. However, those students who reported increased study times on subsequent tests also tended to increase their self-evaluation judgments. Thus, it appears that after receiving performance feedback on the first test, high self-monitoring students altered both the amount of time that they spent studying and their metacognitive self-evaluations. Presumably, these high self-monitors allocated more time on subsequent tasks in order to maintain their goal of appearing favourable to others. Thus, students who were the most concerned with keeping up their social appearances (i.e. high self-monitors) were also the most likely to

exert the greatest effort expenditure on task. Evidence also suggested that certain personality traits affect metacognitive self-evaluations. Specifically, Lin et al. found that competitive students rated their metacognitive abilities higher than non-competitive students. The researchers suggested that competitive students are more likely motivated to set achievement goals, which include stabilizing confidence across time. Also, the researchers suggested that highly competitive students may hold a more challenging orientation, which may motivate them to work harder towards meeting their goals. Interestingly, the researchers failed to find a relationship between students' cognitive abilities and self-perceived metacognitive skills when mediated by personality.

Inaccurate calibration judgments may stem from such factors as faulty task analysis, a lack of self-knowledge (Bandura & Schunk, 1981; Butler, 1996), a lack of strategy knowledge (Schraw & Graham, 1997), or from maintaining an ego-orientation (Kroll & Ford, 1992). Similarly, students with learning disabilities (LD) are typically less accurate calibrators than their non-disabled peers (Butler, 1996; Klassen, 2004). For instance, LD and non-disabled students have been reported to share similar performance judgments for writing, even though the LD students had documented writing disabilities (Graham, Schwartz, and MacArthur, 1993). One plausible explanation for these findings is that struggling students do not have the requisite cognitive abilities to make accurate comprehension judgments (Butler, 1996). Another explanation is that these students perceive more pressure to appear socially desirable due to a continual lack of academic success (Alvarez & Adelman, 1986). For example, students who feel threatened by their lack of success and perceive themselves as failures may sense an increased need for presenting an image of competency. These students may also be motivated to overstate their abilities due to anticipating behavioural consequences such as an intervention for acknowledging a weakness. Research examining the calibration skills of students with LD will be discussed briefly in order to further explore the relationships between calibration accuracy and ability, and calibration accuracy and goal orientation.

In a review of 22 empirical studies examining the calibration skills and self-efficacy beliefs of students with LD, Klassen (2002) found that although LD and non-LD students reported similar self-efficacy beliefs, LD students typically performed at lower skill levels. Klassen defined calibration as the degree of congruence between efficacy beliefs and actual performance. Overall, an analysis of the studies revealed that LD students were generally better at calibrating mathematical performance than writing or reading performance. In fact, in all five studies examining LD students' calibration accuracy for mathematical performance, students' performance predictions were generally accurate. Still, in the domains of reading and writing, calibration accuracy was low, with students with documented writing difficulties making the least accurate performance predictions. According to

Butler (1996), students with learning disabilities are less metacognitively aware, tending to be poor calibrators, because they place too much emphasis on the concrete demands of the task at hand rather than the more obscure tasks, such as self-monitoring.

In a study designed to examine the overstated self-evaluations of LD students, Alvarez and Adelman (1986) had students predict their performance for increasingly difficult math problems. Results indicated that 68% of the predictions were accurate and 30% of the predictions were overestimations. These results are similar to those generally reported in non-disabled populations. Interestingly, the researchers found that while LD students typically overestimated their performance predictions for tasks within their expected range of capabilities, they made accurate predictions for the easiest and most difficult tasks. In contrast, as mentioned, non-disabled students generally overestimate their performance predictions for the most difficult tasks, while underestimating their abilities for the easiest ones (Ferrell, 1995; Hacker et al., 2000). It has been suggested that students may need the extra confidence in order to engage in and to persist on more challenging tasks (Bandura, 1982). However, this does not explain why LD students reportedly overestimate their abilities on tasks which are within their range of capabilities. LD students may make overestimated performance predictions in order to protect their egos. In fact, Alvarez and Adelman suggest that it is because LD students are able to recognize which tasks are within their expected range that they feel the most threatened and, thus, feel the most compelled to overestimate their performance predictions. These findings suggest that students with LD may have the cognitive ability to accurately predict their comprehension, as demonstrated by their ability to accurately calibrate for the most demanding of tasks. Yet these students may be motivated to report overestimations for tasks which they are capable of answering correctly and, thus, feel the most threatened by.

Finally, Alvarez and Adelman (1986) had students fill out a measure of self-protectiveness in order to assess how threatening the overall task was. Although students typically were reluctant to admit that they perceived the task as threatening or that they predicted their performance with consideration of how best to protect their self-image, they tended to evaluate their peers differently. For instance, students were more apt to suggest that their peers were defensively motivated to overestimate their performance predictions.

Social and cultural influences

The definition of metacognition can be broadened from an awareness of one's cognitive processes to an awareness of others' cognitive processes as well (Jost, et al., 1998). In fact, thinking about other people's thinking has been found to influence one's own metacognitive beliefs. For example, in an experimental setting, Karabenick (1996) found that students' self-reports of

comprehension declined as the number of questions asked by co-learners increased. Similarly, it has been suggested that one's own thinking can be greatly influenced by the way in which one perceives what others' are thinking about one's thinking. Research has found that students' confidence judgments for novel tasks may be altered by manipulating the performance feedback they receive from others (Bouffard-Bouchard, 1991). Another way in which one's thinking is influenced by others is through the act of social comparison. According to Butler (1993), students seek either normative information, which they gain from their environment by comparing their performance to the performance of others, or objective information, which is gained by comparing their performance to the demands of the task. Thus, social influences appear to affect the manner in which one thinks about one's own thinking.

Students' susceptibility to social persuasion and its impact on performance judgments and achievement were studied by Bouffard-Bouchard (1991) using a verbal concept-formation task. Participants included students who shared similar domain experience and prerequisite knowledge for the novel task. In order to examine the scope of the influence of social persuasion, Bouffard-Bouchard arbitrarily divided students into one of two groups. Students received different feedback regarding their performance, after performing the verbal task, depending on which of the two groups they had been assigned to. Regardless of performance, students assigned to one group received positive feedback. This group was referred to as the high self-efficacy group. Students in another group received negative feedback, also regardless of performance. This group was referred to as the low self-efficacy group. Students in the high self-efficacy group were told how well they were performing in relation to their peers, while students in the low self-efficacy group were told how poorly they were performing. Following an initial task and feedback session, students continued to consecutively perform three similar tasks, each time making performance predictions.

Results indicated that students' self-efficacy judgments were susceptible to manipulation. In fact, students assigned to the high self-efficacy group were more accurate than those assigned to the low self-efficacy group in predicting performance, even though both groups performed similarly. This finding is particularly interesting since all participants were initially shown to have had equal knowledge within the domain and the self-efficacy group in which they were assigned was randomly chosen. Eighty-four percent of the students in the high self-efficacy group reported an objective to complete the four experimental tasks, while only 31% of the low self-efficacy group reported this same objective. This finding suggests that students who received positive feedback believed themselves to be more efficacious than those who received negative feedback. That the low self-efficacy group did not share the same ambitious

goals may suggest that students' persistence is partially mediated by their self-efficacy beliefs through the achievement goals they set.

At one time or another, most students have probably experienced feeling as though they understood the material being covered in class until their fellow classmates began raising questions. As mentioned earlier, research has found that students' self-reported comprehension levels go down as peers' questioning of class material goes up (Karabenick, 1996). Further, students who report having the highest awareness of their peers' presence also tend to be the most affected by their peers' questioning. Thinking about how other people think may be beneficial to one's learning. For example, a student may be overly confident in his or her own comprehension until a fellow student raises a question. Not only may the student benefit from thinking about the particular question raised but also by considering why he or she had not thought about the question or by considering how the classmate's thinking lead to the question. It is logical to assume that students who are better at monitoring their own comprehension may also be likely to pay closer attention to classmates' questions, since self-monitors generally question their comprehension throughout the learning process (Butler & Winne, 1995). Of course, as Karabenick points out, students are less likely to pay as close attention to peer questioning when the questions are asked by a peer or peers who generally ask a lot of questions anyway. Karabenick suggests that students' comprehension judgments are most affected when the peers doing the questioning are considered to be worthy or of similar abilities. In other words, one must believe that the way one thinks is similar to the way a peer thinks in order to have one's own confidence shaken by peer questioning.

In an exploratory study, Klassen (2004) investigated the effects of culture (immigrant Indo Canadian vs. non-immigrant Anglo Canadian) on students' self-efficacy beliefs for mathematics. According to his findings, both groups of students were capable of calibrating performance, with Indo Canadian students reporting slightly higher levels of efficacy, while also achieving slightly higher performance levels. As mentioned earlier, according to Bandura (1982), sources of self-efficacy beliefs include mastery experiences (past performance), vicarious experiences (watching others), social/verbal persuasion, and physiological or emotional states. It is through these experiences, Bandura suggests, that self-referent thoughts are gained and feelings of what one is capable of are established.

In Klassen's study, Indo Canadian students' math performance was predicted by their self-oriented experiences (mastery experiences and physiological events) and by other-oriented events (vicarious experiences and social persuasion), whereas the only significant predictor of Anglo Canadians' performance was self-oriented experiences (mastery experiences and physiological events). Regardless of culture, mastery experiences were reported as the most influential source of students' self-efficacy beliefs. However, immigrant Indo Canadian students also placed a heavy emphasis

on other-oriented experiences such as social comparison and external feedback. In fact, a significant difference was found between the vicarious experience source ratings of students, with Indo Canadian students reporting them as significantly more influential. Similarly, a modest effect was found in the higher source ratings of social persuasion among Indo Canadian students. Regardless of source magnitude differences, self-efficacy beliefs were found to predict math performance across cultures.

The degree to which physiological arousal affects students' self-efficacy beliefs also appears to be related to students' cultural backgrounds (Eaton & Dembo, 1997; Klassen, 2004; Steinberg, Dornbusch & Brown, 1992). In particular, fear of failure has been suggested as a highly motivating catalyst among non-Anglo populations. For example, in a study conducted by Eaton and Dembo (1997), fear of failure was indicated as the strongest predictor of Asian American students' academic behaviour. In contrast, fear of failure was the least successful predictor of academic behaviour among non-Asian American students. Also, the researchers found that although Asian American students reported less optimistic self-efficacy beliefs, they still outperformed their non-Asian American peers and were more accurately calibrated. According to research, non-Asian parents assume lower expectations while maintaining overestimations of their children's academic abilities, which works against high academic achievement for non-Asian students (Steinberg et al., 1992; Stevenson, Chen, & Uttal, 1990; Stigler, Smith, & Mao, 1985). Thus, Asian American students may strive harder to meet their parents' goals while evaluating themselves more critically. As mentioned, low self-efficacy beliefs have been suggested to generate motivational and affective deficits in students (Bandura, 1986).

In a large cross-cultural study examining the academic beliefs of 3,000 students from several cities (East Berlin, West Berlin, Los Angeles, Berne, Tokyo and Prague) researchers found that across cultures, students as young as seven years of age shared very similar beliefs regarding their abilities, and, likewise, their perceptions of what is needed to succeed in an academic setting (Stetsenko, Little, Gordeeva, Grasshof & Oettingen, 2000). In another large scale cross-cultural study, the confidence judgments of 551 post-secondary students from five countries (Taiwan, Palestine, Israel, the Netherlands and the United States) were examined (Lundeberg, Fox, Brown & Elbedour, 2000). All participants were instructed to immediately report their confidence judgments (performance calibration) for correctly answering each question on their respective final exams. Although there was a great deal of performance variation within each country, students performed similarly across countries, with students from Taiwan and Palestine scoring slightly below the mean. However, students' calibration skills were significantly different across countries. For example, Palestinian students reported the greatest overall confidence, while Taiwanese students reported the lowest. Additionally, Palestinian students were as likely to be overconfident in their performance predictions for both their correct and

incorrect responses, while Taiwanese students showed the greatest discrimination. Students from the United States made the most accurate predictions when reporting the greatest feelings of certainty, whereas, Palestinian students made the least accurate predictions when reporting the greatest feelings of certainty. Overall, performance accuracy was related to confidence judgments in the United States, Taiwan, Israel, and the Netherlands, but not in Palestine. The researchers suggest that Palestinian students' overconfidence may reflect a need to present a positive self-image since Arabic societies tend to focus on achievement in terms of what it means for the community as a whole rather than for the individual. Thus, Palestinian students may want to preserve their feelings of self-worth by adopting a system of overconfidence. Still, it is important to point out that many Asian societies are also considered collective societies. It has been suggested that students within these Asian societies tend to evaluate themselves against more stringent standards, often resulting in higher calibration accuracy, possibly due to an increased awareness of one's parents' and one's own academic goals (Steinberg et al., 1992; Stigler et al., 1985). Thus, it remains unclear what role different societal structures play on students' performance judgments and self-efficacy beliefs. Although there are still too few studies to understand the impact that culture has on students' calibration judgments it does appear that students from around the world tend to share similar academic beliefs and have fairly competent calibration skills (see Zabrucky et al., 2009, for a further discussion).

Although overconfidence may stimulate the necessary motivation required to tackle new and challenging tasks, little is known about the long-term effects of overconfident calibration judgments. In a related area of research, Robins and Beer (2001) studied students' self-enhancement bias, which was defined as the difference between students' self-perceived academic ability and their actual ability. In the study, students filled out six questionnaires regarding their self-perceived abilities over a four year college experience. The first questionnaire was completed during the first week of the students' freshmen year. Each questionnaire included measures of students' self-serving attributes, ego-involvement, self-esteem, subjective well-being and narcissism. In order to establish an initial objective measure of academic ability, the researchers combined students' SAT and high school GPA scores, creating a single composite score. Finally, graduation status and academic achievement (cumulative GPA) were used as the final objective measures.

Students who performed at lower achieving levels, while overestimating their abilities on self-evaluations, were referred to as self-enhancers. Self-enhancers typically attributed their success to their natural abilities and effort while simultaneously dismissing their abilities as a contributing factor when unsuccessful. Instead, self-enhancers were most likely to attribute their failures to situational variables, which they perceived as beyond their control. Interestingly, self-enhancers reported

feeling happier than usual after completing objective tasks for which they had overestimated their abilities. Thus, it appears that self-enhancing tendencies may generate beneficial feelings of affect, at least in the short-term. However, the researchers found that towards the end of their college careers, self-enhancers were more likely to disengage from their academic experiences. In particular, self-enhancers became less ego-involved with their academics, reporting that grades were less important to them. This detachment may reflect a growing sense of failure since self-enhancers continuously fall short of meeting their inflated self-perceptions. In comparison to their peers who held accurate perceptions and self-diminishing perceptions, self-enhancers reported lowered feelings of well being and self-esteem at the end of their educational experiences. Finally, although self-enhancers initially reported higher confidence in their abilities to succeed and to earn higher grades than their peers, their confidence did not translate into higher GPA's nor did it increase the likelihood of them completing college. In fact, self-enhancers were slightly more likely to drop out in comparison to students who held accurate and self-diminishing perceptions. Thus, although it appears that self-enhanced perceptions may be beneficial in the short-term, it is unclear what the long-term effects on students are. It is important to note that in this study researchers did not examine the calibration skills of students, but instead, examined what may be a closely related area of research, self-enhancing tendencies.

Conclusions

Researchers studying metacognition would benefit from a more systematic examination of all aspects of how one thinks about thinking. By bridging the gap between cognitive and social cognitive theories and empirical data, researchers will be better able to understand the complex set of factors that affect students' metacognitive judgments. For example, evidence suggests that students' calibration skills are influenced by more than ability and prior performance. Instead, researchers have found that individual differences such as self-efficacy beliefs (Bandura, 1982; 1986; Finney & Schraw, 2003; Klassen, 2004; Pajares, 1996; Pajares & Kranzler, 1995; Pajares & Miller, 1995; Zimmerman & Bandura, 1994), level of expertise (Glenberg & Epstein, 1987; Glenberg et al., 1987; Weaver, 1990), goal-orientations (Butler, 1993; Kroll & Ford, 1992; Lin et al., 2001; Lin-Angler et al., 2004), susceptibility to social influences (Bandura, 1982; Bouffard-Bouchard, 1991; Karabenick 1996; Klassen, 2004) and cultural differences (Eaton & Dembo, 1997; Klassen 2004; Steinberg et al., 1992; Lundeberg et al., 2000; Zabrucky et al., 2009), also affect students' metacognitive judgments.

In the present paper we have emphasized the role that self-efficacy plays in influencing students' calibration of comprehension judgments. Research findings have shown that self-efficacy beliefs play an integral part in the calibration paradigm by influencing performance predictions (Finney & Schraw, 2003; Klassen, 2004; Pajares, 1996; Pajares & Kranzler, 1995;

Pajares & Miller, 1995) and by making direct and independent contributions on performance (Chen, 2002; Pajares & Kranzler, 1995; Zimmerman & Bandura, 1994; Zimmerman, et al., 1992). Thus, it is recommended that investigators continue to examine students' self-efficacy beliefs, as it may be all but impossible to disentangle them from the calibration paradigm. Additionally, by examining the sources of students' self-efficacy beliefs, researchers can explore how self-oriented (mastery experiences and physiological events) and other-oriented events (vicarious experiences and social persuasion) influence students' beliefs and why they affect individual students differently.

Although students' overconfident performance judgments or self-enhancing tendencies have been suggested to be beneficial in the short term (Bandura, 1982, 1986; Zimmerman, 1990, 1995), it still remains unclear what the long term effects are. For example, students may require the extra motivation gained from overconfidence in order to engage and to persevere on challenging tasks (Bandura, 1982; Schunk 1990). However, research indicates that students' performance judgments are influenced more by their prior judgments than by their prior performances (Hacker et al. 2000). Thus, students may need more than additional motivation in order to improve their metacognitive skills. Similarly, some students continually deny their failures and inadequacies in order to preserve a socially desirable appearance (Lin et al., 2001). Thus, even if students have the requisite monitoring abilities not all students will use them. According to Robins and Beer (2001) inflated self-perceptions may be beneficial in certain domains, such as in the area of health and sports, yet harmful in others, such as in an academic setting.

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