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Effects of Anchoring on Perceived Self-efficacy, Task Persistence and Performance

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This study explores the effects of anchoring using social comparative feedback on the perceived self-efficacy judgments of children. A sample of 256 children in Singapore attempted to solve a mathematics problem-solving task under conditions of high, low and no anchor. Anchoring was achieved by giving bogus information (high anchor: very easy task, low anchor: very difficult task) about hypothetical peers' performance on the mathematics task Results showed that anchoring influenced students' self-efficacy judgments and persistence time. Lower ability students had a more external control orientation as well as lower self-efficacy judgments than higher ability students. Anchoring also affected higher ability students' persistence time to a greater extent than in lower ability students.

INTRODUCTION

The relationship between children's self-efficacy beliefs and academic achievement have been extensively studies (e.g., Bandura, 1977, 1986; Carr, Borkowski, & Maxwell, 1991; Meece, Wigfield, & Eccles, 1990; Middleton & Spanias, 1999; Weiner, 1979, 1985; Wigfield & Eccles, 1992). Children who believe that good grades are caused by internal and controllable causes (Weiner, 1979), who believe that they can produce the responses that lead to desired outcomes (Bandura, 1977); who have higher self-esteem and stronger internal attributions about success (Carr, Borkowski, & Maxwell, 1991), and who believe they possess high ability (Stipek, 1981) perform better academically than those who do not.

Pintrich and De Groot (1990) suggested that perceived self-efficacy of students played a facilitative role in the process of cognitive engagement and that raising self-efficacy beliefs might lead to increased use of cognitive strategies and thereby higher academic performance. Zimmerman and Martinez-Pons (1990) found that students' perceptions of both verbal and mathematical efficacy were related to their use of self-regulated strategies. Pajares and Miller (1994) found mathematics self-efficacy to be more predictive of problem solving than gender, mathematics self-concept, perceived usefulness of mathematics, or prior experience with mathematics. Teachers who are more attuned to bolstering their students' self-efficacy beliefs are better able to adjust their classroom practice to motivate their students (Middleton & Spanias, 1999).

It can be argued that, if self-efficacy beliefs influence levels of achievement (Bandura, 1977; Pintrich & De Groot, 1990), then efforts to facilitate the development of higher self-efficacy beliefs should yield positive outcomes for academic achievement.

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Self-efficacy and Anchoring

The term "self-efficacy" has been used to refer to perceived competence and confidence (Pintrich & De Groot, 1990), perceived capabilities (Zimmerman & Martinez-Pons, 1990) and perceived ability and performance expectations (Meece, Wigfield & Eccles, 1990). Although it has been used across different settings, self-efficacy encompasses one's beliefs or expectations about capabilities of attaining a certain level of performance on a specific task.

Self-efficacy affects behavior through motivation (Bandura, 1977). Through the exercise of forethought, people motivate themselves and set their own goals and plan courses of action to realize their goals. If individuals have a high sense of efficacy in a given area, they will set high goals and persist when they encounter difficulties. If their sense of efficacy is low, they may avoid a task altogether or give up easily when problems arise (Zimmerman & Martinez-Pons, 1990).

Anchoring is a cognitive heuristic first proposed by Tversky and Kahneman (1982). According to this heuristic, in the face of uncertainty, people make judgments or estimates based on an initial value and they then adjust upward or downward to yield a final estimate. However, such judgments are often insufficient, leaving judgments biased in the direction of the initial anchor value. The anchoring heuristic was deemed suitable for use in manipulating judgments of self-efficacy because making judgments of efficacy involved making a decision in a situation of uncertainty, especially so if the task is an unfamiliar one (Cervone & Peake, 1986). Self-efficacy beliefs can also be influenced through providing bogus normative comparisons (Bouffard-Bouchard, 1989).

Comparison of one's own competence and achievements with those of relevant others plays an important role in the development and maintenance of self-efficacy (Bandura, 1986; Bandura & Jourden, 1991). Peers' levels of achievement influence the individual's perceived academic competence through social comparison processes (Pomerantz, Ruble, Frey, & Greulich, 1995; Ruble, Boggiano, Feldman, & Loebl, 19 80) and this effect increases with age (Aboud, 1985; Nicholls & Miller, 1984; Schunk, 1983c).

Bandura (1986) outlines two conditions under which self-efficacy appraisals, gauged through social comparisons, are especially sensitive to vicarious information. The first is the amount of uncertainty about one's own capabilities. This happens when people have little prior experience on which to base evaluations of their personal competence. Lacking direct knowledge of their own competence, they rely more heavily on the experience of others. The second is the absence of an objective standard of measuring the performance. Activities that lack clear performance criteria do not provide a factual basis for judging one's capabilities. Such activities do not in themselves provide sufficient information to gain knowledge of one's capabilities. Most human activities are evaluated in terms of social criteria. Hence, social comparative information figures prominently in self-efficacy appraisals.

Purpose

This study examines the effects of anchoring and ability levels on primary school students' self-efficacy judgment, locus of control beliefs, task persistence and task achievement on a specific mathematics task. Since children tend to socially compare themselves with others, a same-aged peer's performance is used as an anchor value for the student's own self-efficacy judgment task. Figure 1 shows the proposed links

between anchoring, ability levels, perceived self-efficacy, task persistence and task performance.

The following hypotheses were developed in the current study:

- Hypothesis 1: A high anchor value induces a higher level of self-efficacy compared to a low anchor value.
- Hypothesis 2: Higher ability students have higher self-efficacy judgments than lower ability students across all levels of anchoring.
- Hypothesis 3: Subjects in the high-anchor condition show a higher level of persistence on the task as compared to subjects in the low-anchor condition.
- Hypothesis 4: Anchoring affects higher ability students' persistence to a greater extent than in lower ability students.
- Hypothesis 5: Subjects in the high-anchor condition show a higher level of achievement on the task as compared to subjects in the low-anchor condition.
- Hypothesis 6: Anchoring affects higher ability students' achievement to a greater extent than in lower ability students.
- Hypothesis 7: Lower ability students show a more external control orientation as compared to higher ability students.

METHOD

Sample

A convenience sample of 256 (146 males, 110 females; 154 Chinese, 102 non-Chinese) (mean age 12 years) primary 6 students in Singapore participated in this study. Ability groupings were based the students' school academic results at the end of Primary 4. There were 76 students in the lower-ability group, 90 in the average-ability group, and 90 students in the higher-ability group.

Research Design

This study used a 3 x 3 factorial design with 3 anchor conditions (high, low, none) and 3 levels of student ability (higher, average, lower). Within each ability level, students were randomly assigned to one of three experimental conditions – a high-anchor condition, a low anchor condition and a no-anchor condition (see Table 1).

Table 1

Distribution of Students across Ability Levels and Anchoring Conditions

	Anchoring			
	High Anchor	Low Anchor	No Anchor	Total
Ability level				
High	30	30	30	90
Average	30	30	30	90
Low	26	25	25	76
Total	86	85	85	256

Anchoring was done by providing students with bogus social comparative information of the performance of a hypothetical peer on a mathematics task. Mathematics

was selected as the task because mathematics appears to trigger the most anxiety, especially among underachievers who repeatedly experience failure in it (Bandalos, Yates, & Thorndike-Christ, 1995).

Participants in the high-anchor condition were informed that the test is *very easy*, and that an average student has an *80%* chance of answering all the 4 questions correctly. Participants in the low-anchor condition were told that the test is *very difficult* and that an average student has a *10%* chance of getting all the questions correct.

The first and second questions in the mathematics test were solvable and were used to measure achievement on the mathematics task. The third and fourth questions had no possible answers and could not be solved. They were designed to test subjects' level of persistence.

Measures

Self-efficacy After glancing through the 4 questions in the test and reading the anchoring information, subjects indicated how sure they were of their ability to get all the sums correct. The perceived self-efficacy scale ranged from 0 to 100 in 10-unit intervals from high uncertainty (0%) through to complete certainty (100%). This judgment provided a measure of task-specific self-efficacy. At the end of the mathematics task, subjects were again asked to rate their perceived efficacy on the same mathematics task in the future.

This method of measuring self-efficacy is based on procedures developed by Bandura and Schunk (1981) and used extensively in studies of self-efficacy (e.g., Bouffard-Bouchard, 1989; Schunk, 1981, 1983a, 1983b, 1983c).

Crandall Intellectual Achievement Responsibility (IAR) Questionnaire The Crandall Intellectual Achievement Responsibility (IAR) Questionnaire (Crandall, Katkovsky, & Crandall, 1965) consists of 34 forced-choice items which ask the subjects to select the alternative which best explains the occurrence of success and failure on academic tasks. For example, one question asks, "When you do well on a test at school, is it more likely to be (a) because you studied for it or (b) because the test was especially easy?" Each item presents one internal causal explanation and one external causal explanation. Making an internal causal explanation implied the application of effort and taking personal responsibility. For the present study, internal attribution was measured by summing all items whose internal response implied that personal effort was the cause of either success or failure. The maximum possible internal score is 34. Crandall's IAR scale has been shown to have acceptable reliability scores (Crandall, Katkovsky, & Crandall, 1965; Reid & Croucher, 1980; Zsolnai, 2002). Cronbach alpha for the IAR in the current study was .62.

Children's Nowicki-Strickland Internal-External Control Scale (CNSIE) The Children's Nowicki-Strickland Internal-External Control Scale (Nowicki & Strickland, 1973) is appropriate for children from ages 9 through 18 years. It consists of 40 questions which are answered either "yes" or "no". For the CNSIE scale, the lower the score, the more internal is the orientation. The maximum external score is 40. For the present study, a question, "If you find a four-leaf clover, do you believe it might bring you good luck?" was deemed not suitable for children in the Singapore context. As children in Singapore are not likely to have extensive knowledge of a four-leaf clover and do not associate it with good luck, this question was changed to "If you break a mirror, do you believe that it might bring you bad luck?" The CNSIE ques-

tionnaire has acceptable reliability measures (Martin, Richardson, Bergen, Roeger, & Allison, 2005; Richardson, Bergen, Martin, Roeger, & Allison, 2005; Shepherd, Owen, Fitch, & Marshall, 2006). Cronbach alpha for the CNSIE in the current study was .67.

Procedure

The Crandall's IAR and the CNSIE questionnaires were first administered to the 256 students in their respective classes. Students were told that it was not a test and they could take their time to complete the questionnaires. One month later, the students randomly assigned to the anchoring conditions completed the mathematics task in groups of 30. When students had completed the task, they raised their hands to signal to the teacher, instead of walking to the teacher to hand in the paper. This was to make it less obvious for students to know how many of their peers have finished the mathematics task so that they would not feel any undue pressure to complete the task. Students who finished early were not allowed to leave the class but were required to engage in silent reading until all had finished. A research assistant unobtrusively recorded the time each student took to complete the mathematics task.

When all the 256 students had completed the study, they were debriefed about the experiment. The students were assured that, because the mathematics test is unsolvable, it does not provide information about one's actual abilities on the task.

RESULTS

A series of 3 x 3 ANOVAs with anchor (high, low, none) and ability (higher, average, lower) as factors were computed to assess group differences in self-efficacy judgments, task persistence, task achievement, Crandall's IAR and CNSIE scores. Scheffe post hoc test was used to test specific predictions concerning differences between the experimental conditions.

Self-efficacy

Hypotheses 1 and 2 The main effect for anchoring on perceived efficacy was significant F (2,247) = 51.16, $p < .001$. Scheffe post hoc analysis revealed that the low-anchor condition subjects' mean self-efficacy (34%, SD = 25.74) was significantly lower than the mean efficacy for the no-anchor condition subjects (54.82%, SD = 24.72) and than for high-anchor condition subjects (66.98%, SD = 16.02), $p < .001$. A high anchor value induces a higher level of self-efficacy compared to a low anchor value.

The main effect for ability on perceived efficacy was significant F (2,247) = 12.78, $p < .001$. Scheffe post hoc analysis revealed that the high-ability subjects' mean self-efficacy (58.89%, SD = 28.58) was significantly higher than the mean efficacy for average-ability subjects (53.33%, SD = 24.22) and than for low-ability subjects (42.24%, SD = 23.01), $p < .001$. The mean perceived efficacy for average-ability subjects was also significantly higher than the mean efficacy for low-ability subjects, $p < .01$. Higher ability students have higher self-efficacy judgments than lower-ability students across all levels of anchoring.

However, the interaction effect between anchoring and ability levels on perceived efficacy was not significant, F (2, 247) = .81.

Persistence time

Hypotheses 3 and 4 The main effect for anchoring on persistence time was significant, F (2,247) = 73.78, $p < .001$. The main effect for ability on persistence time was significant, F (2,247) = 121.28, $p < .001$. However, the main effects are qualified by the significant interaction effect of ability and anchoring on persistence time, F (4, 247) = 35.19, $p < .001$ (see Figure 1). Scheffe post hoc tests revealed that for the average-ability group, the mean persistence time for high-anchor condition (21.59 minutes) was significantly higher than that for no-anchor (13.03 minutes) and low-anchor (9.81 minutes) conditions, $p < .001$. For the high-ability group, the mean persistence time for the high-anchor (34.39 minutes) was significantly higher than the low-anchor (18.81 minutes) and that of the no-anchor groups (14.82 minutes), $p < .001$. The mean persistence time for the low-anchor was significantly higher than that of the no-anchor group, $p < .001$. For the low-ability group, however, there was no significant difference in the mean persistence time between all three anchor conditions.

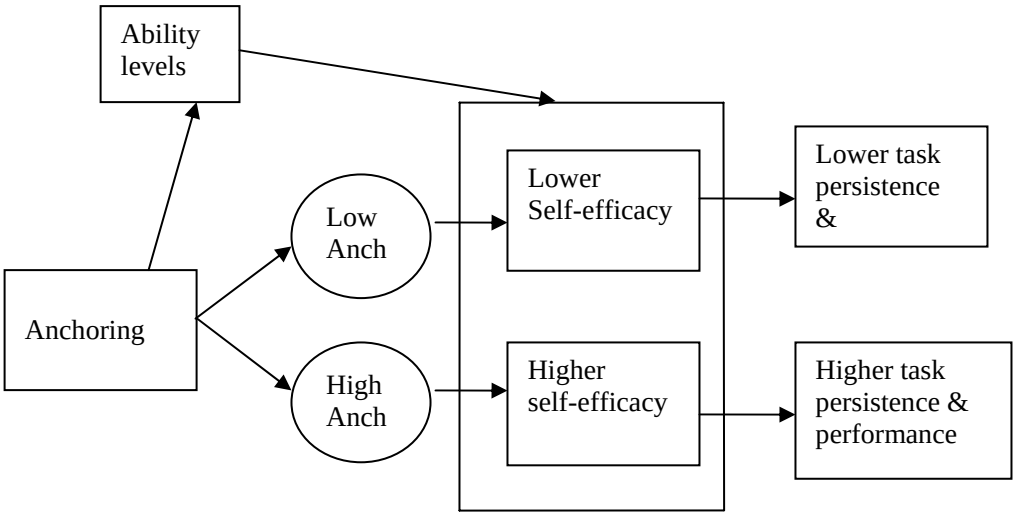

Figure 1. Proposed Links between Anchoring, Perceived Ability Levels, Task Persistence and Task Performance

As expected, a high anchor resulted in greater persistence time compared to when there was no anchor. However, what was unusual was that even when a low-anchor was presented, students also showed greater persistence than when there was no anchor. Anchoring influenced higher ability students' persistence time to a greater extent than with lower ability students.

There was also a correlation between self-efficacy judgments and persistence time, $r = .25$, $p < .01$.

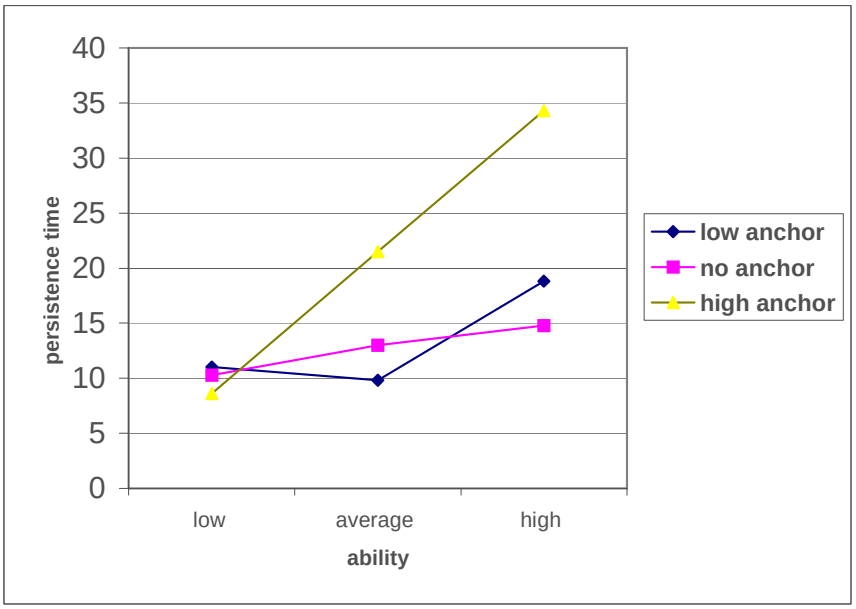

Figure 2. Interaction Effects between Ability and Anchoring on Persistence Time

Achievement

Hypotheses 5 and 6

Only ability showed a significant main effect on the measure of achievement, F (2,247) = 97.98, $p < .001$. Scheffe post hoc analysis revealed that the high-ability subjects' mean achievement (81.11%, SD = 24.38) was significantly higher than the mean persistence time for the average-ability subjects (54.44%, SD = 26.65) and the low-ability subjects (24.34%, SD = 27.68), $p < .001$. The average-ability subjects' mean achievement was also significantly higher than that for low-ability subjects, $p < .001$.

The main effect of anchoring on achievement was not significant, F (2, 247) = .78. Interaction between anchoring and ability on achievement was also not significant, F (2, 247) = 1.9.

Measures of control belief

Hypothesis 7

Only ability showed a significant main effect on the Crandall's IAR scores, F (2,247) = 4.94, $p < .01$. Scheffe post hoc analysis revealed that the mean Crandall's IAR score for low-ability (22.91, SD = 4.43) was significantly lower than the mean for average-ability (24.96, SD = 4.25), $p < .05$. This meant that low-ability students had a more external attribution style as compared to average ability students. There was no difference between the IAR scores for high-ability students (24.49, SD = 4.38) and for average-ability students.

Only ability showed a significant main effect on the measure of CNSIE, F (2,247) = 6.93, $p < .01$. Scheffe post hoc analysis revealed that the mean CNSIE score for low-ability (18.83, SD = 4.06) was significantly higher than the mean for average-

ability (16.37, *SD* = 4.9) and the mean for low-ability (16.13, *SD* = 6.05), $p < .01$. This meant that low-ability students had a more external locus of control as compared to average-ability and high-ability students.

There were no other significant main effects of anchoring and interactions between anchoring and ability on the 2 measures of control beliefs, maximum *F*-values = 3.02, $p > .05$. On the whole, results suggest that lower ability students had a more external control orientation as compared to the higher ability students.

DISCUSSION

Anchoring and perceived self-efficacy

The results supported the hypothesis that anchoring influences students' self-efficacy judgments. Providing social comparative information influenced students' self-efficacy judgments and persistence time. This finding supports Bandura's (1986, 1992) postulation that one important source of self-efficacy information comes from social comparison of one's performance with the performances of others. This result suggests that self-efficacy judgments are context-dependent and that social comparison information is significant in the estimates of self-efficacy. This point emphasizes the influential role that teachers and peers play in providing students with cues to encourage then and help them develop the motivation to extend their capabilities, particularly when faced with new tasks or domains of learning.

Persistence time and achievement

Differences in self-efficacy judgments resulting from anchoring manipulation were found to influence persistence. Subjects in the high-anchor condition showed a higher level of persistence on the task as compared to subjects in the low-anchor condition. Similar results were obtained in previous research where self-efficacy was manipulated and the subsequent behavior monitored (Bouffard-Bouchard, 1989; Cervone & Peake, 1986).

Nonetheless, the direct causal link between self-efficacy judgments and persistence time cannot be conclusively established in the current study. It is possible that the anchoring treatment itself, and not the self-efficacy judgments, had brought about differences in persistence time. Bandura (1977) qualified that, although perceived self-efficacy influences performance, it is not the only determinant of behavior. Knowledge, competence, various forms of self-knowledge and self-belief act in concert to provide adequate explanations of behavior (Bandura, 1986).

In terms of achievement, it was found that anchoring did not affect achievement levels. It was the students' ability level, rather than anchoring and self-efficacy variables, that determined the level of achievement. This leads to the conclusion that although anchoring and self-efficacy contain a motivational component that determines how long a student persists on a task, it is still the student's ability level that had a significant impact on his or her actual achievement on the task.

Internal-external control beliefs and self-efficacy

Lower ability students displayed a more external control orientation compared to higher ability students. Lower ability subjects also showed lower levels of perceived self-efficacy than the higher ability group. From these results, it can be seen that specific efficacy differences parallel the general control orientation differences.

Lower ability students thus have a more external general attribution style and lower specific efficacy judgment as compared to higher ability students.

These findings are consistent with the prior research on achievement motivation. Underachievers and learned helpless children generally have lower self-esteem and external attribution orientations compared to achievers (Weiner, 1979, 1985). This has implications for later development because, as a child matures and advances academically, affective and motivational states become critical factors in determining performance, especially in the primary school years. Children who do not have a high sense of personal control are less persistent, have poor expectancies for future tasks and generally do not use viable learning strategies. They do not see the usefulness of being strategic because they do not understand their capacities to cause success and to minimize failure. In contrast, achieving children see themselves as causal agents and they make use of appropriate learning strategies. They learn about the importance of effort and become self-directed (Carr, Borkowsky, & Maxwell, 1991).

Extent of influence of anchoring on ability groups' persistence time

The effect of anchoring on persistence time was stronger in higher ability students than in lower ability students. Using social-comparative information to improve persistence time seems to be more effective for average and higher ability pupils. For lower ability students, persistence time on task was not significantly enhanced by high-anchoring.

There are a few possible explanations for the interaction effects between anchoring and ability on persistence time. Instead of being anchored to a high self-efficacy judgment, it is possible that lower ability students made upward comparisons based on their prior experiences and felt that they could not measure up to the expected standards, hence there was no incentive to persist on the task.

Bandura and Jourden (1991) tested the impact of different patterns of social comparison on complex decision-making. Subjects assumed the roles of organizational managers and were put under conditions of social comparison in which they achieved progressive mastery or progressive decline relative to the attainments of their comparators. While progressive mastery enhanced the perceived efficacy and performance, relative decline undermined self-efficacy and produced a deterioration of performance. Vrugt's (1994) found that both perceived self-efficacy and downward comparison contributed to positive feelings of students and these feelings influenced their course grades.

In the current study, the general orientations of lower ability students can be assumed to be in a stage of relative decline. It is possible that lower ability students have become used to comparisons with their higher ability peers that put them in a less favourable light in academic areas. It is not surprising for students who have experienced a continuing history of failure to believe that they lack the ability to succeed.

The effect of anchoring did not significantly improve lower ability pupils' persistence time on task as their prior experiences had put them in a position whereby they tended to make upward comparisons. While the anchoring term, "an average primary 6 pupil", had been designed to create an impression of a similar other for comparison, it could have had a different meaning for lower ability students. Students could have used their prior negative experiences when interpreting the social comparative information and seen the "average primary 6 pupil" as a superior other.

When they make such an upward comparison, it is possible that this hinders their motivation to make an attempt to increase their persistence time even when the anchor was high.

The second interpretation of the interaction effect of anchoring and ability on persistence time has to do with the way in which different ability students seek information to make self-evaluations. In the present study, in the case of higher ability students, their persistence time under both high-anchor and low-anchor conditions were higher than the no-anchor condition. It appears that when any kind of social comparative information is presented, whether it has a high or low anchor, it has the effect of increasing higher ability students' persistence time on task. It is possible that higher ability students have a heightened sensitivity to such social-comparative information while lower ability students do not pay much attention to the information about how others have performed. This explanation is consistent with Ruble and Flett's (1988) study, whereby elementary children who were high, medium or low in math ability were given opportunities to evaluate their own or peers' performance. Ruble and Flett (1988) reported that high-ability children engaged in the most evaluative information seeking while low-ability children engaged in least information-seeking. High-ability children also showed relatively greater interest in making comparisons with self or absolute standards. Future research could tease out the confounding effects by studying comparison patterns in a more qualitative manner.

Limitations of study

It was assumed that students were not affected by how fast their classmates completed the mathematics task. The test conditions were controlled such that how fast the students completed the test was made as inconspicuous as possible. However, in spite of all these, there exists the possibility that some students were influenced by the speed at which their peers completed the test. Absolute elimination of this confounding factor would only be possible if subjects did the test in an isolated confined venue.

In the Singapore context, the term "test" might have created anxiety for the students (Gregory & Clarke, 2003; Parker, Cai, Tan, Dear, Henderson, Poh, & Kwee, 2003). Though the students did not work with time constraints, they could have felt stress from their perceived "test" environment. This presents itself as a confounding factor that could have contributed to the difference in results between the different ability groups. This limitation may be overcome in future research by the use of qualitative research methods to examine how students feel when placed under "test" conditions.

In the current study, the sample of students was taken from a school where all students of a given grade level within the school are assigned to separate classes on the basis of their academic performance. The current study thus treated all higher ability, average-ability and lower ability students as three homogeneous groups respectively. It did not explore within-group or within-class differences.

Future studies could examine how different ability students process the social comparative information or whether they process it at all. They could be asked whether the hypothetical student is perceived to be similar to them in ability or academic background. Interview techniques would be useful in yielding such qualitative results.

CONCLUSION

As a short term strategy, boosting self-efficacy judgments through anchoring is useful. This occurs if the time lapse between treatment and testing is short, i.e., social comparative information is given minutes prior to the test. It is not known how long the enhanced efficacy can be sustained without changes in skill level. On a practical level, providing social-comparative information should be done in a discerning and sensitive manner. This process should be designed to encourage and enhance self-efficacy. However, there is the possibility that some students may feel threatened when they received such social comparative information. While social-comparative information is a useful short-term strategy for enhancing students' self-efficacy judgments, the use of internal comparisons (i.e., comparing with one's own past performance) as a longer-term strategy to encourage and enhance students' self-efficacy should be examined. Future studies could examine the effectiveness of using internal comparisons to provide students with the long term desire to persist and do well.

Despite the limitations of the current study, it extends previous findings on the relationships between anchoring, perceived self-efficacy, task persistence and performance. It is important for future studies to examine more closely the subjective interpretations that students make with regards to social-comparative information.

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