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ABSTRACT
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metacognitive activity under each goal-orientation was illustrated.
These results are consistent with research on goal-orientation and
motivation, and they provide theoretical and practical conclusions
for using metacognition and goal-orientation in education. Four
appendixes present sample problems, task instructions, the
questionnaire itself, and questionnaire responses by metacognitive
activity. (Contains 2 tables and 38 references.) (Author/SLD)

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Effects of Goal-Orientation on Metacognitive Activity

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Abstract

This study examined the effect of goal-orientation on subjects' metacognitive activities during problem solving. Twenty female undergraduate students were randomly assigned to a learning or performance goal-orientation condition. The subjects were given an open-ended problem solving task with instructions highlighting their respective goal-orientation. A questionnaire measuring metacognitive activities was administered before, during and after the problem solving task. The results found that students under a learning goal-orientation utilized metacognitive activities that were less efficient in solving the problem, but more likely to improve the solver's understanding. Performance goal-oriented subjects tended to utilize metacognitive activities which would lead to an efficient, accurate solution without regard for self-development. A pattern of metacognitive activity under each goal-orientation was illustrated. These results are consistent with research on goal-orientation and motivation, and they provide theoretical and practical conclusions for utilizing metacognition and goal-orientation in education.

Effects of Goal-Orientation on Metacognitive Activity

Despite a lack of consensus among researchers, the concept of metacognition has continued to interest practitioners and theorists alike. Since its introduction nearly twenty years ago the importance and relevance of metacognition to effective learning and teaching has established itself as a key variable influencing one's education (Wang, Haertel & Walberg, 1993). Much of this interest has centered on the feasibility of utilizing metacognition as a tool to empower an individual to better regulate their own thoughts and behavior. However, an overall theory of metacognitive use, functioning, and type has not yet been constructed.

Research on goals in motivation has recently focused on goal-orientation, a condition in which a single goal is generalized across an individual's framework for interpreting and acting on information. Studies have found students' goal-orientations to be influential in their learning strategies, preference for challenging tasks, and beliefs about the causes of success and failure (Ames & Archer, 1988; Dweck, 1986; Elliott & Dweck, 1988). However, researchers continue to call for a more specific explanation of the goal-orientation processes, and a further exploration of the links between cognition and motivation (Ames & Archer, 1988).

This research examined the effect of goal-orientation on the use of metacognitive activity during problem-solving. Patterns of metacognitive activity compliment the aims of the specific goal-orientation, thus illuminating the processes involved in goal-orientation, and offering additional insight into the relationship between cognitive processes and motivation.

Metacognition

The specific definition of metacognition has been difficult for theorists to agree upon, much less measure (Brown, Bransford, Ferrara & Campione,1983; Flavell, 1979; Garner & Alexander, 1989). Flavell (1979) defined metacognition as, "... any conscious cognitive or affective experiences that accompany...(p. 906)" cognition or the knowledge of such experiences. This early definition portrays metacognition as both a process and product of cognition. Consequently, it was unclear what distinguished the cognitive from the metacognitive. Forrest-Pressley & Waller (1984) and Meichenbaum, Burland, Gruson & Cameron (1985) asserted that ongoing operations were cognitive and the overseeing of those operations was metacognitive. This distinction directed attention toward the use of metacognition as a tool for self-direction or self-regulation of cognitive processes (Schutz, Ridley, Glanz & Weinstein, 1989; Zimmerman, 1990).

Brown and Campione (1987) further by asserted that metacognitive theorists have been looking at three different aspects: "The ability to reflect on one's own thought processes...", i.e. one's domain knowledge about thinking and thought processes; "Control processes...", i.e. using that domain knowledge in processing information; and "General self-regulatory skills assumed to be involved in all problem solving and strategic learning."(p. 3) Brown and Campione subsequently defined metacognition

as a number of different skills and knowledge that allow an individual to learn independently in a domain, i.e. to manage their thought processes.

Metacognitive Activities

Today metacognition is defined as a multitude of cognitive processes embedded in two distinct realms: metaknowledge, i.e. what one knows about their own cognitive processes, abilities, and knowledge; and metacognitive activity, i.e. the processes that have executive control over cognitive processes (Haller, Child & Walberg, 1988; Swets, Herrnstein, Nickerson & Getty 1988; Pinard, 1992).

Researchers have explored, categorized, and theorized about the myriad mental activities involved in metacognition (Derry, 1989). Metacognitive activities enable one to deliberately and consciously guide their own thoughts and thought processes, and provide the justification for metacognition's pivotal role in the concept of self-regulated learning. Metacognitive activities also require a higher level of attention, comprehension, reflection, and consciousness than cognitive activity (Pinard, 1992).

Metacognitive activities generally include awareness, monitoring and control of one's own thought processes (Haller et al. 1988). Studies of metacognitive activity tend to focus on a specific metacognitive activity in the context of comprehension, execution, or evaluation during a task. Table 1 displays a semi-comprehensive list of the mental activities across task stages.

Insert Table 1 about here

Metacognition in Practice

Despite its many and varied conceptions, metacognition is considered a critical aspect of the concept of self-regulation, i.e. the ability to consciously control one's own thoughts, feelings, and behavior (Zimmerman, 1990). Brown and Campione (1987) summarize empirical work that has examined the relationship between various aspects of metacognition and their effects on students' performance. They cite the positive effects of high levels of metacognition on students' conscious control of learning, transfer of rule learning, and ability to plan, monitor, correct errors and change their own learning behavior. Further, in explicating what mental activities comprise metacognition, researchers have attempted to teach metacognitive activities to students in the hope that students' mental processing abilities will develop and ultimately lead to the creation of self-regulated learners (Ghatala, Levin, Pressley & Lodico, 1985; King, 1990; Palincsar & Brown, 1984; Paris, Cross & Lipson, 1984; Paris & Winograd, 1990; Zimmerman, 1990). The general assumption that the control of metacognitive processes is based in the individual is commonly accepted (Brown, et. al. 1983; Flavell, 1979).

A number of studies have illuminated individual tendencies in metacognitive activity. Individuals do not always use metacognitive processes effectively and efficiently. For example, even though the ability

to effectively monitor comprehension increases with age, it has been found that adults often do not monitor comprehension effectively (Garner & Alexander, 1989). The use of strategies has been found to effectively aid in solving problems of many types. However, it seems that students have difficulty in learning to consistently use new, more effective strategies (Brown & Campione, 1987). In studies where students were given training and instruction on effective strategies for solving a problem, the students tended to revert back to the less effective strategies they used prior to the training (Pressley, Ross, Levin & Ghatala, 1984; Garner & Alexander, 1989). Numerous studies also find that both adults and children have significant difficulty in estimating the accuracy of their metacognitive knowledge. For example, Metcalfe (1986) found that subjects repeatedly rated their own state of understanding (nearness to problem solution) incorrectly, particularly right before an incorrect solution to a problem was proposed.

An individual's goals may help clarify the reasons why some individuals effectively utilize metacognitive activities and others do not by illuminating the link between metacognitive activities and the motivational status of an individual. While it is important to explore how one might teach individuals metacognitive activity skills that improve performance, this study emphasizes why individuals use the metacognitive skills they already possess. In other words, what influences cognitive functioning during the process, regardless of the immediate performance outcome?

Goal - Orientation

Goals have been a cornerstone of motivation research (Locke & Latham, 1990), as well as a critical component of self-regulated behavior (Karoly, 1993). Their importance has led to the development of goal theory and an emphasis on applying it to current and future research on motivation (Ames, 1992). There has been a call, however, to more fully explicate the dimensions of goal theory, so that goal theory might be more effectively utilized in practice (Blumenfeld, 1992). Ridley, Schutz, Glanz and Weinstein (1992) assert that a relationship between metacognition and goals (particularly the act of goal-setting) has been implicitly assumed by many researchers. They agree that a relationship can exist, and in many cases does, but the factors which determine that relationship need to be explored. How goal-orientation affects metacognition is one step towards a greater understanding of the interrelation of the cognitive and motivational realms (Braten, 1992).

The idea of goal-orientation was introduced by Dweck (1986) as a "set of concerns" or a "framework" for processing incoming information created by a single goal. Dweck was primarily interested in the differences in motivation between students based on their beliefs in their own abilities. Dweck found that specific beliefs about ability were important determinants of achievement behavior, but the key to performance was the students' purpose, i.e. the students' motivation to continue their efforts as a result of their ability beliefs. Harackiewicz and Sansone (1991) distinguish between "purpose" goals and "target" goals. They explain, "Target goals guide an individual's behavior, and purpose goals suggest a reason for the behavior (p. 21)". An individual's goal-orientation is a purpose goal.

Two types of goal-orientations have been studied most intensively. A learning or mastery goal-orientation defines success as improvement over time and places value on a student's effort and what was learned. Students perceiving a mastery or learning goal-orientation are more likely to engage in a variety of "motivation-related variables that are conducive to positive achievement," (Ames, 1992) including, but not limited to, attributions for success to effort (Weiner, 1979 cited in Ames, 1992), preference for challenge and risk-taking, and positive attitudes about learning (Ames & Archer, 1988; Elliott & Dweck, 1988). Research on goal-orientation has shown that a mastery/learning goal-orientation often promotes behaviors that lead to success in school. Consequently, research has turned to examining the factors needed to induce a mastery goal-orientation as an intervention for the classroom (Ames, 1992; Meece, 1991).

A performance goal-orientation defines success in relation to other's performance. Value is placed on ability, and normative performance is the ultimate concern. Self-improvement, learning, and effort are not considered a priority. In fact, high effort under a performance goal-orientation is often believed by the subject to be the result of lack of ability (Ames, 1992; Ames & Archer, 1988; Dweck, 1986). Students perceiving a performance goal-orientation have been found to utilize a pattern of motivation which leads to negative affect, negative judgements of ability, avoidance of challenging tasks, and less use of self-regulatory strategies (Dweck, 1986; Elliott & Dweck, 1988; Jagacinski & Nicholls, 1984 cited in Ames, 1992). Ames (1992) sums up the preference for mastery/learning goal-orientation quite succinctly, "Thus, research evidence suggests that it is a mastery goal orientation that promotes a motivational pattern likely to promote long-term high-quality involvement in learning,"(p. 263).

Goal-Oriented Metacognitive Activity

Blumenfeld (1992) examined goal theory as it impacts classroom learning and motivation. One question identified as requiring further study was: "Does perception of a classroom as mastery-oriented (learning oriented) consistently translate into more strategic learning? If this is not the case, what mediates the relationship?"(p. 276). This research attempts to find out what kinds of metacognitive activities are occurring given different goal-orientations.

An individual's goal-orientation has an influence on his/her perception of information and how that information is processed. The present study asserts that an individual's goal-orientation will influence the types of metacognitive activities display during problem solving.

Research Questions

There are two research questions examined. First, is metacognitive activity affected by one's goal-orientation? The second question is based on the outcome of the first. If metacognitive activity is affected by one's goal-orientation, what metacognitive activities are more or less likely under each goal-orientation?

Individuals operating under different goal-orientations should elicit metacognitive activities complimentary to the purpose of the goal-orientation. The underlying belief for a performance goal-orientation is that intelligence is a fixed entity (Dweck, 1986). Individuals strive to protect their ego from

the attributions to their ability given failure in task performance. Their main purpose is performing well on the task relative to, and in the eyes of, others. One would expect a performance goal-orientation to be lacking in metacognitive activity. In fact, the general conclusion seems to be that performance goal-oriented individuals are less likely to use self-regulatory strategies (Dweck, 1986; Pintrich & De Groot, .990). However, research of self-regulated behavior tends to focus on the self-regulation of behaviors necessary for classroom success, such as learning. Performance goal-oriented individuals may utilize metacognition and self-regulatory activities that meet their individual concerns, which may not necessarily include classroom success.

The mastery/learning goal-orientation has a foundational belief that intelligence is a malleable construct capable of growth and improvement, i.e. learning (Dweck, 1986). Individuals strive to maximize their learning through challenging tasks and the effort and risk of pursuing those tasks. Their main purpose is growing, developing, learning, improving and progressing in relation to themselves regardless of their success on the specific task. Metacognition would seem to be the ultimate tool of individuals pursuing learning and self-improvement through a task. The research in metacognition supports this assertion. However, as indicated, research on goal-orientation and metacognition has aimed toward general self-regulatory behaviors leading to achievement rather than specific metacognitive activities, e.g. learning strategies (Ames & Archer, 1988; Pintrich & DeGroot, 1990; Garcia & Pintrich, 1991), strategy use (Elliott & Dweck, 1988), self-regulatory activities (Miller, Behrens, Greene & Newman, 1993), and self-directed learning (Thomas, Strage & Curley, 1988).

In this study I attempt to illustrate the specific metacognitive activities utilized by subjects under a given goal-orientation. I measure metacognitive activity with a self-report questionnaire administered at different points throughout the process of solving an insight problem.

Method

Participants

The subjects of this study were 20 female undergraduate students attending an introductory education class in a large midwestern university. The students were given extra credit points for their participation in the study. Subjects varied in age (18-40 years old) and experience and/or expertise in problem-solving.

Materials

A four part questionnaire measured metacognitive activity use prior to, during and after a problem solving task. The specific items were partly based on the Attitude Toward Statistics Instrument used in a study by Miller, Behrens, Greene and Newman (1993) to measure self-regulatory behaviors of students in relation to their motivational patterns. Multiple questions measure each metacognitive activity to strengthen the statistical measures and conclusions that might be drawn. Further, each item offers the participant a choice of one of two equally desirable options so as to avoid any one option being chosen for reasons

other than those intended, i.e. use of that particular metacognitive activity. The other components of the questionnaire were designed to reconfirm the subjects' goal-orientation and gather demographic data.

The study tested whether different goal-orientations elicited different types of metacognition given the same task. Given the latter, the task needed to facilitate the method by which metacognition was measured, as well as lend itself to the utilization of the various aspects of metacognitive activity, as defined earlier.

Metacognitive activity is thought to increase when subjects are faced with situations requiring "careful, highly conscious thinking,"(Flavell, 1979, p. 908). Tasks that include novelty, complexity (require planning and evaluation), risk, open-endedness, and are affectively neutral would be most likely to encourage metacognitive activity (Flavell, 1979). Earley, Connolly & Ekegren (1989) found that given a novel task that allows multiple alternative strategies, students receiving a nonspecific goal (e.g. "Do your best.") are more likely to perform better than those receiving specific, difficult goals. This is contrary to goal setting research, however a nonspecific goal, such as "Do your best," could be considered conducive to a mastery goal-orientation by setting the cognitive framework for how to view the problem solving process, i.e. do your best rather than another's best. A specific, challenging goal, in contrast, may dictate a performance goal-orientation.

The specific task met the following criteria: (a) The task was open to misinterpretation and/or misunderstanding. The subject could generate multiple meanings from both the task and the specific requirement of the task. Multiple potential meanings made possible the measurement of comprehension, monitoring, and awareness. (b) The task was complex enough to require the use of a strategy for more effective solution, as well as take enough time to solve/complete so that the possibility of multiple strategies being employed was maximized. (c) The task was open-ended so as to have multiple solutions that appear logical, even though they may not be correct. An open-ended task allowed the individual to employ the evaluative aspects of metacognition while working through the task. The open-endedness was also necessary so that there was some potential for the subject to lose track of the original task, thus requiring mo.e evaluation and monitoring of thought processes. (d) Finally, the task needed to have a strategy or he.iristic that was more effective than all the others so that the subject could learn something from the task, thus validating the learning goal-orientation.

The task was composed of an open-ended, multiple solution problem preceded by 3 to 4 statements of relevance to solving the problem correctly, thus setting up a brief, yet vague, context to a situation (see Appendix A). The objective was to formulate a solution to the problem. The subject was allowed to ask the experimenter questions regarding the situation to gather more information, but the answers were limited to "yes," "no," or "not relevant."

Procedure

The participants were randomly assigned to one of two groups. Each group was given a set of task instructions designed to highlight either a performance or mastery/learning goal-orientation (see

Appendix B). In addition, the performance condition offered students extra points for performance as well as a promise to record the process. Elliott and Dweck (1988) felt that the promise of recording would "...make the value of displaying competence high ...," a quality that the performance goal-orientation emphasizes (p. 7). The learning condition offered students extra points for their ability to explain what they learned at the conclusion of the task. In addition, students were told that the learning goal-oriented task would help them in thinking through future problems, and be beneficial to their studies. Again, Elliott and Dweck felt that the desirability of the learning goal-oriented problem would be enhanced by the promise of possibly acquiring skills that could be used in other contexts, i.e. transferred. The effectiveness of this procedure in highlighting goal-orientation has been verified by other studies (Ames, 1992; Ames & Archer, 1988).

The subjects then read the problem. Prior to any attempts at solving the problem the experimenter administered a brief questionnaire asking the subjects to rate understanding of the task and problem (Questionnaire Part I in Appendix C).

The experimenter then began the task of solving the problem, allowing the subjects to ask questions. After 10 questions the experimenter asked the subjects to complete a second questionnaire to rate their understanding of the problem, the effectiveness of their processes for solving the problem, and their evaluation of any solution they may have generated (Questionnaire Part II in Appendix C). Again, the experimenter allowed the subjects to ask questions. After 10 more questions from the subjects a third questionnaire was administered (Questionnaire Part III in Appendix C). Finally, the experimenter again proceeded with the task, and after fielding 10 more questions from the subjects, asked for a solution. The correct solution was then given to the subjects, allowing the subjects to appropriately evaluate what might have been the best strategy for reaching the correct solution, if they were inclined to do so. If the problem was solved by the group, another problem was distributed, and the measurement process continued using the new problem. Problem replacement was a feasible and valid procedure because the measurement tool was meant to measure metacognitive activities during different points in the problem solving process, and subsequently administered as such. A last questionnaire was administered to further evaluate the nature of metacognition used as well as verify the goal-orientation used by the subjects (Questionnaire Part IV in Appendix C).

<div align="center">Analysis and Results</div>

Analysis

The measures for this study are based on the responses subjects provided from the questionnaire. Those responses are the dependent variables. The independent variable is goal-orientation determined by random assignment and strengthened by the conditional verbiage in the instructions under each orientation.

Each item on the questionnaire has response options of A or B. All responses indicative of metacognitive activity were coded as 1, and those responses not indicative of metacognitive activity coded

as 0 (see Appendix D for questionnaire responses indicative of metacognitive activity). For each question a proportion of A versus B responses can be calculated across all subjects.

The first hypothesis examines the effect of each goal-orientation on metacognitive activity. This was easily calculated using a normal test for binomial, since each question constitutes a binomial trial. The second hypothesis asserts significant differences in metacognitive activity between the performance and learning goal-oriented subjects. Given that there is independence between groups as well as participants, a normal test for proportions was also obtained. Since the hypothesis claims that one group will outperform the other, the test is directional.

Obtaining a z score and p value for each individual question, and basing conclusions on those outcomes is statistically quite weak because the probability of committing a Type I error is greatly increased due to the number of comparisons being made. To avoid this problem, the questions on the questionnaire have been grouped by the metacognitive activity they purport to measure (as indicated in Appendix D). Each group constitutes a family. The Holm technique (or Stepwise Dunn) was used for conducting planned comparisons. While the Dunn technique tests each family member (each individual question) at alpha divided by the number of members in the family, the Holm technique allows one to increase the alpha level with each significant p value. The sample size required for this study with an alpha of .05 at a power of .80 is 16, or 8 subjects per group.

Results

Data were collected from 36 subjects. Of the 36 subjects, 16 reported a goal-orientation different from the highlighted goal-orientation. The large percentage of subjects reporting a goal-orientation opposite the highlighted goal-orientation was unexpected, and caused speculation about the varying stability of goal-orientation across individuals. Because this study depended on the certainty of the individual's goal-orientation, only subjects reporting a goal-orientation that matched that highlighted by their group were retained. This left ten subjects in each of the goal-orientation conditions. The subjects were all female and had an average age of 23.4 years in the performance goal-orientation condition and 23.7 years in the learning goal-orientation condition.

Using the Holm technique to determine the critical value, a number of metacognitive activities were significant at $p<.05$ under each goal-orientation (see Table 2).

Insert Table 2 about here

Metacognitive Activities Used in Each Group

Subjects under the learning goal-orientation indicated an awareness of their prior knowledge to facilitate the problem solving and learning process (questions 31 and 32 in Appendix C). Significant metacognitive activities also included consideration of the strategy (questions 6 and 7 in Appendix C) and context comprehension (questions 1 and 3 in Appendix C) after being introduced to the problem but prior

to attempts to solve. Strategy monitoring during the early attempts to solve the problem (question 12 in Appendix C), as well as an evaluation of strategy effectiveness after the solution was known (Question 26 in Appendix C), were also significant.

Under the performance goal-orientation a somewhat different pattern was found. Like the learning goal-orientation, context comprehension prior to problem solving was found to be significant (questions 1,2 and 3 in Appendix C) as was strategy monitoring early in the problem solving process (questions 12 and 13 in Appendix C). Performance goal-oriented subjects did not, however, indicate using any other metacognitive activities before or after the problem solving task. In contrast to the learning goal-oriented subjects, performance goal-oriented subjects reported significant strategy consideration later during the task (question 17 in Appendix C), and comprehension monitoring both early (question 10 in Appendix C) and late (question 18 in Appendix C) in the problem solving.

Group Differences in Metacognitive Activity

A significantly greater proportion of subjects under the learning goal-orientation were found to utilize their awareness of prior knowledge versus those in the performance goal-orientation ($z=2.33$, $p<.01$). Interestingly, the performance goal-oriented subjects showed a significantly greater proportion utilizing comprehension monitoring during the later stages of problem solving ($z=2.45$, $p<.01$).

A 2-factor analysis of variance, subjects' reported goal-orientation by their highlighted goal-orientation across all questions for all subjects, found no interaction effects. Significant main group effects somewhat m rored the results reported for the limited subject pool. Subjects reporting a learning goal-orientation showed significantly more evaluation of strategy effectiveness after problem-solving ($F=4.545$, $p<.05$). Subjects in the performance goal-orientation group showed significantly more comprehension monitoring both early ($F=7.623$, $p<.01$) and later ($F=5.992$, $p<.05$) in the problem-solving process.

Question 29, designed to measure comprehension monitoring during execution of the task, was thrown out because it was mistakenly put in Part IV of the questionnaire (see Appendix C), which is administered after the subject has completed working on the task. Question 30 was also thrown out because its meaning and intent were difficult to consistently interpret.

Discussion

This research sought to test two hypotheses: (1) That an individual's goal-orientation has a significant effect on their metacognitive activity; and (2) the metacognitive activities elicited by individuals under a performance goal-orientation will significantly differ from those of a learning goal-oriented individual.

Individuals in the learning goal-orientation group exhibited metacognitive activities indicative of an emphasis on learning from the task to improve and grow relative to their own level of ability. Subjects in the learning goal-oriented group indicated a great consideration of the elements of the problem in relation to their own prior knowledge, but did not indicate an awareness of their own ability level. Prior to starting

the problem they did engage in metacognitively considering their comprehension of the problem context; however, they did not consider the actual task of the problem. Instead they gave consideration to the variety of approaches they might pursue in reaching a solution. Learning goal-oriented subjects also monitored their strategy use and efficiency early in the problem solving process as well as their continued comprehension of the problem. They did not give much effort to monitoring their progress in relation to their efforts. Finally learning goal-oriented subjects evaluated the effectiveness of their strategy use after the task was completed, and did not judge the feasibility of the strategies they may have used. They did not consider strategy usefulness or potential transfer.

Subjects in the performance goal-oriented group indicated significant strategy monitoring in the early stages of solving the problem, even more so than the learning goal-orientation subjects. Performance goal-oriented subjects were also found to monitor their comprehension of the problem context in both the early and later stages of solving, although more so in the early stages.

The performance goal-oriented group indicated significantly greater context comprehension prior to beginning work on the problem than the learning goal-oriented group.

How can these outcomes be explained? The learning goal-orientation is, of necessity, a no pressure situation. There is no pressure to perform within certain guidelines of competence or efficiency. The essence of the learning goal-orientation is motivation through intrinsic enjoyment of both the task and the resultant self-development and personal growth. Given this, it would not be surprising to have individuals utilize either minimal or well-practiced metacognitive activities in a more relaxed approach to problems. The results of the experiment indicate to me an individual goal-orientation that is able to enjoy the process of the interaction between their knowledge base and the problem itself. And, although affect is not of issue in this research, it is a necessary part of achievement motivation under the learning goal-orientation.

The performance goal-orientation is under pressure to perform both accurately and efficiently. In order to achieve that level of performance individuals must utilize as many cognitive tools as are available in their repertoire. As I indicated earlier, other researchers' general conclusion that performance goal-orientated individuals are less likely to utilize self-regulatory strategies does not mean they will not use them at all. In fact, if one considers the context difference between general motivation to engage and solve problems and solving a single problem that you have no choice but to solve in order to save face in front of your peers (as was the case in the experiment), it is not at all against the theoretical parameters to assert that an individual would use metacognitive activities to aid in solving the problem.

Another interesting explanation of the results is the type of metacognitive activity exhibited by each group in terms of problem solving efficiency. The learning goal-oriented subjects tended to utilize metacognitive activities that took time away from problem solving, e.g. considering prior knowledge, alternate solutions. However, performance goal-oriented subjects utilized metacognitive activities that did not compromise their efficiency in problem solving, e.g. monitoring comprehension, monitoring strategy.

The problem-solving efficiency difference is most evident in the significant propor:tional differences found between subjects' use of metacognitive activity under each goal-orientation. The learning goal-oriented subjects utilized an awareness of their prior knowledge before solving, yet did not utilize comprehension monitoring during the solving process. The performance goal-oriented subjects utilized comprehension monitoring during solving, but attempted to avoid time consuming metacognitive activities that had no direct impact on performance such as awareness of prior knowledge. Thus, it seems the results found can be justified by the theory given that subjects were put in a situation that offered no choice but to solve the single problem.

Subjects reported operating under a goal-orientation different from the highlighted goal-orientation of their group in nearly half the cases. One potential reason for the lack of consistency in goal-orientation in this study may be the definition used for each goal-orientation. The distinction between performance and learning goal-orientations lies in the route through which individuals seek feelings of competence, a basic component of intrinsic motivation. Learning goal-oriented individuals achieve competence through self-improvement. Performance goal-oriented individuals achieve competence through performance exceeding that of others. This basic dichotomy leaves a great deal of room for finer distinctions. For example, Ng and Bereiter (1995) theorize three levels of goal-orientation, all of which comprise a more distinct version of the learning goal-orientation.

Implications for Education and Future Research

The results of this research indicate that there is a relationship between goal-orientation and metacognitive activity, and that the relationship has definable characteristics unique to each type of goal-orientation. Results also indicate that specific goal-orientations affect the specific types of metacognitive activity used before, during, and after problem-solving.

The practical benefits of highlighting a learning goal-orientation in the classroom are well documented, as are the detrimental effects of a performance goal-orientation. A goal-orientation is a statement of purpose which raises the question of educational purpose. If the purpose of education is to endow the learner with a set of skills, then it appears that either goal-orientation would be sufficient. Situations that call for a rapid acquisition of skills or immediate efficiency and performance, as our economic system so often requires, may find a performance goal-orientation to be desirable. If the purpose of education is to facilitate an individual's long-term development, the learning goal-orientation is the more appropriate. However, the learning goal-orientation may set up a situation where individuals learn for the sake of learning and self-development, which may become their sole purpose at the expense of implementation.

Both learning and performance groups indicated that the use of metacognitive abilities could be of great value in their attempts to solve other problems. One approach educators might take is to incorporate goal-orientation into attempts to teach metacognitive activities. For example, an educator could highlight a given goal-orientation prior to a task, and then utilize the elicited metacognitive activities to illustrate both

the example and value of the metacognitive activity so that in the future students can consciously utilize those activities. Although, as evidenced by the elimination of original data from this study, the specific variables that determine goal-orientation are not yet fully understood.

Educators could also utilize these findings to indicate when they might be unknowingly highlighting a goal-orientation they are seeking to avoid. For example, if the students are indicating their use of a pattern of metacognitive activity indicative of a given goal-orientation, an instructor can utilize that information to alert themselves to the type of learning environment he/she is highlighting. Consequently, an instructor could modify the learning environment to highlight a more desirable goal-orientation.

Theoretically, the findings of this study illustrate the relationship between motivation and cognition. Particularly noteworthy is the implied finding that, even under a performance goal-orientation that does not encourage long-term motivation, one's metacognitive activity over the course of a single problem does not appear adversely affected. And, as illustrated earlier, a performance goal-orientation may actually inspire effort in immediate practice even as it fails to inspire motivation to continue and challenge oneself over time. The entire situation creates an interesting dilemma in that one's intentions become an issue rather than the immediate outcome. In other words, if the outcome is the same, does it matter whether it was done for self-improvement or to outperform another? Given the empirical findings on motivation under each goal-orientation, one might be inclined to argue that a learning goal-orientation will keep the learner motivated to learn. But, under a performance goal-orientation, one could learn merely by their efforts to perform. Even if the latter case does not lead to the most advantageous situation, it may be the best that can be attained within the classroom for individuals whose whole world is performance goal-oriented outside the classroom. Perhaps a different goal-orientation, one that blends learning and performance, would be most effective for some individuals. And, it is also possible that some individuals need to function under a performance goal-orientation until they have developed more mature cognitive or emotional processes enabling them to be successful under a learning goal-orientation.

This research offers other researchers and educators a spring-board from which other studies and ideas can be generated. The value of metacognition lies not only in its use as a cognitive tool, but also in its ability to illuminate a cognitive view of motivation and affect in both process and environment. Further research in this area might focus on the continued effort to clarify the processes involved in goal-orientation, an effort that furthers the illumination of the cognitive, affective and motivation relationship.

This specific study could be expanded in a number of ways, including the addition of other goal-orientations; varying the task type and how many times the task is performed; adding a measure of motivation during the task and comparing it to a similar measure at a later date under varying goal-orientations; varying the subjects by age or other variables, and venturing into more qualitative measures of both motivation and metacognition. A personal interest lies in exploring a creativity goal-orientation and the metacognitive activities involved in such a state. Further, one might ask the reverse of this research,

i.e. if goal-orientation elicits metacognitive activity, can metacognition be utilized to highlight goal-orientation, and thus affect motivation?

Another interesting pursuit would be examining the different perspectives subjects hold during a task and why they perceive the activity that way; in other words, a closer examination of the dynamics involved in goal-orientation development, particularly at different ages through childhood into adulthood.

In closing it is my hope that this research inspires educators to carefully consider and utilize the complex interactions between thought, feeling and motivation in their efforts to help individuals develop, grow and produce.

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Appendix A

Sample Problems*

1. The man was afraid to go home because the man with the mask was there. Why?

2. A young woman walked into a place and asked for a drink of water. The man behind the counter suddenly pulled out a gun and pointed it at her. A few seconds elapsed, and then the woman smiled, thanked the man, and left. Why?

3. A man's dead body hangs from a rope tied to the center of a ceiling beam in a large, empty room. The feet are 10 feet from the floor. No other items are in the room. The man killed himself by hanging. How?

4. A traveler on a deserted road came upon a body of a man lying by the roadside, dead. The dead man was wearing a knapsack. Though there were no marks on the body, or blood anywhere, the traveler could tell immediately the cause of death. What was the cause of death?

5. Don and Dan enter a tavern and are served identical drinks. Don drinks his quickly, and feels fine. Dan drinks his very slowly, and dies. Why?

6. A man has been murdered while sitting in the driver's seat of a car. Although there are numerous bullet wounds in the body, and all the doors of the car are tightly closed and locked and the windows are completely rolled up, there are no bullet holes anywhere in the car. What happened?

**7. There is a man strapped to a chair, in a cabin, on a mountain. He is dead. How did he die?

*Story problems 1-6 found in Stories with Holes (date unknown).

**No known source.

Task Instructions

Learning Goal-Orientation Instructions

"Here are some problems that are quite difficult. By working with these problems, you'll probably learn new things. But you'll probably make a bunch of mistakes, get a little confused, maybe feel a little dumb at times - but eventually you'll learn some very useful things.

"The things you learn from this task may even be helpful to you in thinking through future problems, and could benefit your studies. The number of points you get for participating is ____. If you are able to tell me about what you learned from the problem you will get additional points depending on what you learn.

"I am going to read a brief story to you with a problem posed at the end. Your task is to generate the correct solution to the problem. To help with this task you may ask me any question about the story, however I can only answer 'yes,' 'no,' or 'not relevant.'

"If you feel you have the solution, do not verbalize it, simply write it on the paper in front of you. You may take notes if you wish."

Performance Goal-Orientation Instructions

"Here are some problems of different levels of difficulty. Some are hard, some are easier. By working with these problems you may not learn new things, but it is a good opportunity to display your competence in problem solving.

"The number of points you get for participating in this experiment is ____. If you are able to solve the problem you will get additional points depending on how efficiently you solve the problem. In addition, we will be taping your performance so that we can critique it at a later date by experts.

"I am going to read a brief story to you with a problem posed at the end. Your task is to generate the correct solution to the problem. To help with this task you may ask me any question about the story, however I can only answer 'yes,' 'no,' or 'not relevant.'

"If you feel you have the solution, do not verbalize it, simply write it on the paper in front of you. You may take notes if you wish."

Appendix C
Metacognitive Activities Questionnaire
Questionnaire Part I

For each item, choose the statement which most accurately and honestly reflects your thoughts. Do not try to guess what is appropriate to the experiment, simply choose the answer that most describes your thinking at this moment.

1.   A. I read the problem at least two times.

   or

        B. I read the problem only once.

2.   A. I asked myself if I understood the problem.

   or

        B. I understood the problem right away.

3.   A. I understand the problem without using a mental picture of it.

   or

        B. I have a mental picture of the problem.

4.   A. I immediately understood what the problem was asking me to do.

   or

        B. I thought about whether or not I understood what the problem is asking me to do.

5.   A. I knew right after reading the problem what the task required.

   or

        B. I have considered what the problem task required.

6.   A. I have already considered a plan to solve this problem.

   or

        B. I don't think I will need a plan to solve this problem.

7.   A. I think I know the solution.

   or

        B. I have considered more than three solutions.

STOP AT THIS POINT. DO NOT TURN TO THE NEXT PAGE UNTIL INSTRUCTED TO DO SO.
Questionnaire Part II

For each item, choose the statement which most accurately and honestly reflects your thoughts. Do not try to guess what is appropriate to the experiment, simply the answer that most describes your thinking at this moment.

8.   A. I thought about how to solve this problem before I asked any questions.

or

        B. I was ready to ask questions as soon as I read the problem.

9.   A. I am not using a plan or strategy at this time.

or

        B. I am using a plan or strategy at this time.

10.   A I have reconsidered my understanding of the problem.

or

        B. I am confident that my initial understanding is correct.

11.   A. I still have a clear idea of what the problem is asking of me.

or

        B. I have rechecked to see if the task is still as I understood it to be the first time I read it.

12.   A. I asked myself whether or not the strategy I am using is working well/not well for this problem.

or

        B. I have not considered whether the plan I am using is working well or not at this point. It seems satisfactory.

13.   A. I thought about whether I am going to continue using this plan.

or

        B. This plan seems fine. I have not considered discontinuing it.

14.   A. I have not given much thought to how near a solution I am.

or

        B. I considered how near the solution I am.

15.   A. I am not sure of a solution, but fee! I am moving towards one.

or

        B. I have reconsidered at least two tentative solutions.

STOP AT THIS POINT. DO NOT TURN TO THE NEXT PAGE UNTIL INSTRUCTED TO DO SO.

Questionnaire Part III

For each item, choose the statement which most accurately and honestly reflects your thoughts. Do not try to guess what is appropriate to the experiment, simply the answer that most describes your thinking at this moment.

16.   A. I thought about how to solve this problem before I asked any questions.

or

      B. I was ready to ask questions as soon as I read the problem.

17.   A. I am not using a plan or strategy at this time.

or

      B. I am using a plan or strategy at this time.

18.   A. I have reconsidered my understanding of the problem.

or

      B. I am confident that my initial understanding is correct.

19.   A. I still have a clear idea of what the problem is asking of me.

or

      B. I have rechecked to see if the task is still as I understood it to be the first time I read it.

20.   A. I asked myself whether or not the strategy I am using is working well/not well for this problem.

or

      B. I have not considered whether the plan I am using is working well or not at this point. It seems satisfactory.

21.   A. I thought about whether I am going to continue using this plan.

or

      B. This plan seems fine. I have not considered discontinuing it.

22.   A. I have not given much thought to how near a solution I am.

or

      B. I considered how near the solution I am.

23.   A. I am not sure of a solution, but feel I am moving towards one.

or

      B. I have reconsidered at least two tentative solutions.

STOP AT THIS POINT. DO NOT TURN TO THE NEXT PAGE UNTIL INSTRUCTED TO DO SO.

Questionnaire Part IV

For each item, choose the statement which most accurately and honestly reflects your thoughts. Do not try to guess what is appropriate to the experiment, simply the answer that most describes your thinking at this moment.

24.   A. I have considered whether the solution given is reasonable or not.
    or
        B. I knew right away that the solution given was correct.

25.   A. I was pretty sure that the solution given was the only solution.
    or
        B. I have considered other solutions might be feasible even after the solution was given.

26.   A. I thought about whether the strategy or plan I used to solve this problem was effective.
    or
        B. I am confident that the strategy or plan I used to solve this problem was effective.

27.   A. I haven't thought of using this sort of solution in solving other problems at this point.
    or
        B. I have considered using this sort of solution in other problems.

28.   A. I have thought about whether I can use the plan I used to help solve other problems.
    or
        B. I have not considered the possibility of using the plan I used to solve this problem to solve other problems at this point.

29.   A. I have rechecked to see if I now understand the problem differently.
    or
        B. I am confident that I understand the problem.

30.   A. I feel I have learned something from solving this problem.
    or
        B. Solving this problem did not teach me anything I didn't already know.

31. Before starting this problem (but after knowing what the problem was):
        A. I thought about what I knew regarding thinking and/or the thought process.
    or
        B. I did not need to consider what I knew regarding thinking and/or the thought process.

32. Before starting this problem (but after knowing what the problem was):
      A. It was unnecessary to consider my background knowledge regarding the elements of the problem.
   or
      B. I considered what I knew regarding the elements of the problem.

33. Before starting the problem (but after knowing what the problem was):
      A. I considered how confident or unsure I was about my abilities.
   or
      B. I knew my abilities and did not have to think about them.

34. I felt:

very confident in my abilities				unsure		not confident in my ability			
1	2	3	4	5	6	7	8	9	10

35.   A. I thought about whether I would solve the problem or not.
   or
      B. I was close to certain that I would either solve or not solve the problem.

36. My primary purpose in solving this problem was to:
_____

37. I have given some thought to what I have learned from solving this problem.
      YES   or   NO

  If YES: I learned_____

38. What do you feel was your overall goal during this task?
_____

39. My gender is: Male   Female

40. My age is: _____ .

Appendix D

Questionnaire Responses by Metacognitive Activity

Part I

Comprehension - Context comprehension.

    1. I read the problem at least two times.

    2. I asked myself if I understood the problem.

    3. I have a mental picture of the problem.

Comprehension - Task comprehension.

    4. I thought about whether or not I understood what the problem was asking me to do.

    5. I have considered what the problem task required.

Comprehension - Strategy use/type consideration.

    6. I have already considered a plan to solve this problem.

    7. I have considered more than three solutions.

Part II

Comprehension - Strategy use/type consideration

    8. I thought about how to solve this problem before I asked any questions.

    9. I am using a plan or strategy at this time.

Execution - Comprehension monitoring.

    10. I have reconsidered my understanding of the problem.

    11. I have rechecked to see if the task is still as I understood it to be the first time I read it.

Execution - Strategy monitoring.

    12. I asked myself whether or not the strategy I am using is working well/not well for this problem.

    13. I thought about whether I am going to continue using this plan.

Execution - Monitoring of progress (given effort expended).

    14. I considered how near the solution I am.

    15. I have reconsidered at least two tentative solutions.

Part III

(Repeat Part II)

Part IV
Evaluation - Solution feasibility.

    24. I have considered whether the solution given is reasonable or not.

    25. I have considered other solutions might be feasible even after the solution was given.

Evaluation - Strategy effectiveness.

    26.. I thought about whether the strategy or plan I used to solve this problem was effective.

Evaluation - Solution and strategy usefulness (transfer).

    27. I have considered using this solution in other problems.

    28. I have thought about whether I can use the plan I used to help solve other problems.

Execution - Comprehension monitoring.

    29. I have rechecked to see if I now understand the problem differently.

Awareness - Post-task evaluation of learning.

    30. I feel I have learned something from solving this problem.

Awareness - Prior knowledge awareness.

    31. Before starting this problem (but after knowing what the problem was), I thought about what I knew regarding thinking and/or the thought process.

    32. Before starting this problem (but after knowing what the problem was), I considered what I knew regarding the elements of the problem.

Awareness - Awareness of ability level.

    33. Before starting the problem (but after knowing what the problem was), I considered how confident or unsure I was about my abilities...

    34. I felt:

very confident in my abilities   unsure   not confident in my ability

    1   2   3   4   5   6   7   8   9   10

    35. I thought about whether I would solve the problem or not.

Reverification of Goal-Orientation

    36. My primary purpose in solving this problem was to:

    37. I have given some thought to what I have learned from solving this problem...

    38. What do you feel was your overall goal during this task?

Table 1.

<u>Metacognitive Activities by Ability</u>

<u>Awareness</u>

Prior knowledge including domain knowledge and knowledge of cognition

and metacognition (i.e. how information is processed).

Personal knowledge of feelings, moods, personal history/events.

<u>Comprehension</u>

Comprehension of the context of the problem.

Comprehension of the task (i.e. what the problem is asking you to do).

The consideration of strategy options.

<u>Execution</u>

Monitoring of effectiveness and appropriateness of strategy/plan, level of

comprehension; degree, level and focus of attention; and the progress on the

task at hand.

<u>Evaluation</u>

Evaluation of solution feasibility and usefulness (transfer).

Evaluation of strategy effectiveness and usefulness (transfer).

Evaluation of understanding,prior knowledge and/or learning (evaluating

any changes in your understanding due to the process).

Table 2.
Normal Scores for Metacognitive Activity and Comparison of Proportions Under Each
Goal-Orientation.

Metacognitive Activity	Questionnaire Number	Goal-Orientation Learning / Performance		Proportion Comparison
Awareness (measured post-task)				
Awareness of ability level	33	1.27	-0.63	0.79
	35	1.27	1.27	
Prior knowledge awareness	31	1.89*	0.63	2.33**
	32	3.16*	0.63	
Comprehension				
Strategy use/type consideration				
Prior to solving(Prior)	6	3.16*	1.89	1.63
	7	1.89*	0.63	
Early in solving(Early)	8	-0.63	0.0	0.96
	9	0.0	1.27	
Later in solving(Late)	16	0.63	0.0	0.34
	17	1.27	2.53*	
Comprehension				
Context comprehension (Prior)	1	2.53*	2.53*	0.77
	2	1.27	2.53*	
	3	2.53*	2.53*	
Task comprehension (Prior)	4	0.63	0.63	0.67
	5	0.63	1.89	
Execution				
Monitoring of progress				
Early	14	-0.63	-0.63	0.67
	15	-0.63	-1.89	
Late	22	0.63	-0.63	0.64
	23	-0.63	-0.63	
Strategy monitoring				
Early	12	2.53*	2.53*	0.42
	13	1.27	1.89*	
Late	20	0.63	1.27	1.03
	21	0.63	1.89	
Execution				
Comprehension monitoring				
Early	10	0.63	2.53*	1.41
	11	0.63	1.27	
Late	18	1.27	2.53*	2.45**
	19	-1.89	1.27	
Evaluation (measured post-task)				
Solution feasibility	24	-0.63	-1.27	0.33
	25	-0.63	-0.63	
Strategy effectiveness	26	1.89*	0.0	1.48
Solution and strategy usefulness	27	0.63	1.89	0.0
	28	1.89	0.63	

Note. Probability levels determining significance for normal scores under each goal-orientation are based on the results of the Holm Technique. *$p < .05$. **$p < .01$.