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THE ROLE OF GOAL ORIENTATION
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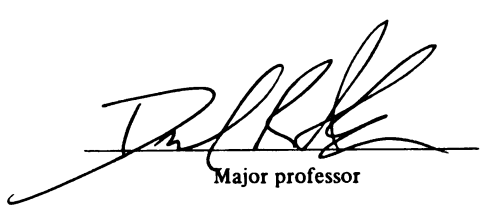

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REACTIONS TO PERFORMANCE FEEDBACK:

THE ROLE OF GOAL ORIENTATION AND SELF-REGULATORY FOCUS

By

Cori A. Davis

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ABSTRACT

REACTIONS TO PERFORMANCE FEEDBACK:

THE ROLE OF GOAL ORIENTATION AND SELF-REGULATORY FOCUS

By

Cori A. Davis

Individuals' reactions to performance feedback are poorly understood (Kluger & DeNisi, 1996). It is proposed that goal orientation and self-regulatory focus may help explain reactions to feedback. Specifically, the research 1) examines the moderating effects of goal orientation and self-regulatory focus constructs on the relationship between performance feedback and effort, 2) investigates the relationship between goal orientation and self-regulatory focus variables, 3) studies the process variables of controllability and affect, and 4) measures multiple types of effort (time spent on task, self-report, time spent studying knowledge information, and time spent studying test tips information). Findings did not support the three proposed sets of relationships. Negative feedback had a strong main effect such that those who received negative feedback tried harder than those who received positive feedback regardless of goal orientation or self-regulatory focus. Exploratory analyses were conducted to further investigate the relationships between the variables. These analyses revealed that performance-avoid goal orientation tended to overpower other types of goal orientations as well as self-regulatory focus effects. Results, limitations, and implications of this study are discussed.

Dedicated to Doug and Janet Davis

Sometimes it's easy to get lost in the dark,
and become blind to who you are, where you're from, and what really counts.

Your unconditional love and support have always been my light.

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INTRODUCTION

The importance of giving employees feedback regarding their performance has long been recognized both in applied and research settings. With recent trends such as 360-degree feedback (Peiperl, 2001) and developmental performance appraisals, understanding the reactions that employees have to performance feedback is vital. With these and other types of feedback-based initiatives, it is often assumed that individuals will benefit and change their behavior as necessary to improve their performance in response to feedback. Unfortunately, this assumption is often unreasonable (Ilgen & Davis, 2000; Ilgen, Fisher, & Taylor, 1979; Kluger & DeNisi, 1996).

It was once thought that the nature of the feedback message itself (e.g. positive or negative) was a clear predictor of subsequent performance behavior. Kluger and DeNisi (1996) showed that it is not that simple. Their meta-analysis reported that few consistent results have been found that verify the direct effect of the nature of feedback on performance. In other words, just because a person is given praise does not necessarily mean that he or she will be motivated to "keep up the good work" or "reach for even higher goals." Nor is it the case that negative feedback can always be expected to motivate future performance. One exception to the inconsistency of results has been found. Results are fairly consistent in showing that motivation is lessened in cases where negative feedback is given repeatedly (Diener & Dweck, 1978, 1980; Mikulincer, 1994). Overall, however, research has provided inconsistent evidence for the relationship between feedback and subsequent motivational reactions (Kluger & DeNisi, 1996).

This inconsistency begs the question: If feedback appears to be necessary to learn from past behavior, but the nature of the feedback message is not directly responsible for

post-feedback behavior, then what is? Answers to this question have varied widely. In an attempt to integrate various perspectives on the relationship between feedback and performance, Kluger and DeNisi (1996) developed the Feedback Intervention Theory (FIT). FIT integrates concepts from control theory (Carver & Scheier, 1981), goal setting theory (Locke & Latham, 1990), action theory (Frese & Zapf, 1994), action identification theory (Vallacher & Wegner, 1987), and learned helplessness theory (Mikulincer, 1994), among others.

The introduction of FIT provided a theoretical framework by which the effects of cognitive and motivational factors on reactions to feedback can be examined (Kluger & DeNisi, 1998). Recent trends in industrial psychology have focused on motivational factors that deal with one's method of self-regulation. Goal orientation and self-regulatory focus are two such motivational theories that have received a fair amount of attention. The first goal of this study was to examine the moderating effects of goal orientation and self-regulatory focus constructs on the relationship between performance feedback and effort. In addition, this study investigated the process variables by which goal orientation and self-regulatory focus have been shown to work: attributions and affect. The following two sections on goal orientation and self-regulatory focus will describe the rationale for the research. More elaborate discussions of goal orientation and self-regulatory focus are provided in the literature review.

Goal Orientation

Goal orientation (GO) is a construct that has been consistently shown to moderate the relationship between feedback and effort. However, this relationship has really only been explored in negative feedback situations. Dweck and colleagues (e.g. 1988, 1989)

found that mastery-oriented individuals were more likely to exert effort than performance-oriented individuals in the face of failure. This finding is generally explained in the literature via cognitive processes, namely attributions. It has been found that those with a mastery GO tend to attribute their behavior to controllable causes such as effort, whereas performance-oriented individuals tend to make attributions to uncontrollable causes such as ability (Dweck & Leggett, 1988). Therefore, in the face of failure, mastery-oriented individuals are more likely to believe that they can change their performance through increased or redirected effort.

Although the dual dimensional taxonomy of GO is still widely used, more recent GO studies have found support for adding a new component to the performance side of GO: *the way in which people approach outcomes*. Research has shown that within a performance orientation, individuals may either approach positive outcomes or avoid negative outcomes (Elliot, 1999; VandeWalle, 1997). These have been termed performance-prove orientation and performance-avoid orientation, respectively. Differences in reactions to feedback between these orientations have only recently begun to be explored.

Self-Regulatory Focus

Others who have addressed the effects of feedback on effort have evoked self-regulatory focus (SRF) to explain the inconsistencies in the effect of feedback on effort. SRF theory stems from Higgins' (1997) attempts to break down the underlying mechanisms by which individuals approach desired end-states. He argues that people tend toward certain types of end-states, and that, depending on this tendency, they use different self-regulatory systems. Higgins divides end-states into what he calls self-

guides. Self-guides can refer to one's sense of duty and obligation, labeled "ought self-guides" or to one's hopes and wishes, labeled "ideal self-guides." Those with ought self-guides tend to regulate themselves by avoiding mismatches to desired end-states, and those with ideal self-guides tend to regulate themselves by approaching matches to desired end-states. He calls these two self-regulatory systems *prevention SRF* and *promotion SRF* respectively.

Recently, Kluger, Van-Dijk, Kass, Stein, and Lustig (2000) explored Higgins' (1997) SRF constructs as moderators of the relationship between feedback and effort. Kluger et al. (2000) found that individuals who were promotion-focused tended to *increase* effort in response to *positive* feedback, and *decrease* effort in response to *negative* feedback. Conversely, when individuals were prevention-focused, they tended to *increase* effort in response to *negative* feedback, and *decrease* effort in response to *positive* feedback.

In the SRF literature, the moderating effect of SRF on the relationship between feedback and effort is assumed to occur because of differences in affective states following feedback as a function of SRF. Higgins (1997) has found that affect leads to arousal. The higher a person's arousal, whether positive or negative, the more motivated a person is. Kluger et al. (2000) have argued that, in response to positive feedback, a promotion-focused person would feel elated and a prevention-focused person would feel satisfied. According to Higgins (1997), elation is an arousing emotion, therefore motivating, whereas satisfaction is not. In contrast, Kluger et al. (2000) have argued that when people with a prevention focus fail, they feel anxious, but failure for those with a promotion focus leads to sadness and depression, not anxiety. Since anxiety, not sadness

or depression, is arousing (Higgins, 1997), Kluger et al. (2000) claimed that failure should be motivating primarily to those with a prevention focus.

Kluger et al.'s (2000) findings still account for the likelihood that failure always results in negative feelings, and success in positive feelings, but the degree of arousal (excitement) associated with failure or success depends on one's regulatory focus. Specifically, failing to meet an outcome (prevention focus goal) or succeeding in fulfilling an outcome (promotion focus goal) results in emotions characterized by high arousal (anxiety and elation, respectively). Alternately, meeting an obligation or failing to fulfill a desire results in low arousal (satisfaction and depression, respectively) (Roney, Higgins, & Shah, 1995; Strauman & Higgins, 1987).

Contributions of SRF and GO for Understanding the Effects of Feedback on Effort

The preceding discussion shows that both SRF and GO have provided some explanation for inconsistent reactions to performance feedback. When two conceptual positions are offered to understand the same relationship, it is common to compare the two, preferably in a strong inference sense. Yet, in this case, weaknesses in the SRF measure make strong inferential comparisons between the theoretical constructs of SRF and GO difficult at the empirical level. SRF measures will be described later, however, it is important to recognize that all measures used in the past have failed to possess psychometric properties that are greater than marginal. The result is that any direct, empirical comparison between SRF and GO that finds stronger relationships for GO cannot rule out the possibility that the differences are due to the reliabilities of the measures.

However, the two theoretical positions do make some potentially unique contributions with regard to the suggested mediators between feedback and effort. As was mentioned earlier, GO research has only addressed the effects of negative feedback on effort, and the psychological mechanisms it proposes as the source of effects are cognitive. Specifically, the mechanisms are attributions. On the other hand, SRF relies primarily on affective/emotional mediators of the feedback to effort relationship. Taken together, the two positions suggest a model with attributions and affect as mediators between feedback and effort as shown in Figure 1.

Although Figure 1 treats SRF and GO separately, conceptually there exists considerable overlap among the key constructs. This overlap goes unrecognized by each of the respective literatures, as evidenced by the failure of each literature to refer to the other. However, both theories are plainly derived from how people go about approaching or avoiding outcomes. For this reason, a third goal of this study was to investigate the relationship between goal orientation and self-regulatory focus variables.

Both SRF and performance-avoid and performance-prove constructs specify the ways in which individuals regulate their behavior in order to reach goals. Prevention focus and performance-avoid GO are similarly characterized by an avoidance regulation, while promotion focus and performance-prove GO by an approach regulation. This comparison is less clear for mastery GO as research has shown that individuals use an approach regulation in mastery situations (Elliott, 1999). However, the GO literature conflicts with Kluger et al.'s (2000) findings with regard to reactions to negative feedback. The GO literature has shown that mastery-oriented individuals will persist in

the face of failure whereas Kluger et al.'s (2000) found that those with an approach regulation (promotion focus) will quit in the face of failure.

In addition to mastery not mapping onto promotion focus in a regulation sense, it also does not completely map on with regard to outcomes. Mastery is typically described as being concerned with learning and development and promotion is concerned with approaching ideal needs. Ideal needs refer to advancement, growth, and accomplishment as opposed to prevention-focused needs for safety, responsibility, and security. Reaching for ideal needs may involve advancement and accomplishment through learning, similar to mastery performance, but it is not necessarily so. In fact, SRF studies that manipulate both promotion and prevention typically do so in performance contexts without any references to learning or development (Higgins, Shah, & Friedman, 1997).

Given the similarities between GO and SRF, rather than suggest that the two theories make different predictions, it is more reasonable to suggest that the outcomes suggested by one theory may also result from the other. However, given that mastery does not map on as easily as performance-prove and performance-avoid to the SRF constructs, the hypotheses in this study focused on the similarities between the performance GO variables to the SRF variables. The hypotheses concerning mastery GO, then, were considered to be exploratory. This leads us to Figure 2, which shows the overarching model proposed in this study. The model treats GO and SRF as congruent constructs, and incorporates the affective and cognitive processes from both literatures.

Complexities of Past GO and SRF Research

State/trait differentiation of constructs. GO and SRF theories are unique in that their constructs are considered to be individual traits as well as condition-dependent

states. Therefore, conflicts may exist between one's trait GO or SRF and the state created by the context of their environment. In research, there are problems both with considering state and trait constructs independent of each other, and with considering them in combination.

With any strictly individual differences (or trait) perspective, elements of cognitions and situations are ignored. Furthermore, an exclusively individual differences focus makes application of these theories difficult with regard to practice. In practice, people perform tasks and get feedback. Once they are on the task there is little control over the way people are; rather control lies in the environment where people work and, to some extent, the situations to which they are exposed to. For this reason, theories are of limited use if they do not address controllable variables. That is not to say that an individual differences approach is not useful, rather it is bounded in terms of practical utility.

Of course, similar logic can be applied to a strict state interpretation. Manipulating GO or SRF within a particular situation may certainly sway people in particular directions, however, individuals' trait GO or SRF may still impact their behaviors. This study will measure traits and manipulate states. Specifically, GO will be both measured as a trait and manipulated as a state, whereas SRF will be only measured as a trait. The decision to manipulate GO was made because such manipulations have been shown to be robust in the past, especially in comparison to SRF manipulations, which have been rarely performed. SRF is typically measured as an individual difference in Higgins' (1997) work. It is important to keep in mind when reading about the various theories in this work that GO and SRF refer to both trait and state constructs.

Measurement of effort. Typically, there are two ways in which effort has been measured in research looking at feedback, SRF, or GO effects. First, it is common for research involving the assessment of effort to use one-item self-report measures (Kluger et al., 2000). Not only do one-item scales typically have unknown or low reliabilities, but self-report measures of effort do not necessarily equate to the actual amount of effort exerted. Respondents' own estimates of effort may be biased. It is one thing to report having tried harder; it is quite another to actually have done so.

Second, both GO and self-regulatory literatures treat performance as the result of effort where effort is an amorphous behavior without reference to the content of behaviors in which the effort is directed. Yet the theories direct us toward very different outcomes that for both themes tend to be of two types – effort to prevent negative outcomes and protect appearances, and effort to learn and grow. Therefore, if we are to investigate the theoretical impact of constructs like GO or SRF, we should expect effort would be invested in somewhat different activities. Therefore, the fourth goal of this study was to measure multiple types of effort: time spent on task, self-report, time spent studying knowledge or content information, and time spent studying achievement or heuristic information).

Focus of Research

In sum, reactions to feedback remain poorly understood. The findings from the GO literature as well as those produced by Kluger et al. (2000) are steps forward. Both lines of research bring to bear interesting ideas that should be expanded upon, and possibly integrated with one another, but both are also limited due to the way in which key constructs are measured. The research conducted here was aimed at addressing some

of the limitations in a study that incorporated both SRF and GO as explanatory constructs. Specifically, the research 1) examined the moderating effects of goal orientation and self-regulatory focus constructs on the relationship between performance feedback and effort, 2) studied the process variables of controllability and affect, 3) investigated the relationship between goal orientation and self-regulatory focus variables, and 4) measured multiple types of effort (time spent on task, self-report, time spent studying knowledge or content information, and time spent studying achievement or heuristic information).

The literature review that follows describes the two main theories being addressed in this research and the processes by which they are presumed to work. A discussion of effort will then be offered, followed by the specific hypotheses tested in this study.

REVIEW OF THE LITERATURE

Goal Orientation

Goal orientation refers to the reasons individuals approach tasks. According to Dweck (1989), there are two types of GO, performance and mastery. Performance orientation is characterized by an emphasis on demonstrating high ability and appearing competent (Jagacinski, 1992). This is contrasted with mastery GO, which emphasizes improvement, developing skills, and mastering the task (Butler, 1987; Dweck, 1986). These orientations were once thought to be opposite ends of a single continuum, but were later shown to be independent constructs (Button, Mathieu, & Zajac, 1996). Theoretically, then, an individual can exhibit both orientations at once.

Dweck (1989) compared mastery and performance orientations with regard to performance and found that a performance orientation was often maladaptive. This was mainly due to the tendency of performance-oriented individuals to quit after failure, as opposed to mastery-oriented individuals who were more likely to persist after failure. Dweck argued that the persistence was due to their tendency to try to learn from their mistakes.

Research has also shown that those with a performance orientation tend to hold an *entity theory* about their ability. This means that these individuals view their ability as being fixed and uncontrollable. In contrast, individuals with a learning-GO tend to hold an *incremental* theory about their ability meaning that they view ability as changeable (Elliot & Dweck, 1988; VandeWalle, 1997, VandeWalle, Brown, Cron, & Slocum, 1999). This has obvious implications for attributions, particularly for controllability.

This would suggest that those who are mastery-oriented would be more likely than those who are performance-oriented to attribute their performance to unstable and controllable factors.

More recent GO research has shown evidence for a further delineation of the performance orientation construct. Elliot and colleagues (Elliot & Church, 1997; Elliot & Harackiewicz, 1996) believed there were two dimensions: performance-avoidance and performance-approach. Similarly, VandeWalle (1997) separated performance-orientation into performance-avoid and performance-prove. Their separate dimensions of performance orientation differ with regard to self-regulatory characteristics. According to VandeWalle, those with a performance-avoid GO are more likely to exert effort toward avoiding negative outcomes, whereas those with a performance-prove GO are likely to exert effort toward approaching positive outcomes. Research has shown that performance-avoid individuals tend to be concerned with looking incompetent or performing poorly. Alternatively, performance-prove individuals tend to be concerned with looking competent and proving that they can perform better than others (Elliot, 1999; Elliot & Church, 1997; VandeWalle, 1997).

VandeWalle, Cron, and Slocum (in press) investigated the effect of the three dimensions of GO on performance after feedback was given on a preliminary task. They included three mediators: self-report effort, self-efficacy, and self-set goal level. Interaction analyses for the relationships between GO and feedback were not performed. However, they did find significant positive relationships between mastery GO and effort, as well as between performance-prove GO and effort. There was a non-significant, negative relationship between performance-avoid GO and effort. Although this study did

not differentiate between feedback levels, it lends support for further study of the effort differences between those with a performance-prove and a performance-avoid GO.

In sum, the literature on GO implies that the way in which people respond to performance feedback, specifically negative performance feedback, may be influenced by GO. The combination of negative feedback and high performance goals has been shown to lead to decreased effort even to the point of quitting (Dweck, 1989). One possibility for this is that the performance is attributed to ability and is seen as beyond the person's control. Under a mastery orientation, effort is not expected to drop off with negative feedback and may even increase. If so, according to the theory, we would expect that effort would be invested in learning more about the task presumably to perform better in the future.

As mentioned previously, GO is influenced by situational conditions and, yet, also possesses trait-like characteristics. When the situation does not dictate what goals are favored, the trait goal preferences should have more influence on behavior. Conversely, if the situation offers strong cues, trait goal preferences may be overridden by the situational cues (VandeWalle, 1997). The present research created conditions believed to impact GO and also measured individuals' pre-study levels of person-specific variance on the construct.

Attribution Theory

As previously mentioned, the mechanisms thought to be most responsible for GO's effect on effort are attributions. Attributions are defined as the causal ascriptions of events and behaviors. Fiske and Taylor (1991) refer to attributions as being fundamental to further judgments, emotional reactions, and behavior. Attribution theory addresses the

perceptions of individuals with regard to their performance and provides a framework for understanding the different things that people attribute their performance to. Dimensions of attributions include locus of causality, stability, and controllability (Russell, 1982; Weiner, 1980, 1985). Locus of causation refers simply to whether attributions are made to the self (internal) or to something external. For instance, if someone performs poorly on an exam, do they blame themselves for not studying enough, or do they blame the instructor for developing unfair test questions?

Stability refers to how "changeable" the cause of performance is. Two common examples are ability and effort. Ability is normally considered to be relatively stable and slow to change, and effort is normally considered to be unstable or changeable. Therefore, going back to the exam example, one could blame himself or herself for not having the ability to pass the exam, or for not putting forth enough effort studying to pass the exam.

Last, controllability refers to whether individuals think that they have control over the cause of their performance. It is important to keep in mind that controllability is not dictated by the stability of the cause. For instance, just because people attribute their performance to an unstable cause does not guarantee that they feel they have control over changing their performance. Emotions are a good example. If someone is overcome by anger in a given situation, it does not necessarily mean that this is a stable condition. In a few hours the person may calm down and no longer be angry. Nonetheless, some would consider becoming angry an uncontrollable event.

Appropriate Outcomes. A general finding in the literature is that people attribute success to internal, stable, and controllable factors and failure to external, unstable, and

uncontrollable factors (Fiske & Taylor, 1991; Taylor, Fisher, & Ilgen, 1984). This is also known as a self-serving bias because essentially people are taking credit for success and denying responsibility for failure (e.g. Miller & Ross, 1975).

These three dimensions of attributions all interact with each other to form various types of attributions. In other words, attributions vary in internality and also vary in stability and controllability. The number of combinations is often great. However, with regard to motivation, the main issue is the belief that the cause of behavior can be changed through increasing effort (Bandura & Wood, 1989; Martocchio, 1994; Martocchio & Dulebohn, 1994). If persons are convinced that no amount of trying is going to change their performance, then chances are they will not be motivated to exert more effort. This belief that behavior can or cannot be changed is mainly captured in the controllability dimension, and therefore that dimension was the focus in this study as far as attributions are concerned.

Self-Regulatory Focus

Higgins' (1997, 1998) theory of SRF is derived from his attempt to "shed some light" on the fundamental nature of approach-avoidance motivation. Higgins' stance is that it is not enough to explain motivation through the age-old idea that people always approach pleasure and avoid pain. Psychologists need to understand the underlying principles involved in why this is so. This led to Higgins' explorations of the different ways people approach pleasure and avoid pain.

In order to explore the processes that underlie the operation of approach-avoidance motivation, Higgins' looked to the self-regulation literature. Approach-avoidance is in-and-of itself a form of self-regulation, and Higgins' goal was to determine

if there are other self-regulatory principles that underlie approaching pleasure and avoiding pain. Self-regulation is generally concerned with both the end-state of behavior, usually defined in terms of positive or negative, and the direction of regulation, usually defined in terms of approach or avoidance (Carver & Scheier, 1981, 1982; Higgins, 1987, 1997, 1998; Higgins, Bond, Klein, & Strauman 1986; Kanfer, 1990).

An important contribution from the self-regulation literature is that it expands on the basic approach-avoidance idea. In addition to the concept that individuals simply approach pleasure and avoid pain, the self-regulation literature informs us that both directions of regulation can be used to accomplish both types of end-states. In other words, one can *approach a "match"* with desired outcomes as well as *approach a "mismatch"* to undesired outcomes. Similarly, one can *avoid a "match"* with undesired outcomes, or *avoid a "mismatch"* with desired outcomes. "Match" and "mismatch" in this context refers to the gap between a person's behavior and his or her outcomes.

According to self-regulation theories, there are four means by which individuals approach pleasure and avoid pain, and the predilection for using different types of regulatory systems depends largely on the valence of the end-state. Further delineating positive end-states in his self-discrepancy theory, Higgins distinguishes between two types: *ideal* self-guides and *ought* self-guides (Higgins, 1987, 1996; Higgins, et al., 1986; Higgins, Klein, & Strauman, 1985; Higgins, Roney, Crowe, & Hymes, 1994). Ideal self-guides refer to individuals' representations of their hopes, wishes, or aspirations. Ought self-guides refer to individuals' representations of their duties, obligations, and responsibilities.

As noted above, the ways individuals approach desired end-states can be

differentiated into two systems: either by avoiding a mismatch to the desired end-state, or by approaching a match to the desired end-state. Higgins (1997, 1998) has labeled these approaches *prevention* and *promotion* SRF (respectively). He describes what type of focus is relevant with regard to self-guides, concluding that those with ought self-guides tend toward a prevention SRF and those with ideal self-guides tend toward a promotion SRF.

Now, what does having a promotion or prevention focus imply? Higgins has asserted that one's SRF has implications for performance, strategic tendencies, emotions, decision-making, and value of incentives (Higgins, 1997, 1998; Higgins et al., 1997). In general, those with a prevention focus tend to be concerned with protection, safety, and responsibility and are therefore less likely to engage in risky behaviors or strategies that promote error. Those with a promotion focus are more concerned with advancement, growth, and accomplishment, and unlike those with a prevention focus, those with a promotion focus are more likely to engage in behaviors that involve risk (Higgins, 1997; Kluger, 2000).

In sum, other models of self-regulation including control theory distinguish between approaching desired end-states and avoiding undesired end-states (Carver & Scheier, 1981; Kanfer, 1990). However, they do not go further to assure different types of end-states fit the construct being regulated as Higgins' theory does (Higgins, 1997). More importantly with regard to reactions to feedback, Higgins' theory suggests when a positive outcome may lead to more or less effort. Specifically, because those who are prevention-focused are engaged avoiding a mismatch to the desired end-state, they are likely to reduce effort once they have reached this end-state due to their concern for

protection, safety, and responsibility. Alternatively, those who are promotion-focused are engaged in approaching a match to their desired end-state and therefore are likely to exert effort once they reach this end-state due to their concern for advancement, growth, and accomplishment.

Affect

There is extensive evidence that people feel disappointment or depression-type emotions when they fail to meet their hopes or ideals, and agitation or anxiety-type emotions when they fail to meet their obligations or responsibilities (Higgins et al., 1986; Roseman, 1984; Roseman, Spindel, & Jose, 1990; Scott & O'Hara, 1993; Strauman & Higgins, 1987). It has also been found that when hopes or ideals are met, people tend to feel cheerfulness or elated-type emotions. Likewise, when obligations or responsibilities are met, people tend to feel quiescence or satisfaction-type emotions (Higgins et al., 1997).

When translated into prevention and promotion terms, prevention-focused individuals are more likely to be satisfied in the response to positive feedback, and anxious in response to negative feedback. Promotion-focused individuals are more likely to be elated or depressed after receiving positive or negative feedback, respectively.

Kluger, et al. (2000) extended these findings into the performance domain. They hypothesized that when arousal-type emotions occurred in response to performance feedback, people would be motivated to put forth effort to improve. Arousal-type emotions are those that elicit activity as opposed to acquiescence from a person (Kluger, Lewinsohn, & Aiello, 1994; for a review of the dimensions of affect see Russell, 1980, 1991; for a criticism of the dimensional view of affect see Ortony, Clore, & Collins,

1988; Lazarus, 1991). Therefore, Kluger et al (2000) proposed that feelings of anxiety and elation should be motivating. In other words, prevention-focused individuals should be more motivated by negative feedback, and promotion-focused individuals by positive feedback.

Affect has been less thoroughly explored in the GO area. Dweck (1986, 1999) found that performance-oriented individuals were more likely to feel negative affect such as anxiety in the face of obstacles. Dweck and Leggett (1988) found that mastery-oriented individuals were generally more optimistic in receipt of negative feedback than were performance-oriented individuals.

Affect is only just beginning to be explored in connection with the dual dimensionality of performance GO. With regard to arousal-type emotions, Elliot and McGregor (1999) found that state test anxiety, or worry, mediated the relationship between performance-avoid goals and performance. Cron, Slocum, and VandeWalle (2001) investigated the effects of mastery and performance-avoid GO on emotional valence (positive and negative) following negative feedback. They found that a mastery orientation helped to reduce the intensity of negative emotions that can cause lowered levels of subsequent self-set goals. Further, the intensity of negative emotional responses to negative feedback was related to performance-avoid GO. Researchers have yet to investigate both valence and arousal qualities of affect in relation to GO.

The Nature and Measurement of Effort

Kluger et al.'s (2000) and VandeWalle, et al.'s (in press) studies are based on a one-item, self-report measure of effort, yet such measures have a number of drawbacks. First, single, self-report items are rarely defensible, regardless of their content due to the

difficulty in determining their reliabilities. Second, self-report measures of effort are problematic because people tend to overestimate how much effort they put into work (Mitchell, 1974). Finally, effort tends to be treated by researchers as an undifferentiated construct. Effort is effort. Yet, the theories about putting forth effort typically assume that the effort is invested for some purpose. What the person invests his or her effort in is really what is important.

With respect to Kluger and many others, effort is expressed in terms of simply working to perform the task. However, effort can be exerted for different purposes. Two stand out. One is to learn something, accomplish mastery types of things. The other is to look good for others, avoid criticism, etc. Therefore, in an attempt to study the phenomenon of effort expenditure more precisely, this study set up conditions where effort was assessed independent of the actor's self-report, and differentiated in terms of whether it was directed toward mastery and accomplishment or simply toward more time spent on the task.

CONCEPTUAL FRAMEWORK AND HYPOTHESES

Purpose

Performance feedback is a key feature in organizations and all other performance settings, yet how people respond to it is uncertain. The following hypotheses address how the motivational theories of GO and SRF potentially add to our understanding of reactions to feedback. The present research addresses the effects of GO and SRF on the relation between feedback and effort, the relationship between GO and SRF themselves, and the impact of controllability and affect in the process. In addition, some of the limitations inherent in past research with regard to measuring effort and differentiating between state and trait GO will be explored. The hypotheses are outlined in Table 1, and the general conceptual models can be seen in Figures 2 and 3.

Moderation Effects of GO on the Relationship Between Feedback and Effort

As described in the literature review, GO has been shown to moderate the relationship between feedback and effort. It has been fairly well established that those with a mastery orientation are more likely to persist in the face of negative feedback as compared to those with a performance orientation. Responses to feedback between performance-prove and performance-avoid oriented individuals is not so clear. However, one can make some inferences in this regard. Performance-avoid oriented individuals are concerned with looking bad in front of others. In other words, performance-avoid individuals tend to focus on avoiding negative outcomes. Conceptually, then, performance-avoid has similarities to prevention SRF. Given this similarity, one could predict that performance-avoid individuals will react similarly to those who are

prevention-focused in response to feedback. Specifically, performance-avoid individuals may be more likely to try harder in response to negative feedback than in response to positive feedback.

The same logic could be followed for performance-prove GO. Those with a prove GO try to look good compared to others by outperforming them. Therefore, those with a performance-prove GO attempt to approach positive outcomes. This orientation is conceptually similar to promotion SRF. Therefore, one can predict that performance-prove individuals will react similarly to promotion-focused individuals in response to feedback. Specifically, performance-prove individuals are more likely to try harder in response to positive feedback as opposed to when responding to negative feedback. The following hypotheses are not yet making any assumptions about where individuals are devoting their study time. Rather, it is expected that the total amount of effort exerted will differ between individuals.

Hypothesis 1a. Individuals with higher levels of performance-avoid GO will display higher levels of effort when they receive negative feedback and lower levels when they receive positive feedback.

Hypothesis 1b. Individuals with higher levels of performance-prove GO will display higher levels of effort when they receive positive feedback and lower levels when they receive negative feedback.

Relationship Between GO and SRF

Given that GO and SRF have major conceptual similarities, it is expected that measures of these constructs will be correlated. Specifically, mastery GO, performance-prove GO, and promotion SRF are all concerned with approaching positive outcomes and

are expected to be correlated. Alternatively, performance-avoid GO and prevention SRF are concerned with avoiding negative outcomes and are expected to be correlated.

Hypothesis 2a. Measures of promotion SRF will be positively correlated with measures of mastery GO.

Hypothesis 2b. Measures of promotion SRF will be positively correlated with measures of performance-prove GO.

Hypothesis 2c. Measures of prevention SRF will be positively correlated with measures of performance-avoid GO.

The Moderating Effect of SRF on the Relationship Between Feedback and Effort

This set of hypotheses deals with the rationale behind Hypotheses 1a-1b. Kluger et al. (2000) used Higgins' (1997) theory of SRF as a moderator of the relationship between feedback and effort (Figure 2). Both promotion and prevention-focused persons prefer positive outcomes to negative ones. But, according to Higgins, they differ in their approach to the two. Promotion-focused people seek positive outcomes; they direct their attention to them and strive to get them. Prevention-focused people, by contrast, focus on avoiding negative consequences and are less likely to devote time energy to gain positive outcomes. They do the latter only to the extent that by getting positive outcomes they can avoid negative outcomes.

Kluger et al. (2000) adapted this approach to feedback assuming positive feedback is the receipt of positive outcomes and negative feedback is a negative outcome. If so, promotion-focused persons should be more highly motivated to work hard to improve their performance following positive feedback (presumably to get more of the positive outcomes they desire) than those motivated only to prevent poor outcomes.

Under negative feedback the reverse should occur according to Kluger et al. Here, prevention-focused persons should feel the pain of poor performance more and work harder to avoid it in the future.

Kluger et al. (2000) measured SRF by classifying people according to their chosen college major. Those pursuing degrees in the liberal arts (theater, history, languages, religion, etc.) were considered high promotion-focused individuals. Alternatively, those majoring in business and engineering (accounting, business administration, economics, etc.) were considered low promotion-focused individuals. This method of distinguishing between prevention and promotion-focused individuals treats these constructs as independent but not continuous. This is consistent with the terminology we have used throughout this work in describing the differences between self-regulatory foci. There are two reasons for this. One is that this terminology is generally consistent with Higgins' own, and two is that research in general has not really addressed varying levels of prevention and promotion SRF.

Kluger's measure was indirect. It did not assess the process by which individuals' chose their majors, it simply classified individuals. This leaves room for the possibility that other differences between liberal arts and business majors are responsible for the effect.

Our goal was to replicate Kluger et al.'s (2000) findings. However, because we are measuring prevention and promotion each as continuous variables, we are also proposing that the use of measures consistent with Higgins' conceptualization of the continuous nature of prevention and promotion focus may help to refine Kluger's findings.

Hypothesis 3a. Individuals with higher levels of prevention SRF will display higher levels of effort when they receive negative feedback and lower levels when they receive positive feedback.

Hypothesis 3b. Individuals with higher levels of promotion SRF will display higher levels of effort when they receive positive feedback and lower levels when they receive negative feedback.

Attributions

As mentioned earlier, mastery-oriented individuals have been shown to attribute their performance to more controllable factors than do performance individuals (Dweck & Leggett, 1988; Elliott & Dweck, 1988). This, however, does not tell us anything about the difference in attributions between performance-prove and performance-avoid individuals. However, it is expected that individuals will only exert effort if they believe that putting forth effort can improve their performance. As hypothesized above, performance-prove individuals are thought to exert effort when they get positive feedback. Therefore, it would be consistent to hypothesize that these individuals will make controllable attributions for their performance, as mastery-oriented individuals would.

Hypothesis 4a. Individuals with higher levels of mastery GO will make attributions to more controllable causes in positive and negative feedback conditions.

Hypothesis 4b. Individuals with higher levels of performance-prove GO will make attributions to more controllable causes in positive feedback conditions.

In the literature, attributions have been shown to lead directly to affect and effort. More controllable attributions have been linked to higher levels of positive affect as well

as higher levels of effort (Weiner, 1985). In fact, it has been shown that controllability attributions are a necessary condition for a change in effort. In other words, individuals must believe that their performance is under their control in order to believe that exerting effort will change their performance.

Hypothesis 5. As attributions are made to more controllable causes, the level of positive affect will be higher.

Hypothesis 6. As attributions are made to more controllable causes, the level of effort will be higher.

Affect

Because affect has been more thoroughly investigated in the SRF literature than in the GO literature, the inferences regarding the relationships between GO and affect are mainly drawn from Higgins' (1997) work. Based on Higgins (1997), Kluger et al. (2000) suggested that prevention-focused individuals are more likely to be satisfied in the response to positive feedback, and anxious in response to negative feedback. Alternatively, promotion-focused individuals are more likely to be elated or depressed after receiving positive or negative feedback, respectively. If we map performance GO onto this typology, we can then predict that performance-prove individuals would respond similarly to promotion-focused individuals and that performance-avoid individuals would respond similarly to prevention-focused individuals.

Also, if the logic of arousal being a motivating factor is correct, then we can also predict the types of affect mastery-oriented people are likely to exhibit in response to feedback. Dweck (1989) has shown that compared to performance-oriented individuals, mastery-oriented individuals have been shown to increase performance in response to

positive and negative feedback. Therefore, it is hypothesized that mastery-oriented individuals will display arousal-type emotions in response to both positive and negative feedback messages.

Hypothesis 7a. Individuals with higher levels of mastery GO will display higher levels of elation-type affect when feedback is positive, and higher levels of anxiety-type affect when feedback is negative.

Hypothesis 7b. Individuals with higher levels of performance-prove GO (and promotion SRF) will display higher levels of elation-type affect when feedback is positive, and higher levels of depression-type affect when feedback is negative.

Hypothesis 7c. Individuals with higher levels of performance-avoid GO (and prevention SRF) will display higher levels of satisfaction-type affect when feedback is positive, and higher levels of anxiety-type affect when feedback is negative.

It is expected that affect will have a main effect on effort. Higgins work has shown that arousal type emotions such as anxiety and elation are more likely to lead to effort as opposed to non-arousal type emotions such as satisfaction and depression (Higgins, 1987; Kluger et al., 2000).

Hypothesis 8. Arousal (elation/anxiety) will be positively correlated with effort.

Distinction of Effort

Since effort is normally anchored to time spent on task, we thought it would also be interesting to also look at where effort is spent. Therefore, this set of hypotheses is concerned with the types of tasks on which individuals choose to exert effort. Specifically, this study will examine whether effort is extended toward learning or performance tasks. The GO literature informs us that different types of people focus on

different types of information when studying. Mastery-oriented individuals are more likely to focus on learning information, and performance-oriented individuals are more likely to focus on heuristic-type information (Dweck, 1989). Similarly, Elliot & McGregor (1999) have proposed that a performance-prove GO is more closely associated with superficial and instrumental-types of effort as opposed to the more substantial or comprehensive-types of effort that a mastery GO is associated with.

Hypothesis 9a. Mastery GO will be positively correlated with the amount of effort invested in reviewing knowledge information.

Hypothesis 9b. Performance-prove GO will be positively correlated with the amount of effort invested in reviewing test-taking heuristics.

Hypothesis 9c. Performance-avoid GO will be positively correlated with the amount of effort invested in reviewing test-taking heuristics.

METHODS

Design

Overview. Participants performed on two different tests containing actual Graduate Record Examination (GRE) questions[2] with a 15-minute study break between working on the tests. Before the study break, participants received feedback on their first test performance and were allowed to choose how to use their break time in preparation for the second test. The primary behaviors of interest were the ways in which the participants spent their study time during the break. Individual difference measures were collected prior to test taking and the tasks were performed under one of four GO conditions.

The overall design used in this study was a 4 (performance-prove/ performance-avoid/ mastery/ control) x 2 (positive/negative feedback) x A (affect) mixed design where the first variable was experimentally manipulated (the computer program randomly assigned and equally divided participants by GO condition) and the last two were individual difference variables.

Task. There were two types of tasks in this experiment, test-taking and studying. The tasks, like all other parts of this experiment, were computer-administered. The tests that participants took consisted of actual verbal and quantitative GRE questions. More specifically, verbal question types included analogies and sentence completions. Quantitative question types included quantitative comparisons and problem-solving. All of these question types were chosen over other possible types because they had both knowledge and test taking performance components.

The study task involved reviewing information about the above question types. Two types of information were offered: knowledge and test tips[3]. Knowledge information addressed content-based topics such as word meanings in the case of verbal content and geometry rules in the case of quantitative content. Test tips information addressed specific test-taking strategies for each question type. The study information can be seen in Appendix J.

Procedure (See Figure 4 for a time-line of the procedure.)

Participants. A total of 327 undergraduate college students from a large midwestern university participated in this study in partial fulfillment of course requirements. Some participants were dropped from the sample for various reasons resulting in a final sample of 300 participants.[4] Participants were mainly white (78%), 18-21 year old (83%), females (71%). Sessions were conducted with groups consisting of from one to 25 participants. The individuals in these groups were randomly assigned to one of four GO manipulation conditions until the number of participants in each condition was over 60 (mastery N=64, performance-prove N=65, and performance-avoid N=63), then a few more sessions were run for the control group only (N=108). This was done to increase power, allowing analyses of the trait GO and SRF effects to be run within the control group only.

Informed consent. When participants arrived at the computer lab for the experiment, they were asked to enter some identifying information into a computer. At that point, an informed consent form was displayed on the screen. Before continuing on with the experiment, all participants were required to read and agree to this consent form.

The consent form outlined information regarding the incentives offered for this study (see Appendix A).

Pre-task measures. After agreeing to participate, individuals were asked to read some general instructions for the study (see Appendix B) and fill out some general demographics and two individual difference measures (see Appendix C). They included questions about participants' GPAs, ACT/SAT scores, and GRE experience. GRE experience was assessed to identify individuals who already may have been exposed to the information in the tasks. The individual difference measures that individuals were asked to fill out at this time were goal-orientation and self-regulatory focus.

Test introduction Following the questionnaires, participants were given an introduction to the test (see Appendix D). This introduction included a general description of the types of test questions and how long they had to take the test.

Example test questions. Participants were given four example test questions and answers after reading the manipulation statements. There was one example question for each type of test question (sentence completion, analogies, quantitative comparisons, and problem solving). These are shown in Appendix E. All participants had to read the examples before continuing on to the test.

Test 1. Following the test question examples, participants were given test instructions and then Test 1. Participants had 15 minutes to answer as many GRE questions as they could. Test 1 and Test 2 were composed of all four question types. The tests were parallel with respect to format. The particular test questions for both Test 1 and Test 2 were chosen for inclusion based on the percentage of GRE examinees who answered these items correctly between October 1, 1985, and September 30, 1991

(approximately 950,000 individuals). We chose questions with percentages ranging from 50 to 70. The average percentage of items answered correctly within each test was 59. Both tests can be seen in Appendix C.

Feedback. After Test 1, participants were given normative feedback about how they performed on the task compared to others (see Appendix F). Positive or negative feedback was presented. Positive feedback was given to participants who answered eight or more questions correctly, and negative feedback was given to those who answered less than eight questions correctly. Eight was chosen as the feedback division point because pilot tests showed that eight was the median number of questions that students answered correctly. Participants in each experimental manipulation were essentially evenly split between feedback levels. The overall N's for each conditionXfeedback cell are as follows: mastery positive/negative=33/31, performance-prove positive/negative=30/35, performance-avoid positive/negative=32/31, and control positive/negative=67/41.

Goal orientation manipulation 1. Following feedback, individuals in the first three conditions were given a verbal manipulation regarding how to interpret their feedback. Participants in the fourth condition were not given a manipulation (control condition). These GO manipulation messages can be found in Appendix G.

Attributions and affect measures. Participants filled out attribution and affect measures after being presented with the GO manipulation (see Appendix C).

Study task introduction/Goal orientation manipulation 2. After answering the attribution and affect questions, the computer gave participants instructions for the study task (see Appendix H). In addition, a second goal-orientation manipulation was given here (see Appendix I).

Study task. During the first five minutes of study time, participants were forced to study any or all of 4 study screens: verbal knowledge, verbal test tips, math knowledge, or math test tips (see Appendix J). For the last ten minutes of study time, participants were given two additional options: reading information about ethics in psychology[5] and surfing the web. At the beginning of the last ten minutes, a pop-up screen appeared alerting the participants to their new options. The computer program recorded how long each participant spent on each study screen.

Goal orientation manipulation check. In order to find out whether or not the GO manipulation worked, a GO manipulation check was administered following the study time (see Appendix C).

Test 2. After the study task, participants were given brief instructions concerning Test 1, and then took another 15-minute GRE test. This test was similar to Test 1 in format, however the questions were not identical to those in Test 1 (see Appendix C).

Post-task measures. Even though not necessary for this study, pilot studies showed that participants wanted feedback after the second test. Therefore, individuals were told how many questions they got correct after Test 2. Then, participants answered three sets of questions. The first set dealt with their general motivation to perform well on the various components of the task, the second set assessed whether or not individuals were able to distinguish between the content and strategy information from the study task, and the third dealt with score believability for both Test 1 and Test 2 (see Appendix C).

Debrief. Participants were shown the debriefing form as seen in Appendix H.

Measures

All measures can be seen in Appendix C. The means, standard deviations, and reliabilities for each scale can be seen in Table 2. The reliabilities are in bold on the diagonals of the matrix.

Cognitive ability. Individuals' self-reports of their GPA and ACT/SAT scores were used as measures of cognitive ability. Because of the cognitive nature of this task, cognitive ability was controlled for in the analyses where relevant. Because feedback was based on true performance in a cognitively based task, it was necessary to control for cognitive ability in analyses that included feedback. Therefore, in order to control for ability in hypotheses that included feedback, we chose the index of cognitive ability that was most highly correlated with the feedback variable. In this case, ACT/SAT scores was significantly correlated with feedback .57 ($p<.01$), whereas GPA was not significantly correlated ($r=.11$). Therefore, ACT/SAT scores were controlled for in relevant analyses. SAT (mean=1016, SD=226) and ACT (mean=21, SD=4.7) scores were standardized based on 1999 normative test data.

Using ACT/SAT scores in the analyses posed one problem. There were 44 participants in this study who did not report their ACT/SAT scores. Therefore, because list-wise deletion was used for all of the analyses in this study, the number of participants used in the analyses was reduced from 300 to 246 when ACT/SAT scores were included. This lowered the number of people in each conditionXfeedback cell to mastery positive/negative=29/27, performance-prove positive/negative=27/31, performance-avoid positive/negative=27/26, and control positive/negative=59/30.

Goal orientation. Goal orientation was assessed using VandeWalle's (1997) measure. The measure consists of three scales: mastery, performance-avoid, and performance-prove GO. All three scales included ratings from 1 to 7 (agree to disagree). These ratings were converted to a 1 to 5 range for this study in order to keep all rating ranges for all measures consistent. Research by Bendig, Komorita, and Matell and Jacoby has shown that the reliability of most measures is not significantly affected by a change in the number of scale anchor points (as cited in Bass, Cascio, & O'Connor, 1974).

There were four mastery items, five prove items, and four avoid items on VandeWalle's (1997) measure. The reliability for each scale is as follows: mastery (α=.74); performance-avoid (α=.71), performance-prove (α=.60). These scales were correlated: mastery/prove=.17, mastery/avoid=-.38, prove/avoid=.23. These correlations are consistent with those found in the GO literature (VandeWalle, 1997).

Self-regulatory focus. There were two measures used to assess SRF. First was the Selves Questionnaire (Higgins et al., 1985). It is a subjective type of survey that asks individuals to list eight attributes for different self-states. It asks individuals to list attributes of the type of person they think they ACTUALLY ARE, OUGHT TO BE, and IDEALLY WOULD LIKE TO BE.

The measure is scored by taking the number of actual-ought matches and subtracting the number of mismatches. Matches refer to synonym responses on the two scales, and mismatches refer to antonyms. The actual-ought discrepancy score has been used by Higgins to represent an individual's prevention focus. The same process is used to determine the actual-ideal discrepancy score, which is representative of a promotion

focus (Higgins, 1997).

These measures were coded for each participant by two raters. Initially, responses from 20 random participants were chosen and independently rated by each scorer. Then, discrepancies were discussed and scores changed based on mutual agreement. Then, the first rater scored responses from the remaining participants. The second rater scored a randomly selected 20% of the remaining responses. When both raters were done, ratings were compared. Overall, there was a 65% agreement rate for the ought-actual discrepancies, and a 77% agreement rate for the ideal-actual discrepancies.

Because of its focus on discrepancy scores, the Selves Questionnaire is conceptually difficult to interpret and apply in relation to other variables. In fact, the form the Selves Questionnaire used in this study is no longer used in Higgins' research, nor was it used in Kluger et al.'s (2000). Higgins' work now involves a modified version of the Selves Questionnaire that measures reaction times and asks people to rate the importance of various ought, actual, and ideal self-states. The older version of the Selves Questionnaire attempted in this study because of its logistical feasibility relative to the reaction time measure.

Also, because each discrepancy score is determined by comparing either the ideal or ought self-guides to the actual self-guides, the discrepancy scores were correlated .70. This makes it virtually impossible to detect differences between the two on any given variable. Essentially, it is difficult to determine any differences between the two scores at all. For these reasons, the Selves Questionnaire was dropped from this study.

Because the Selves Questionnaire was known to be a poor measure, the author developed a second SRF measure. It originally had 12 items that asked participants why

they chose to be enrolled in their current psychology course. Promotion items were based on ideal self-guides such as wants and hopes, whereas prevention items were based on ought self-guides such as shoulds and responsibilities. Exploratory factor analyses for this measure resulted in two factors, however two of the items showed poor factor loadings (these items are identified in Appendix C). These items were dropped and the remaining items were combined to form a promotion scale (α=.90) and a prevention scale (α=.86). These two scales were correlated r=-.18. These scales did not correlate with the Selves Questionnaire scales. However, given the poor quality of the Selves Questionnaire, it is uncertain as to the implications of the low correlation for judging the validity for the constructed measure.

Controllability. Russell's (1982) Causal Dimension Scale was used to assess attributions. Although this scale measures all three dimensions of attributions, only the three questions that loaded on the controllability factor were examined for this study (see Appendix C). The controllability factor had a low reliability of .43 and was therefore not included in analysis.

The author also developed another measure of controllability. It originally consisted of six items that asked participants to rate their level of controllability for improving their test score. Exploratory factor analysis revealed three factors, but one factor (two items) was dropped due to poor reliability (these items are identified in Appendix C). This left two factors. The first factor was composed of items 1 and 2, which assessed individuals' beliefs for improving their scores on the next test. This factor was named outcome controllability (α=.78). The second factor assessed individuals' beliefs that studying could improve their scores (items 5 and 6). This factor

was named development controllability (α=.80). The scales were correlated r=.26.

Affect. The affect measures used were adapted from the State/Trait Anxiety Index format (STAI: Consulting Psychologists Press Inc., 1968, 1977). The measures were intended to tap both the valence (positive/negative) and degree (arousal) of affect. Because theory does not support that those who received positive feedback would feel negative affect, and that those who received negative feedback would feel positive affect, the positive affect measure was given only to those who received positive feedback, and the negative affect measure was given only to those who received negative feedback. Each measure contained arousal and non-arousal items that factored separately in exploratory factor analysis. However, some items were found to have poor factor loadings and were dropped from the measures (these items are identified in Appendix C).

In addition, the arousal and non-arousal factors were highly correlated within each measure: positive affect=.49 and negative affect=63. The arousal and non-arousal items were made into separate scales despite being highly correlated in order to examine any differences between them. The reliabilities for each scale are as follows: positive non-arousal (satisfaction)=.85, positive arousal (elated)=.91, negative non-arousal (depressed)=.92, and negative arousal (anxiety)=.89.

Effort. Effort was measured in a variety of ways. First, the total time spent studying was measured in seconds. The total time spent studying was bi-modally distributed. Most people either stopped studying after five minutes, or continued to study until the 15-minute study time was over. Second, the amount of time spent studying knowledge information and the amount of time spent studying test tips information were calculated. The time spent studying test tips information was positively skewed. Finally,

a self-report index of study behavior was collected. The self-report measure consisted of two items and had an internal reliability index of .77 (see Appendix C). The total time spent studying and the self-report index of study behavior were highly correlated ($r=.54$, $p<.01$).

GO manipulation check. Participants were given measures of GO manipulation checks prior to the second test. These manipulation checks were intended to gauge the effectiveness of the state GO manipulations. The manipulation check consisted of six items (two for each type of GO) that were based on the wording used in the GO manipulations (see Appendix C). Three (two-item) scales were created: mastery ($\alpha=.87$), performance-prove ($\alpha=.70$), and performance-avoid ($\alpha=.82$).

These scales were highly correlated: mastery/prove=.42, mastery/avoid=.37, prove/avoid =.71. Contrary to hypotheses, all of these correlations were in a positive direction. It was expected that the mastery and avoid scales would be negatively correlated. In addition, when all items were entered into an exploratory factor analysis, the mastery items formed one factor, and the other items formed one factor instead of two. This could have been due to a problem with the scale, or could possibly reflect the general performance GO construct. Nevertheless, these scales were retained.

The manipulation check measures were not correlated with their respective manipulations with the exception of performance-prove ($r=.16$, $p<.05$). Rather, the manipulation checks were significantly correlated with the measures of trait GO and SRF. Both the trait GO and SRF measures were generally correlated in expected directions with the GO manipulation check measures.

First, the trait mastery GO measure was significantly correlated with the mastery GO manipulation check ($r=.20$, $p<.01$). Second, the trait performance-prove GO measure was significantly correlated with both the performance-prove and performance-avoid GO manipulation checks ($r=.30$, $p<.01$ and $r=.28$, $p<.01$, respectively). These correlations are more than likely a result of the performance-prove and avoid GO manipulation measures being so highly correlated. As mentioned, the factor structure of the manipulation check measures was not distinct between the two performance dimensions, indicating that the differentiation between these dimensions is difficult to determine. Finally, the trait performance-avoid GO measure was negatively correlated with the mastery GO manipulation check ($r=-13$, $p<.05$), and positively correlated with the performance-avoid GO manipulation check ($r=.23$, $p<.01$).

A similar pattern of correlations was found between the SRF measures and the GO manipulation check measures. The promotion SRF measure was positively correlated with both the mastery and performance-prove GO manipulation measures ($r=.21$, $p<.01$ and $r=.12$, $p<.05$, respectively). The prevention SRF measure was positively correlated with both the performance-prove and avoid GO manipulation checks ($r=.15$, $p<.05$ and $r=.22$, $p<.01$, respectively).

Performance. Actual performance was based on the number of test questions answered correctly. Performance on the first test was used to determine who would receive positive or negative feedback. Performance on the second test was used in order to identify the incentive winners.

Pilot Studies

Three pilot studies ($N=130$) were run to evaluate the content and timing

components of the tasks, the framing of the GO and feedback manipulations, the variability of individual differences, participants' motivation to perform, distinction between the types of study information, and score believability. Groups of undergraduates went through the task, and then answered questions regarding these issues. This data was analyzed and used to refine the tasks and measures.

Motivation. Participants' motivation to perform on Test 2 was measured with three items (see Appendix C). To promote motivation to study, monetary incentives of $25 were offered to the top two scorers on the second test. Therefore, the first item asked whether or not the incentive was motivating to people. Most indicated not being motivated by the incentive (mean=2.18). However, most people indicated wanting to perform well on the second test (mean=3.70). The latter mean was increased from the pilot study. Test effort was also assessed. The mean ratings of effort on Test 1 and Test 2 were 3.34 and 3.35, respectively

Difference between study screens. Pilot studies showed that people were unable to tell the difference between the types of information on the study screens (see items 1 and 2 in Appendix C). Adjustments were made to the study screens, and although still not high, the mean responses from participants of this study were increased as compared to those from participants in the pilot study: difference between verbal screens=3.50, difference between quantitative screens=3.60.

Score believability. The mean ratings for Test 1 feedback believability were similar in the pilot studies (false feedback) and in the current study (true feedback) with one exception (see items 7-9 in Appendix C). Those who received positive feedback in the current study were more likely to believe their feedback than those who received

positive feedback in the pilot study, or negative feedback in the pilot or current study. Means were as follows for the current study: positive feedback=3.42 and negative feedback=2.92.

RESULTS

Organization of the Results

The discussion of the results begins with a presentation of descriptive statistics for all variables and their intercorrelations. This is followed by the presentation of all of the hypotheses. For the most part, the hypotheses describe the relationship between two constructs. However, in many cases, each of the constructs is assessed by more than one measure of the variable representing that construct. For example, consider effort, the primary dependent variable in this research. Many hypotheses make predictions about the effects of particular variables on effort. Effort was measured in two different ways, one self-report and the other an observation of the amount of time devoted to studying GRE information. Thus, every hypothesis addressing effort will be tested twice – once for each of the two effort measures.

Similarly, predictors were often assessed by multiple means. Sometimes these were with individual differences measures and other times with experimental manipulations of the construct. The end result is that, for any one hypothesis, there were often nX2 tests of it where n represented the number of assessments of the independent variables and 2 the number of effort measures. In the presentation below, the nX2 expressions of each hypothesis are nested under the discussion of the overall hypothesis.

With multiple measures of many variables and several hypotheses that addressed the same dependent variable, each analysis often addressed more than one hypothesis. When this was the case, an analysis was first introduced under the discussion of the first hypothesis to appear in the discussion in which that analysis was needed to address it, and

the table in which it was presented identified that subset of the data appropriate for the hypothesis as well as other ones to be discussed later in the results section.

Finally, by combining many variables for multiple hypotheses in single analysis, there were times when the analyses yielded information about relationships between variables that were not of direct interest to this research. In some cases, these were ignored. However, there were some cases where the pattern of results was of interest to the issues being raised in this research. Therefore, a final section labeled "Other Findings" presents these findings.

Descriptive Statistics

Table 2 presents the means, standard deviations, and intercorrelations among all variables included in the analyses. Where multiple-item scales were used to assess variables, internal consistency reliabilities (coefficient alphas) are represented in bold in the diagonal of Table 2. Specific relationships within Table 2 are discussed in the following section along with the results of additional analyses used to test specific hypotheses.

Moderation Effects of Goal Orientation and Self-Regulatory Focus

Hypotheses 1a-1b. The first set of hypotheses addressed the moderating effect of performance GO on the relationship between feedback and effort. Given the design of this study, various methods were used to investigate this effect. First, because the model addressed the dual nature of performance GO, both performance-avoid GO and performance-prove GO were considered (VandeWalle, 1997). Hypothesis 1a addressed the moderating effect of performance-avoid GO and Hypothesis 1b addressed the moderating of effect of performance-prove GO.

Next, the design of this study allowed for the investigation of both trait and state effects of the two types of performance GO. GO traits were measured prior to the beginning of the study, and GO states were manipulated during the study. All participants completed the trait GO measures and each participant belonged either to a mastery GO, performance-prove GO, performance-avoid GO, or control (no GO manipulation) condition.

The types of effort relevant to Hypotheses 1a and 1b were self-report and total seconds spent reviewing the study screens (time studied). The specific forms of Hypotheses 1a and 1b expressed in the particular variables used are listed below:

- Trait performance-avoid GO will moderate the relationship between performance feedback and time spent studying (Hypothesis 1a).
- State performance-avoid GO will moderate the relationship between performance feedback and time spent studying (Hypothesis 1a).
- Trait performance-avoid GO will moderate the relationship between performance feedback and self-reported effort (Hypothesis 1a).
- State performance-avoid GO will moderate the relationship between performance feedback and self-reported effort (Hypothesis 1a).
- Trait performance-prove GO will moderate the relationship between performance feedback and time spent studying (Hypothesis 1b).
- State performance-prove GO will moderate the relationship between performance feedback and time spent studying (Hypothesis 1b).
- Trait performance-prove GO will moderate the relationship between performance feedback and self-reported effort (Hypothesis 1b).
- State performance-prove GO will moderate the relationship between performance feedback and self-reported effort (Hypothesis 1b).

Regression analyses were used to test Hypotheses 1a and 1b. Identical analyses were used to first regress effort as measured by the time spent studying on the

independent variables (Table 3). These analyses were followed by regressing self-reported effort on the same set of variables (Table 4). In all cases, cognitive ability as measured by self-reported ACT/SAT scores was entered in Step 1 as a control variable. In the same step, the independent variables were added. In the case of Hypotheses 1a and 1b there were five critical ones: feedback, trait avoid, state avoid, trait prove, and state prove. Finally, two additional main effect variables were entered in Step 1. Trait and state mastery variables were entered in order to explore and partial out their effects.

Entered as the second step in the regression analysis were the interactions. In this case, all two-way interactions were entered. In doing so, a number of these were relevant to none of the stated hypotheses. The far left column of Table 3 lists the hypotheses for which each line of the results is relevant, and, when the analysis is relevant for none of the hypotheses, it is listed as other. Finally, the same set of analyses is repeated using self-reported effort. The data for these analyses appear in Table 4.

Turning specifically to Hypothesis 1a, there were no significant interactions between performance-avoid GO and feedback variables as hypothesized for either type of effort. The analysis for Hypothesis 1b showed similar results. There were no significant interactions between performance-prove GO and feedback variables as hypothesized.

Some main effects were found. Feedback had a main effect on both time studied (R^2=.07, $p<.05$; β=-.28, $p<.01$) and self-report effort (R^2=.07, $p<.05$; β=-.27, $p<.01$). In addition, cognitive ability (β=.16, $p<.05$) and trait performance-avoid GO (β=.16, $p<.05$) had significant main effects on time studied.

Summary. Neither trait nor state avoid or prove performance GO moderated the relationship between feedback and effort. There was a fairly consistent main effect for

feedback such that those who received negative feedback actually tried harder, and reported trying harder than those who received positive feedback.

Hypotheses 3a-3b. This set of hypotheses addressed the moderating effect of SRF on the relationship between feedback and effort. It was expected that the dimensions of SRF would have a similar moderating effect between feedback and effort as the dimensions of performance GO. Therefore, Hypotheses 3a and 3b mirrored Hypotheses 1a and 1b such that prevention and promotion SRF were expected to act like performance-avoid and performance-prove GO, respectively. The specific hypotheses are as follows:

- Prevention SRF will moderate the relationship between performance feedback and time spent studying (Hypothesis 3a).
- Prevention SRF will moderate the relationship between performance feedback and self-reported effort (Hypothesis 3a).
- Promotion SRF will moderate the relationship between performance feedback and time spent studying (Hypothesis 3b).
- Promotion SRF will moderate the relationship between performance feedback and self-reported effort (Hypothesis 3b).

As with GO, trait measures of SRF were completed by participants prior to beginning the experiment. Although SRF was not manipulated, the analyses testing Hypotheses 3a and 3b still included the state GO manipulations in order to partial out any effect the manipulations may have had on effort. A similar set of hierarchical regressions was performed for each hypothesis as described for Hypotheses 1a and 1b. Identical analyses were used to first regress effort as measured by the time spent studying on the independent variables (Table 5). These analyses were followed by regressing self-reported effort on the same set of variables (Table 6). In all cases, cognitive ability as

measured by self-reported ACT/SAT scores was entered in Step 1 as a control variable. In the same step, the independent variables were added. In the case of Hypotheses 3a and 3b there were 3 critical ones: feedback, prevention SRF, and promotion SRF.

Entered as the second step in the regression analysis were the interactions. In this case, all two-way interactions were entered. In addition, three-way interactions were assessed for those variables showing significant two-way interactions. In doing so, a number of these were relevant to none of the stated hypotheses. The far left column of Table 5 lists the hypotheses for which each line of the results is relevant, and, when the analysis is relevant for none of the hypotheses, it is listed as other. Finally, the same set of analyses is repeated using self-reported effort. The data for these analyses appear in Table 6.

Turning specifically to Hypothesis 3a, there were no significant interactions between prevention SRF and feedback variables as hypothesized for either type of effort. The analysis for Hypothesis 3b showed similar results. There were no significant interactions between promotion SRF and feedback variables as hypothesized.

Some main effects were found. Feedback had a main effect on both time studied (R^2=.07, $p<.01$; β=-.27, $p<.01$) and self-report effort (R^2=.10, $p<.01$; β=-.28, $p<.01$). In addition, cognitive ability (β=.15, $p<.05$) and promotion SRF (β=.20, $p<.01$) had significant main effects on self-reported effort.

Summary. As with GO, SRF failed to moderate the relationship between feedback and effort. However, promotion SRF had a main effect on self-report effort such that as participants with higher levels of promotion SRF believed that they put forth more effort.

Relationship Between Goal Orientation and Self-Regulatory Focus

Hypotheses 2a-2c. It was hypothesized that promotion SRF measures would be positively correlated to mastery and performance-prove GO measures. Further, it was hypothesized that prevention SRF measure would be positively correlated to performance-avoid GO measures. In this case, the GO manipulation check measures were used to represent state GO. The relationships were assessed using correlations that can be found in Table 2. Specific hypotheses are as follows:

- Measures of promotion SRF will be positively correlated with measures of trait mastery GO (Hypothesis 2a).
- Measures of promotion SRF will be positively correlated with measures of state mastery GO (Hypothesis 2a).
- Measures of promotion SRF will be positively correlated with measures of trait performance-prove GO (Hypothesis 2b).
- Measures of promotion SRF will be positively correlated with measures of state performance-prove GO (Hypothesis 2b).
- Measures of prevention SRF will be positively correlated with measures of trait performance-avoid GO (Hypothesis 2c).
- Measures of prevention SRF will be positively correlated with measures of state performance-avoid GO (Hypothesis 2c).

Of the hypothesized relationships between these variables, promotion SRF was positively correlated with trait mastery GO ($r=.17$, $p<.01$), state mastery GO ($r=.21$, $p<.01$), and state performance-prove GO ($r=.12$, $p<.05$). The prevention SRF measure was positively correlated with both the performance-prove and avoid GO manipulation checks ($r=.15$, $p<.05$ and $r=.22$, $p<.01$, respectively).

Summary. The measures of trait mastery GO and promotion SRF were correlated, but for the most part, the trait performance GO measures were not

significantly correlated with the SRF measures. However, the SRF measures were correlated in the general hypothesized directions with the GO manipulation check measures.

Controllability Relationships

Hypothesis 4a-4b. This set of hypotheses addressed the relationships between GO and controllability. First, mastery GO was expected to be positively related to controllability irrespective of feedback level (Hypothesis 4a). Second, performance-prove GO was expected to moderate the relationship between feedback and controllability (Hypothesis 4a). Both state and trait effects of GO were examined. In addition, the two factors of controllability that were discussed in the methods section were used as DV's (outcome and development controllability. The specific forms of Hypotheses 4a and 4b expressed in the particular variables used are listed below:

- Trait mastery GO will be positively related to outcome controllability (Hypothesis 4a).
- State mastery GO will be positively related to outcome controllability (Hypothesis 4a).
- Trait mastery GO will be positively related to development controllability (Hypothesis 4a).
- State mastery GO will be positively related to development controllability (Hypothesis 4a).
- Trait performance-prove GO will moderate the relationship between performance feedback and outcome controllability (Hypothesis 4b).
- State performance-prove GO will moderate the relationship between performance feedback and outcome controllability (Hypothesis 4b).
- Trait performance-prove GO will moderate the relationship between performance feedback and development controllability (Hypothesis 4b).

- State performance-prove GO will moderate the relationship between performance feedback and development controllability (Hypothesis 4b).

Regression analyses were used to test Hypotheses 4a and 4b. Analyses were used to first regress outcome controllability (Table 7), then identical analyses were performed to regress development controllability on the same set of variables (Table 8). In all cases, cognitive ability as measured by self-reported ACT/SAT scores was entered in Step 1 as a control variable. In the same step, the independent variables were added. In the case of Hypotheses 4a and 4b there were five critical ones: feedback, trait mastery, state mastery, trait prove, and state prove. Finally, two additional main effect variables were entered in Step 1. Trait and state avoid variables were entered in order to explore and partial out their effects.

Entered as the second step in the regression analyses were the interactions. In this case, all two-way interactions were entered. In doing so, a number of these were relevant to none of the stated hypotheses. The far left columns of Tables 7 and 8 list the hypotheses for which each line of the results is relevant, and, when the analysis is relevant for none of the hypotheses, it is listed as other.

Turning specifically to Hypothesis 4a, there were no significant main effects between trait or state mastery GO and outcome controllability. There was, however, a significant standardized regression coefficient for the relationship between trait mastery GO and development controllability (β=.16, $p<.05$), although the overall R^2 for this model was not significant.

The analysis for Hypothesis 4b showed mixed results. There was no interaction between feedback and either trait or state performance-prove GO for outcome controllability. However, there was a significant main effect for trait performance-prove

GO (R^2=.07, p<.01; β=-.21, p<.01). Although the model was not significant, exploratory analyses showed a three-way interaction between feedback, trait performance-prove GO and state performance-avoid GO on outcome controllability (β=1.74, p<.05; see Figure 5). The results of this interaction suggest participants who were given a performance-avoid goal reported increasing levels of controllability as trait performance-prove increased –a trend that was consistent across feedback conditions. Conversely, feedback appeared to play an important role in reports of controllability across trait levels of performance-prove GO. When positive feedback was given, participants in the control condition reported similar levels of controllability regardless of their level of performance-prove GO. However, when given negative feedback, participants high in performance-prove GO reported higher levels of outcome controllability. It appears that negative feedback interacted with trait levels of performance-prove GO, causing participants who were high in the trait to report greater levels of control over their test score.

With regard to development controllability, there was a significant interaction between feedback and state performance-prove GO (R^2=.17, p<.01; ΔR^2= .12, p<.01; β=-.22, p<.05). However, the interaction was in the opposite direction hypothesized (see Figure 6). Those in the performance-prove condition actually expressed lower, not higher, ratings of development controllability than those in the control group following positive feedback. Figure 6 shows the two-way interaction between feedback and state performance-prove GO for development controllability. As the graph indicates, participants in the control condition reported slightly higher levels of development controllability when given positive feedback than when given negative feedback.

Perhaps positive feedback, in the absence of an external goal, acted as a motivator, causing participants to report high levels of development controllability. Conversely, when given a performance-prove goal, participants reported higher levels of development controllability when given negative feedback than when given positive feedback. The graph seems to indicate that positive feedback combined with a performance-prove goal caused participants to report less control over their ability to learn. Perhaps participants stopped trying because they achieved their goal or felt that additional study effort would have minimal impact as they already achieved top performance.

Exploratory analyses showed two other significant interactions in the same model. There was a feedbackXtrait performance-avoid interaction (β=.91, $p<.01$) and a feedbackXstate performance-avoid interaction (β=-.33, $p<.01$). These interactions are difficult to interpret, however they seem to suggest that performance-avoid GO may have had more of an effect on development controllability than did performance-prove GO (see Figures 7 and 8). The graph in Figure 7 depicts the two-way interaction between feedback and trait performance-avoid GO for development controllability. The results are similar to those shown in Figure 6. Participants who were low in trait performance-avoid GO reported less development controllability when given positive feedback compared to negative feedback, similar to participants who were given performance-prove goals. Once again, positive feedback may have caused participants to stop trying or to see little room for improvement. However, the results were opposite for participants who were high in trait levels of performance-avoid GO. Positive feedback resulted in high levels of reported development controllability than did negative feedback. Positive feedback may have caused these participants to see a link between studying and their

ability to learn the information, while negative feedback may have caused them to see studying as having little impact on learning.

The resulted graphed in Figure 8 appear contrary to those in Figure 7. When given a performance-avoid goal, positive feedback caused participants to report lower levels of development controllability than when given negative feedback, while participants in the control condition reported slightly higher levels of development controllability when given positive feedback. These seemingly contradictory findings could be attributable to differences in state versus trait GO. When given a state goal, participants may have stopped trying when they achieved the external goal, seeing further learning or development as unnecessary, while participants graphed in Figure 7 took positive feedback as a sign that they could learn and develop.

Summary. Trait mastery GO and developmental controllability were positively related. There was also a significant interaction between feedback and state performance-prove GO on development controllability, however, it was in the opposite direction of that hypothesized.

Hypothesis 5. Hypothesis 5 addressed the relationship between controllability and affect. Specifically, it was expected that positive affect would increase as controllability increased. In other words, it was expected that people would be more satisfied and elated when ratings of controllability were higher in positive feedback conditions, and less depressed and anxious when ratings of controllability were higher in negative feedback conditions. According to the correlations in Table 2, there were no significant correlations found between any type of affect and either factor of controllability.

Hypothesis 6. It was expected that higher levels of controllability would be related to higher levels of effort. Both types of total effort were examined: time studied and self-report. In addition, both factors of controllability were assessed: outcome and development. These relationships were all investigated using correlations from Table 2.

There was a significant correlation development controllability and self-report effort ($r=.21$, $p<.01$). Apparently, participants who indicated that studying and practice could improve their score also reported that they put forth more effort during the study time. However, the results indicate that these participants did not necessarily invest more time studying than those who had low development controllability scores.

Summary. GO did not consistently predict participants' levels of controllability, and in turn, controllability failed to predict affect or effort.

Affect Relationships

Hypothesis 7a-7c. This set of hypotheses dealt with the relationships between GO and SRF with different types of affect. Specifically, in positive feedback situations it was expected that mastery GO, performance-prove GO, and promotion SRF would be related to elation. Also, it was expected that performance-avoid GO and prevention SRF would be related to satisfaction.

In negative feedback situations, it was hypothesized that mastery GO, performance-avoid GO, and prevention SRF would be related to anxiety. Also, it was expected that performance-approach GO and promotion SRF would be related to depressive-type affect.

Inherent in these hypotheses are multiple relationships. Both trait and state (condition) GO's are relevant, as well as all four types of affect (satisfaction, elation,

depression, and anxiety). It is important to recall that each of these affect-types were fixed to feedback condition. In other words, only those who received positive feedback completed the satisfaction and elation scales. Similarly, only those who received negative feedback completed the depression and anxiety scales. Because scales were not crossed by feedback level, this set of hypotheses was simply assessed using the correlation matrix found in Table 2.

There were no significant correlations between affect and mastery or performance-prove GO. However, those in the performance-avoid GO condition experienced higher levels of negative affect (depression $r=.27$, $p<.05$; and anxiety $r=.30$, $p<.05$) than those in the control condition. Trait performance-avoid GO was also related to depression ($r=18$, $p<.05$). In addition, trait performance-avoid GO was negatively correlated with elation ($r=-.23$, $p<.01$). Given the high intercorrelations of the affect measures, it is difficult to distinguish differences between arousal and non-arousal emotions. However, the findings with regard to performance-avoid GO are consistent with those of Cron, Slocum, and VandeWalle (2001).

Additionally, there were significant correlations with regard to SRF. These correlations are less clear. It seems that both promotion and prevention SRF were positively correlated with negative affect (depression $r=.25$ and .24, $p<.01$; and anxiety $r=.17$ and .18, $p<.05$). Conceptually, it does not make sense that both of these constructs would be related in the same direction with depression and anxiety. This was likely due to the high correlation between the arousal and non-arousal measures.

Hypothesis 8. Hypothesis 8 dealt with the relationship between arousal-type affect (elation and anxiety) and effort. Consistent with Higgins (1997) theory, it was

expected that higher levels of elation and anxiety would be associated with higher levels of effort. Contrary to what was expected, correlations from Table 2 indicated that depression was the only type of affect that correlated significantly with effort. Specifically, depression was positively correlated with both self-report effort and time studied ($r=.29$, $p<.01$ and $r=.30$, $p<.01$, respectively). Therefore, Hypothesis 8 was not supported.

Distinction Between Forms of Effort Behaviors

Hypothesis 9a-c. It was expected that participants' goal orientations would be related to the types of information they chose to study. There were two types of study information: knowledge and test tips. It was hypothesized that mastery GO would be positively related to the amount of time spent studying knowledge information, and that avoid and prove performance orientations would be positively related to the amount of time spent studying test tips information. Both trait and state GO's were examined. Specific hypotheses are as follows:

- Trait mastery GO will be positively related to time spent studying knowledge information (Hypothesis 9a).
- Participants in the mastery GO condition will study knowledge information more than participants in the control condition (Hypothesis 9a).
- Trait performance-prove GO will be positively related to time spent studying test tips information (Hypothesis 9b).
- Participants in the performance-prove GO condition will study test tips information more than participants in the control condition (Hypothesis 9b).
- Trait performance-avoid GO will be positively related to time spent studying test tips information (Hypothesis 9c).
- Participants in the performance-avoid GO condition will study test tips information more than participants in the control condition (Hypothesis 9c).

Similar hierarchical regressions as used to test Hypotheses 1a and 1b were used for this set of hypotheses. Identical analyses were used to first regress effort as measured by the time spent studying knowledge information on the independent variables (Table 9). These analyses were followed by regressing time spent studying test tips information on the same set of variables. In all cases, cognitive ability as measured by self-reported ACT/SAT scores and feedback were entered in Step 1 as control variables. In the same step, the independent variables were added. In the case of Hypotheses 9a-9c, there were six critical ones: trait mastery, state mastery, trait prove, state prove, trait avoid, and state avoid.

Entered as the second step in the regression analysis were the interactions. In this case, all two-way interactions were entered. In doing so, a number of these were relevant to none of the stated hypotheses. The far left column of Table 9 lists the hypotheses for which each line of the results is relevant, and, when the analysis is relevant for none of the hypotheses, it is listed as other.

With regard to time spent studying knowledge information, there were weak results. There were some significant main effects for cognitive ability (β=.15, $p<.05$) and feedback (β=-.22, $p<.01$), however the overall model of the first regression was not significant (see Table 9). No overall model effects or significant standardized regression coefficients were found with regard to time spent studying test tips information. Therefore, no relationships were found between type of GO and time spent studying test tips.

Exploratory analysis was performed to investigate the effects of SRF on choice of study information. The two regressions used for Hypotheses 3a and 3b were used with

time spent studying knowledge information and time spent studying test tips information as the dependent variables. Again, no effects were found for time spent studying test tips information, and the overall model for knowledge information was not significant (see Table 10). However, feedback had a main effect on time spent studying knowledge information (β=-.22, $p<.01$).

Other Findings

Hypothesis 1. Exploratory analyses for Hypothesis 1 showed some significant interactions between trait and state GO's on both types of effort (see Tables 3 and 4). The models in which these interactions were found were not significant, however, the interactions showed some interesting trends. First, Table 3 shows that for total time studied, there was a significant interaction between trait mastery GO and state performance-prove GO (β=-1.23, $p<.05$; see Figure 9). When the trait measure of mastery GO was low, study time was slightly less for the prove condition when compared to the control condition. Individuals with a prove GO tended to be more focused on performance than learning. However, when the trait measure of mastery GO was high, individuals in the prove condition spent more time studying than those in the control condition. The interaction implies that mastery-oriented individuals spent more time studying when given a performance-prove oriented goal than when given no goal (i.e., control condition). It appears that the performance-prove manipulation enhanced participants' goal orientation trait, when that trait was strong. In this interaction, mastery-oriented participants tended to study more when given the performance-prove goal.

Second, Table 3 shows an interaction between trait performance-avoid GO and state performance-prove GO (β=-.95, $p<.05$; see Figure 10) on total time studied. In this interaction, participants who were low in the performance-avoid trait tended to study more when given a performance-prove goal than those who were given no goal (i.e., control condition). However, participants high in the performance-avoid trait spent less time studying when given a performance-prove goal than those who were given no goal. As with Figure 9, the prove manipulation appeared to enhance participants' natural tendencies when the GO trait was strong. Thus, high performance-avoid participants studied less when given a performance-prove goal, as one would expect given their tendency to exert just enough effort in order to avoid performing poorly.

Finally, Table 4 shows a significant interaction between trait mastery GO and state performance-prove GO (β=-1.15, $p<.05$; see Figure 11) on effort. The control condition was consistent with what one might expect: as mastery GO increased, so did study effort. However, the most critical portion of the graph appears to be the differences in self-reported for the performance-prove condition. When given a performance-prove goal, participants who were low in mastery-orientation reported more study effort than participants who were high in mastery GO. It is possible that participants who were low in mastery GO truly studied harder to score higher on the tests, however, with a self-reported measure, it is difficult to rule out impression management as another plausible explanation for the findings.

Hypothesis 3. Table 5 shows the exploratory analyses performed for Hypothesis 3. The second step of this regression was significant (R^2=.14, $p<.01$; ΔR^2= .08, $p<.05$) and showed a significant interaction between promotion SRF and state mastery GO on

total time studied (β=-1.16, $p<.01$; see Figure 12). The graph of this interaction is contrary to what one would expect. When given a mastery-oriented goal, participants tended to spend more time studying if they were low in promotion SRF than when high in promotion SRF. However, the opposite would be expected: promotion SRF should combine with mastery GO to enhance study time further. This contrary finding was more pronounced when compared to the control condition. In the absence of a goal, high promotion participants studied considerably more than high promotion participants who were given a mastery goal. One explanation is that by telling high promotion-focused participants not to focus on performance, the mastery GO manipulation actually increased attention on performance, thus reducing study time.

The third model in Table 5 was also significant, but not incrementally above the second model (R^2=.17, $p<.01$). It contained a significant three-way interaction between feedback, promotion SRF, and state performance-avoid GO (β=-1.26, $p<.05$; see Figure 13). This three-way interaction is consistent with GO and SRF theories. When given positive feedback, low promotion-focused participants in the control condition reported less study effort than those in the performance-avoid condition. However, participants who were high in promotion focus reported greater study time in the control condition but less study time in the performance-avoid condition. This interaction indicates that in the absence of goal manipulation, high promotion-focused participants exerted more study effort when given positive feedback, consistent with GO theory. However, when given a performance-avoid goal and positive feedback, high promotion-focused participants reported less study effort than those in the control condition.

In the negative feedback situation, regardless of condition, participants reported greater study time as levels of promotion SRF increased. However, participants reported greater study time when given a performance-avoid goal than when given no goal at all. Consistent with the research, this finding supports the notion that performance-avoid participants tend to exert more effort when given negative feedback and this trend is enhanced when the participant has a promotion SRF.

Table 6 also shows a significant three-way interaction. For this regression, the third model was significant (R^2=.19, p<.01), however did not add significantly to the variance explained in the first and second models. The three-way interaction in the third model mimicked the three-way interaction found with regard to study time (see Figure 14). Feedback, promotion SRF, and state performance-avoid GO formed a three-way interaction on self-report effort (R^2=.19, p<.01; β=-1.21, p<.05). Therefore, the three-way interaction graphed in Figure 14 is consistent with the interaction graphed in Figure 13. When given positive feedback, high promotion-focused participants spent more time studying than low promotion-focused participants and participants in the performance-avoid condition. There appeared to be little change in the study time of participants in the performance-avoid condition, despite the level of promotion SRF. As with Figure 13, participants in the performance-avoid condition spent more time studying than participants in the control condition as indicated by the parallel lines. Within each condition, the amount of study time also increased for high promotion-focused participants in the presence of negative feedback. Once again, this finding is consistent with the theory. When no goal manipulation was given, high promotion-focused participants spent more time studying, which is similar to what one would expect from

participants high in mastery GO. However, for participants in the performance-avoid condition, negative feedback resulted in more study time when compared to the control condition. Study time also increased for participants who were high in promotion SRF.

Hypothesis 9. Although none of the steps are significant in Table 9. There was a consistent pattern of interactions between trait mastery and state prove on time spent studying knowledge material. There was a significant two-way interaction between trait mastery and state performance-prove GO (β=-1.23, $p<.05$), however, this relationship seemed to be due to a three-way interaction between feedback, trait mastery, and state prove (β=-1.83, $p<.05$). Figure 15 depicts the three-way interaction between feedback, mastery GO, and the performance-prove condition. The interaction is consistent with GO research. When given positive feedback, participants high in mastery GO spent more time studying knowledge materials, (i.e., focused on learning), than those low in mastery GO and participants in the performance-prove condition. Thus, positive feedback appeared to motivate mastery-oriented participants to spend more time learning when no external performance goal is given. Conversely, when given negative feedback and a performance-prove goal, participants spent less time studying knowledge information than participants in the control condition. However, this difference was more pronounced for participants high in mastery-orientation. When given negative feedback and a performance-prove goal, participants high in mastery GO tended to spend less time studying knowledge material than participants low in mastery-orientation and even less time than participants in the control condition. It appears that the performance-prove manipulation re-directed the study efforts of high mastery-oriented participants away from knowledge information.

Table 10 shows a significant interaction between feedback and state performance-avoid GO (β=-.23, $p<.05$; see Figure 16). However, again, it is important to recognize that neither of the models in the regression shown in Table 10 were significant. Figure 16 depicts the two-way interaction between feedback and performance-avoid condition. When no goal manipulation was given, participants who received positive feedback typically spent less time studying knowledge information than participants who were given negative feedback. However, when participants were given a performance-avoid goal the results were more pronounced. Negative feedback resulted in slightly more time spent studying knowledge materials when compared to the control condition, but considerably less time compared to the control condition when positive feedback was given. These data are consistent with the conclusion that positive feedback combined with a performance-avoid goal caused participants to spend less time studying when their performance reached a minimum criterion. Thus the performance-avoid goal may have been de-motivating in the presence of positive feedback.

Finally, Table 10 also showed a significant interaction between promotion SRF and state performance-prove GO (β=-.97, $p<.05$; see Figure 17). Consistent with Figure 15, Figure 17 shows that giving a performance-prove goal caused high promotion-focused participants to spend less time studying knowledge information than low promotion-focused participants and less time than high and low promotion-focused participants in the control condition. Once again, it would appear that giving a performance-prove goal re-directed attention away from knowledge information or learning.

Summary. As a whole, the interactions were consistent with the notion that performance GO had a stronger impact on effort than mastery GO, regardless of which was the state and which was the trait. Furthermore, when compared across performance orientations, performance-avoid appeared to have a stronger impact on effort than did performance-prove or promotion SRF regardless of which was the state and which was the trait. These effects were further enhanced in the presence of feedback.

DISCUSSION

In close to every aspect of our lives, we are inundated by feedback. Feedback may come in various forms, and we may choose to ignore it or accept it, but the goal inherent in almost all types of feedback messages is to maintain or change behavior. In the workplace, feedback carries special significance and is often linked to important internal and external outcomes. In some cases, negative feedback can indicate that one is performing poorly on the job and is unlikely to be promoted, and/or it can result in lowered self-efficacy and negative affect. In other cases, negative feedback can motivate people to improve their behaviors and face tough challenges. Similarly, positive feedback can indicate that one's work will be rewarded, and/or it can result in increased self-efficacy and positive affect. However, positive feedback may also decrease one's motivation move past an already successfully reached goal.

If the goal in giving feedback is to change one's behavior, it is crucial that we understand how feedback works. Unfortunately, there are no clear answers here (Kluger & DeNisi, 1996). Reactions to feedback are impacted by individual differences, cognitions, how the feedback is framed, and of course by the environmental conditions under which it is delivered.

Research has shown GO and SRF to be related to reactions to feedback. These constructs are unique in that they are considered to be both individual differences as well as environmentally induced states. This study was set out to further our understanding of reactions to performance feedback. The hypotheses emerged from a combination of the GO and SRF literatures.

This study had four goals. First, we wanted to replicate the moderation effects of GO and SRF on the relationship between feedback and effort. Second, we wanted to explore the relationship between GO and SRF themselves. Third, we incorporated the process variables of controllability and affect in order to gauge their impact on reactions to feedback. Last, we set out to address some of the limitations inherent in past research with regard to measuring effort and differentiating between state and trait GO. The following section addresses the findings for each goal, limitations of the research in attaining each goal, and implications for future research.

Moderating Effects of GO and SRF

Hypotheses 1 and 3 addressed the moderating effects of GO and SRF, respectively, on the relationship between feedback and effort. There was no support for either of these hypotheses. There are at least three possible reasons for this. First, the negative feedback manipulation in this study had a strong main effect on effort, which may have left little room for more subtle effects of GO or SRF. Second, both the trait and state performance-avoid constructs appeared to have a dominant effect relative to the other GO and SRF constructs. Third, the task itself provided a strong situation that was heavily performance oriented and familiar to participants.

Pervasive throughout the analyses was negative feedback's effect on various types of effort. Despite Kluger and DeNisi's (1996) claim that the feedback message itself is not solely responsible for changes in behavior, it was very consistent in this study. Participants in every condition, regardless of levels of trait GO and SRF, tried harder in response to negative feedback. Reasons for negative feedback's strong effect are likely due to the nature of this task. First, this was a cognitively-based, achievement-oriented

testing situation. Given that college students are likely used to receiving scores (or grades) in their classes, and usually put a premium on high grades, they may have differentially focused on this aspect of the task.

Another reason for negative feedback's strong effect could be that the feedback itself contained an implicit goal. The feedback given to participants was normative, and therefore lent itself to natural goal-setting. Even those in the control condition were likely to evaluate where they stood relative to others and subsequently set personal goals for themselves, particularly in cases where they were told that they performed less well than others. Individuals in the other conditions were given explicit goals. However, these implicit, self-set goals may have over-ridden any effects that the manipulation-stated goals may have had on these individuals. Particularly considering that this was a performance-based task, mastery GO and promotion SRF had little effect on participants' effort levels. This lends support to the theory that perhaps people were setting their own goals in response to the feedback.

The exploratory analyses revealed an interesting finding that could have also had implications for the lack of GO and SRF moderation effects. Although most of the interactions analyzed in the exploratory analyses were not significant, they showed a trend with regard to performance-avoid GO: Performance-avoid GO had a pervasive effect on effort. Whether individuals naturally tended toward a performance-avoid GO, or are put in a performance-avoid condition, they exhibited behaviors typical of that construct. In other words, performance-avoid individuals tried harder in response to feedback, particularly negative feedback, than did other individuals.

This domination effect of performance-avoid GO may have been partly due to the nature of the task. The GRE task was quite performance oriented for two reasons. First, the task was a test taking exercise. Although effort was measured during the study time, the participants were likely influenced to be thinking about performance given that they received feedback on tests.

Second, the GRE task in this study was performance oriented because individuals in all of the conditions were given normative feedback. Therefore, even participants in the mastery condition were told how they performed relative to other participants. Normative comparisons are common in performance GO manipulations. Such feedback was chosen for this study in order to enhance the meaningfulness of the feedback and maintain consistency of feedback messages across the conditions.

In addition to the task being performance oriented, it was also a familiar one for most participants. Given that all of the participants were college students, most took either the ACT or SAT to gain admission to college. These tests are similar to the GRE. Given past experience on such tests, this nature of this task could easily have primed students to consider how they have prepared for and performed on these tests in the past. It is fairly well recognized that studying for 15 minutes is not going to substantially raise someone's GRE score. This perspective could easily have overridden any orientation individuals had toward learning or performance. In a sense, past experience with these types of exams could have served as a barrier for the manipulations if the participants believed that they could neither improve their performance nor learn from the study screens.

Unfortunately, the implications of the nature of the task do not fully explain the results. Given that the task and feedback were performance oriented, we might expect this to lead to a strengthening of the hypothesized relationships affected by the performance GO manipulations. However, this did not prove to be the case, the hypothesized relationships were not significant. In addition, the GO manipulation check appeared to correlate more highly with the trait GO items than with the manipulations.

Relationship Between GO and SRF

Hypothesis 2 addressed the relationship between GO and SRF variables. As discussed in the results, trait mastery GO and promotion SRF were correlated. However, measures between the rest of the constructs were not correlated. This is likely a factor of the quality of the SRF measures. As described in the methods section, a SRF measure was constructed specifically for this study and was not related to an established SRF measure (the Selves Questionnaire).

Despite the lack of significant results for the direct test of the hypotheses, exploratory analysis, although largely not significant, did present some interesting trends. For instance, Figures 15 and 17 show that individuals who are high on both trait mastery GO and promotion SRF responded to performance-avoid goal situations in similar ways. These individuals studied knowledge information less time when given a performance-prove goal than those who were not given a performance-avoid goal (control condition). Although this trend was not consistent, it lends support for further study of the relationships between these variables, particularly considering the limitations presented by the quality of the scales used in this study.

Process Variables

The two process variables under consideration in this study were controllability and affect. There were few significant findings that corresponded with the hypotheses for these variables. The affect variables did not relate as expected with GO or effort. This may have been partly due to the quality of the affect measures. As discussed in the methods section, the arousal and non-arousal components of the affect scales were highly correlated.

Despite the lack of relationships shown for Hypotheses 4 through 7, past research has shown that this is a fruitful line of inquiry. It is fairly well established that attributions are a fundamental part of response to events (Fiske & Taylor, 1991; Weiner, 1986). In addition, researchers have found that negative discrepancies between current performance and self-set goals create emotional responses that can serve as an incentive for increased effort (VandeWalle, 2001; Bandura, 1997).

Given feedback, individuals are bound to feel something about the feedback, and are likely to make attributions for their performance. It comes as no surprise that individuals will be less satisfied with negative feedback than with positive feedback. With respect to attributions, research has shown that in receipt of positive feedback, individuals will attribute their behavior to themselves and conditions they control rather than factors not under their control. Likewise, negative feedback is more likely to produce performance attributions to external factors or, if internal, to things over which the person has no control. Therefore, it is still worth exploring how to increase feelings of controllability in feedback situations, particularly when considering reactions to negative feedback (Ilgen & Davis, 2000).

Distinction Between Forms of Effort Behaviors

The first distinction of effort we examined was actual study time versus self-reported study effort. As discussed in the methods section, the two measures were highly correlated ($r=.54$, $p<.01$). Overall, the findings from analyses using study time as the DV were similar to the findings using self-reported effort as the DV. It appears that individuals were fairly honest and accurate in reporting their effort levels.

The second distinction of effort we examined was time spent studying knowledge information versus test taking heuristics. Hypothesis 9 proposed that mastery-oriented individuals would be more likely to spend time studying knowledge information, and that performance-oriented individuals would be more likely to study test tips information. However, Hypothesis 9 was not supported. There are at least two possible reasons for this. First, it seems that participants had a difficult time telling the difference between the types of study screens. The mean responses for questions pertaining to the differences between screens were 3.50 (verbal) and 3.60 (quantitative). Although these means were higher than those obtained from pilot studies, they were still less than ideal.

In addition, individuals spent much more time on the knowledge screens as opposed to the test tips screens overall (knowledge mean =419.79 seconds, test tips mean=268.42 seconds). The test tips screens were also rated as being less helpful than the knowledge screens for learning (test tips mean=2.84, knowledge mean=3.51) and improving scores (test tips mean=2.98, knowledge mean=3.14). This was likely due to the format and types of information in the tests. It could be that these participants were already familiar with the test format and types of test questions. If so, then they more than likely did not need to focus on test taking heuristics. Alternatively, the test content

may have required a need for "brushing up" on past knowledge. A prime example of this would be the geometry questions. Individuals may have felt that if they reviewed the content information in geometry, they would have a better chance of improving their performance.

Study Limitations

Given the implications and limitation of the results, it is also important to consider some of the broader limitations that may influence the generalizability of this study.

Task. The achievement nature of the task itself may have overridden the likelihood that individuals would exhibit behaviors associated with a mastery GO or promotion SRF. In addition, participants found this task to be dull, and therefore, were less likely to feel motivated to perform. This was confirmed by the moderate to low means on the motivation measures. In addition, when given options to engage in the task, surf the net, or watch the clock count down the end of the study time, the experimenter observed many of the participants choose to simply watch the timer.

In addition, it seems that people were not likely to believe their feedback, particularly in negative feedback situations. It is a common finding that individuals are less likely to accept negative feedback, however, feedback in this study was based on true scores in order to alleviate the effect of low believability in negative feedback situations. This could be due to the fact that even though participants' feedback conditions were based on their true performance, individuals' feedback messages were not accurate as to their true performance. Participants who answered eight or more questions correctly received the positive feedback message, and those who answered seven or less questions

correctly received the negative feedback message. Therefore, the feedback messages for the first test were not individualized based on true score.

Measures. As discussed in the methods section, a number of crucial measures in this study had to be constructed. Measures were created for SRF, controllability, and all forms of affect. Using non-established measures led to uncertainty about the quality and validity of the measurements. In addition, the manipulation appeared to have little effect on the outcome variables within each hypothesis. However, problems arose when attempting to determine the effectiveness of the manipulations because the manipulation check measure had poor structure. The manipulation check items were highly intercorrelated and did not factor well into the expected categories. Therefore, it was difficult to ascertain whether the manipulations did not work, or worked but failed to produce the hypothesized effects.

Future Research

Inclusion of other variables. As with any one study, there were important variables left out of the experiment. Variables such as self-efficacy, are likely to play a role in reactions to feedback. Self-efficacy has been shown to be related to both attributions and affect (Bandura, 1997). It could possibly help further explain the relationships between affect and attributions and controllability. In this study, two types of controllability examined may have tapped into similar constructs as self-efficacy. They both examined individuals' beliefs about their ability to change their behaviors. Essentially, individuals were asked about whether or not they thought they could control their performance on the second test, and if they thought that they could improve their performance through studying. These constructs approach the types of issues that self-

efficacy might tap. However, self-efficacy may play a role earlier in the process, as well as at many points throughout the process.

Differences between GO and SRF. Given that GO and SRF were largely found to be unrelated in this study, this leaves room for further research to investigate the relationships between these constructs. As noted in some of the exploratory analyses, trait and state GO did have interactions with promotion SRF. Perhaps research designed specifically for the purpose of isolating these interactions would shed some light on the distinction between these variables.

Conclusion

Despite the lack of significant findings that emerged from this study, there still remains an interesting question with regard to the relationship between two seemingly parallel constructs. Theoretically, GO and SRF have many similarities, and their respective literatures could possibly benefit from exploring their relationships with each other, and with various process variables such as attributions and affect. Some areas that need to be improved for future research include better measures of SRF and affect. In addition, given the complexities of separating out the various state and trait components in this study, it might be beneficial to investigate these various effects individually.

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ENDNOTES

[1] Because technically participants will have no other measure of their performance except for the feedback they receive, performance and feedback will be treated synonymously here.

[2] All of the test questions used in this study were taken from the following source, reprinted by permission of the Educational Testing Service, the copyright owner.

GRE Practicing to Take the General Test #9, 9th Edition, 1994

[3] All of the study materials used in this study were taken from the following sources, reprinted by permission of the Stanley H. Kaplan Educational Center, the copyright owner.

Lesson Book: GRE Preview, Classroom, Review, 1996
Verbal Home Study: GRE Vocabulary Review List and Word Root List, 1995
Mathematics Home Study: GRE Problem Solving, 1995
Mathematics Home Study: GRE Quantitative Comparisons and Graphs, 1995

[4] Twenty-seven participants were dropped from the study for various reasons. The computer program failed to collect data for some of the participants, and some participants failed to follow experimenter instructions.

[5] Ethics in psychology information was taken from portions of the American Psychological Association Ethics Code (version 1992). The APA Ethics code can be seen on the APA website (www.apa.org). Inquiries concerning the substance or interpretation of the APA Ethics Code should be addressed to the Director, Office of Ethics, American Psychological Association, 750 First Street, NE, Washington, DC 20002-4242.

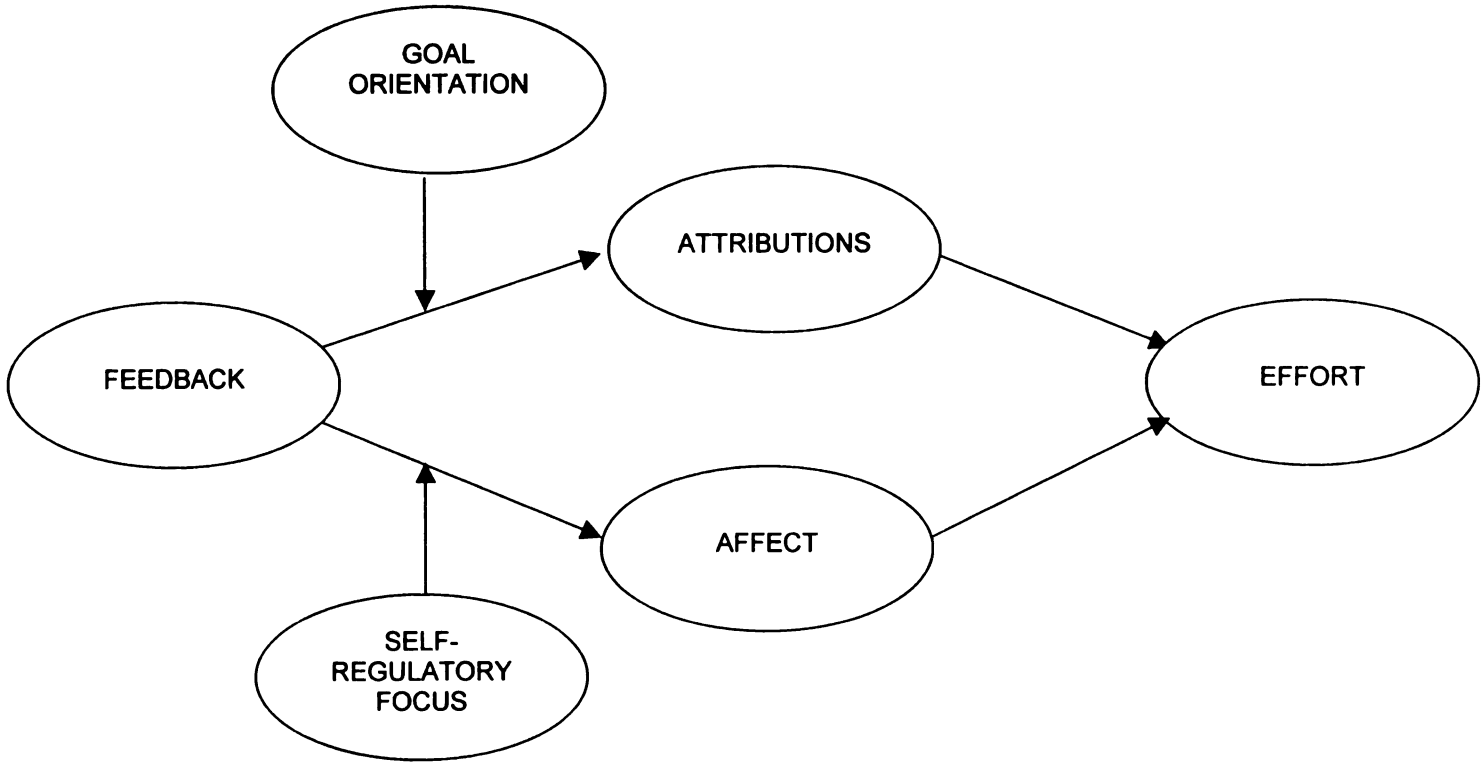


Figure 1. Model based on a strict interpretation of the SRF and GO literatures.

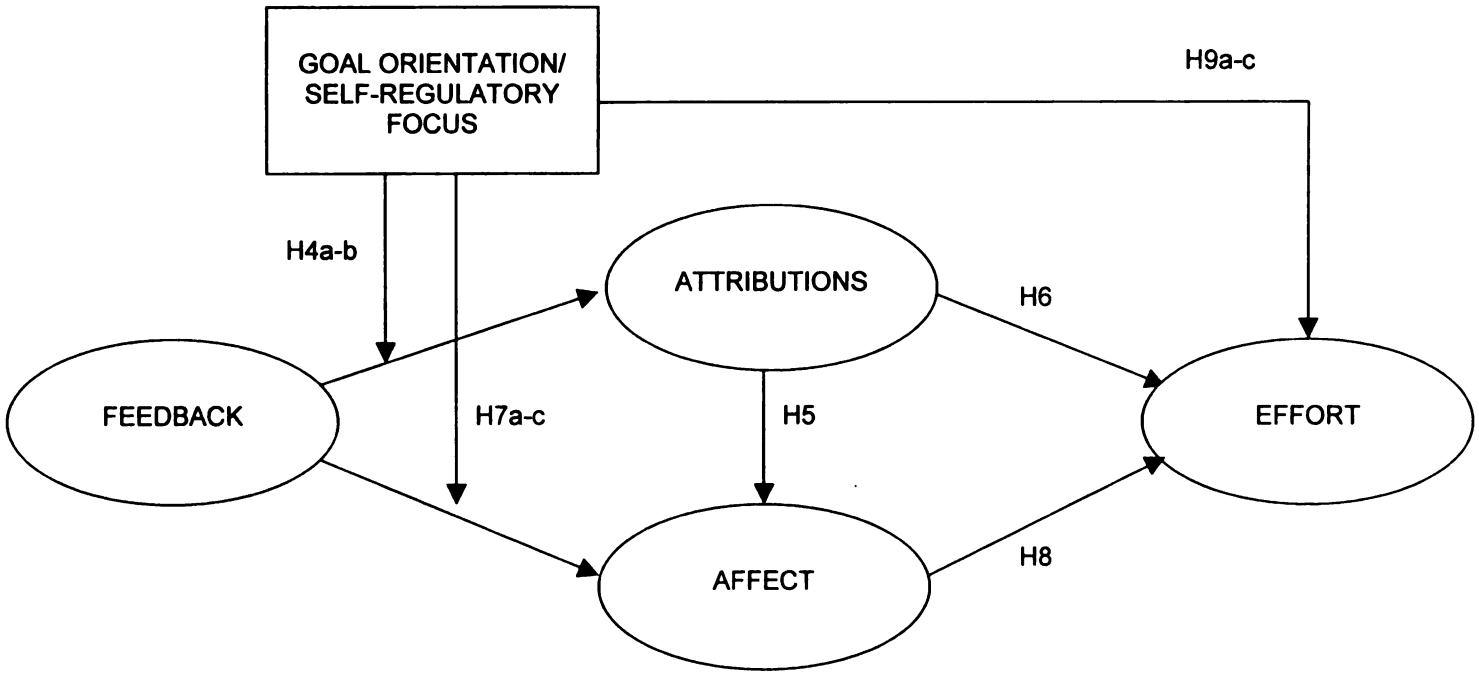


Figure 2. The conceptual model for this study.

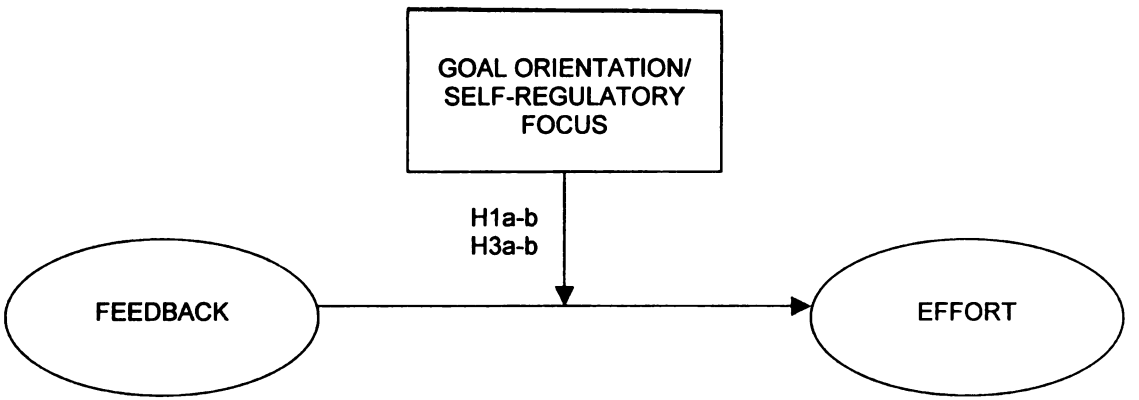


Figure 3. GO and SRF as moderators of the relationship between performance feedback and effort.

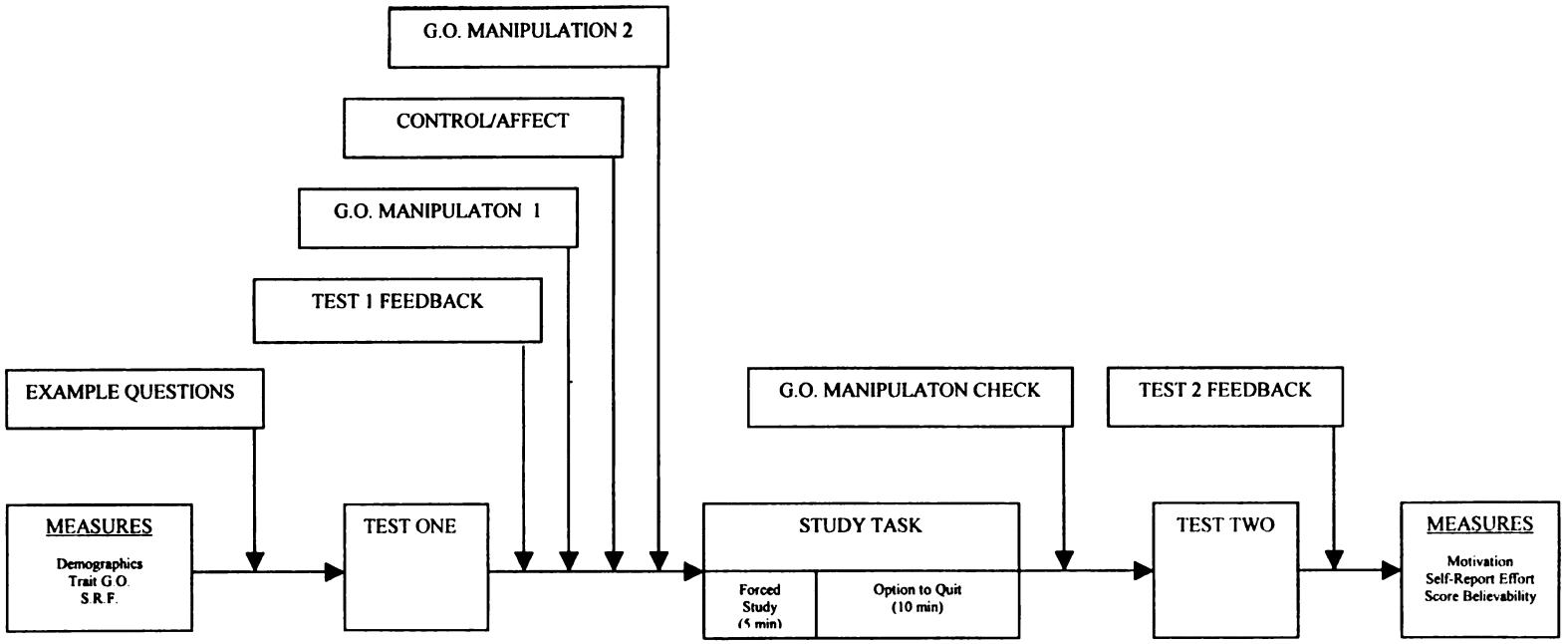


Figure 4. Model of the procedure.

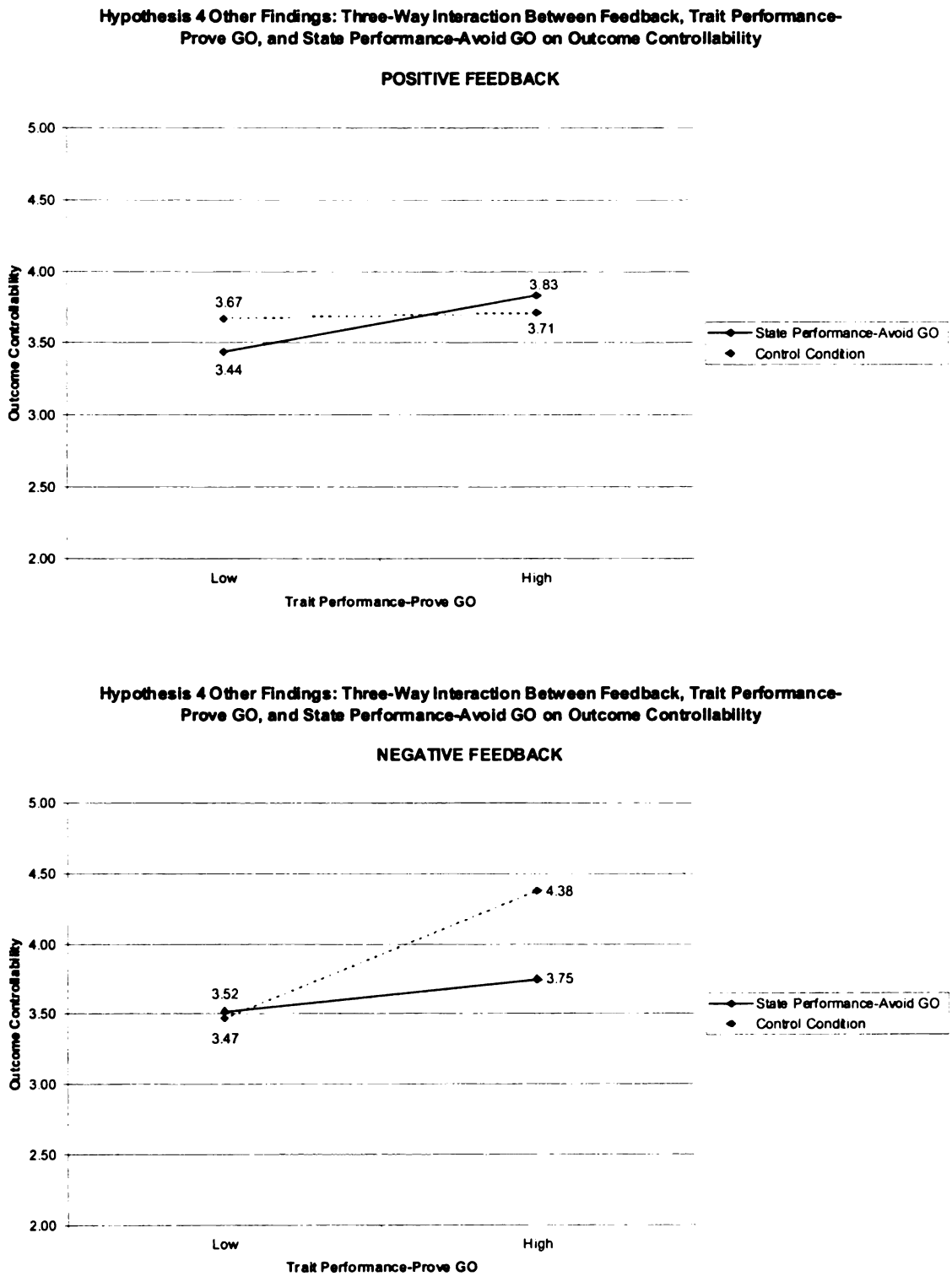


Figure 5. Three-way interaction found in Hypothesis 4 exploratory analyses.

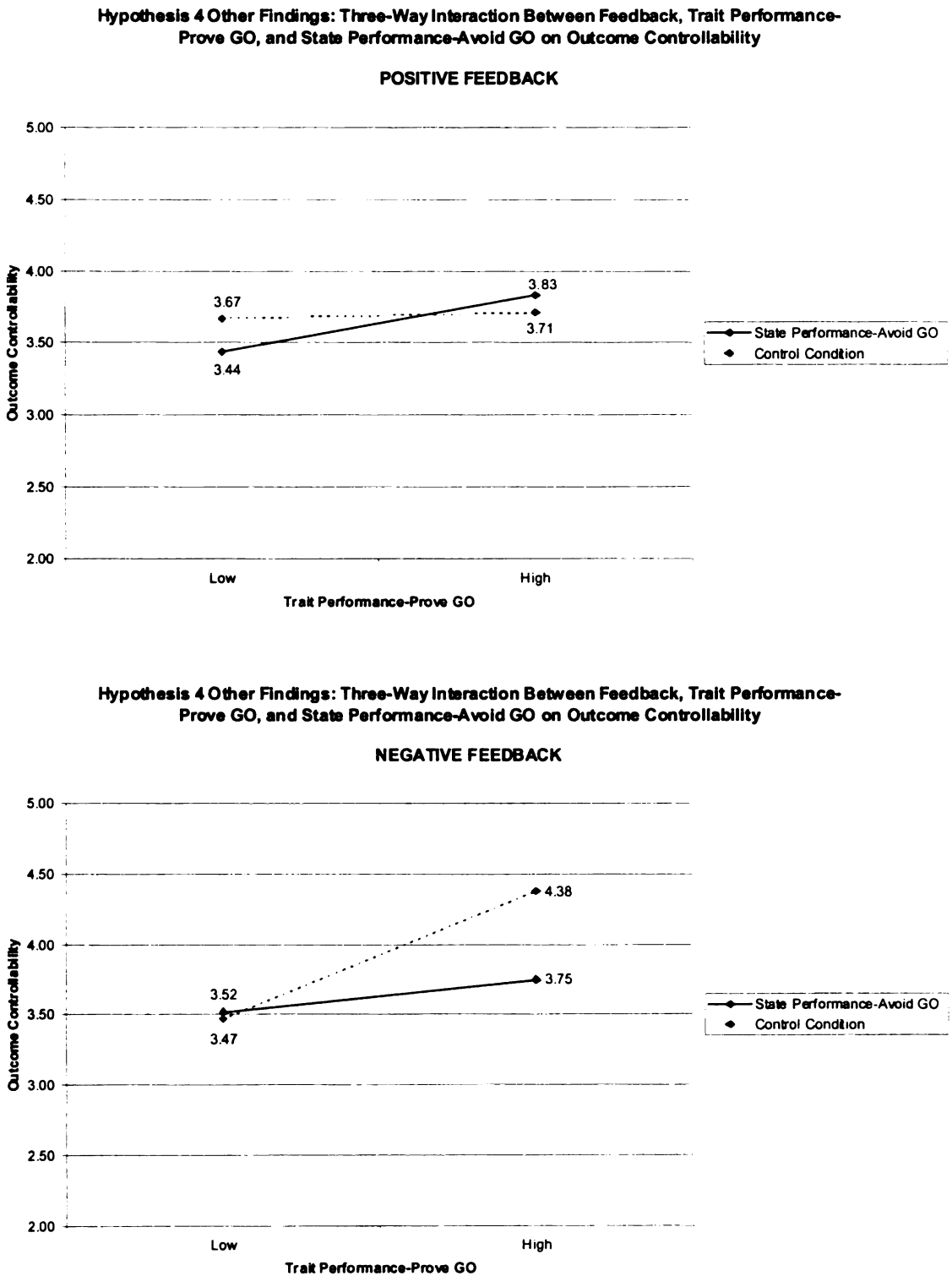


Figure 5. Three-way interaction found in Hypothesis 4 exploratory analyses.

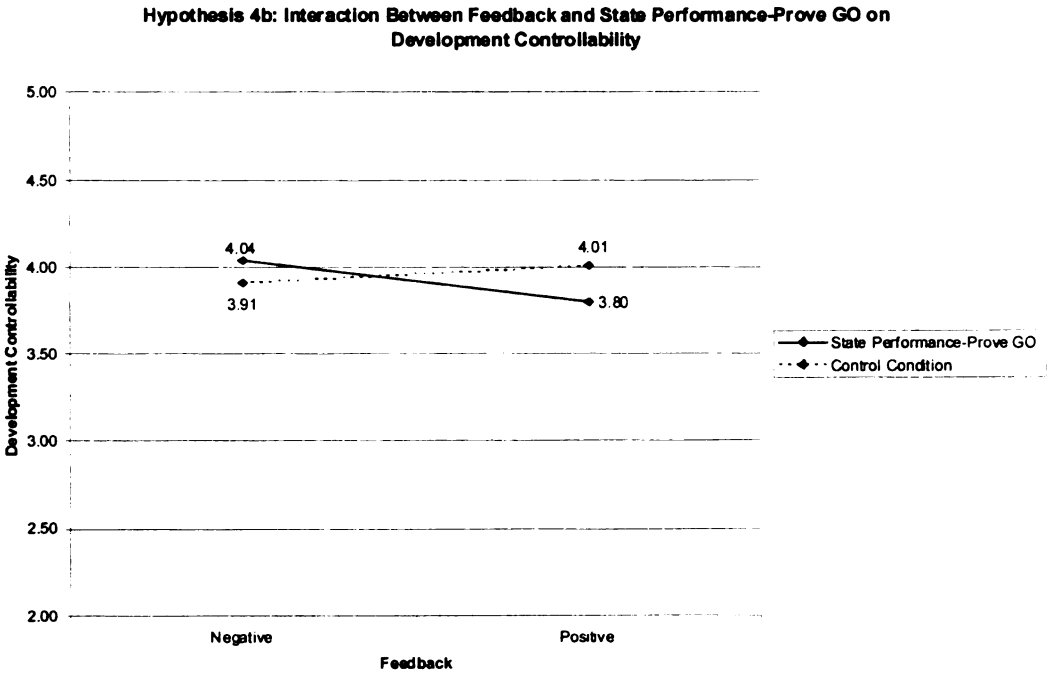


Figure 6. Two-way interaction found for Hypothesis 4b.

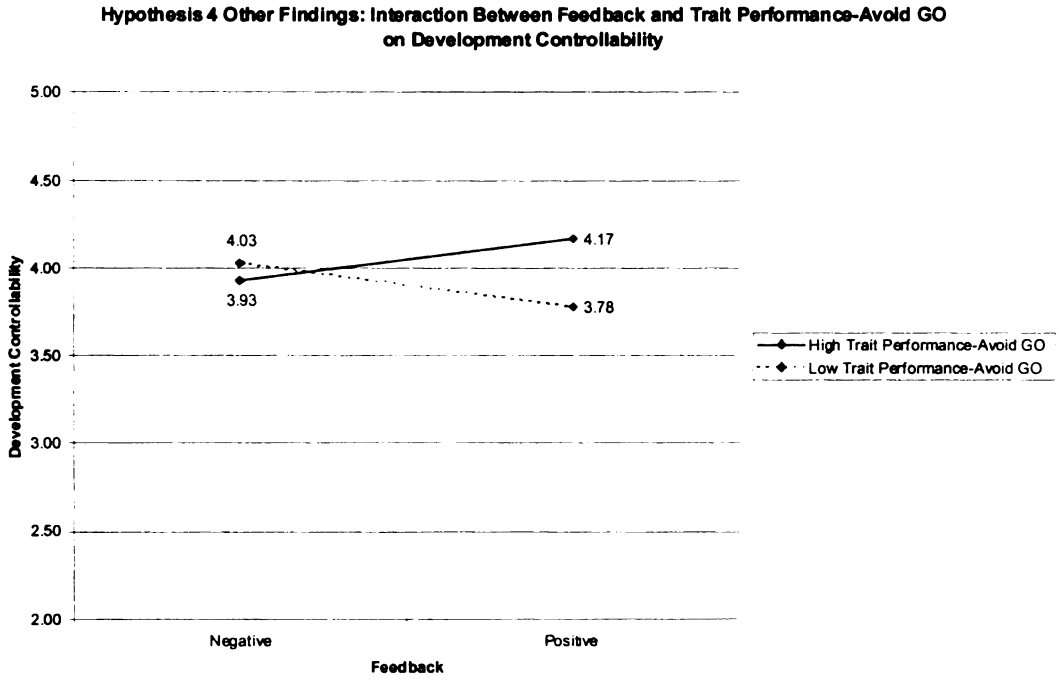


Figure 7. Two-way interaction found in Hypothesis 4 exploratory analyses.

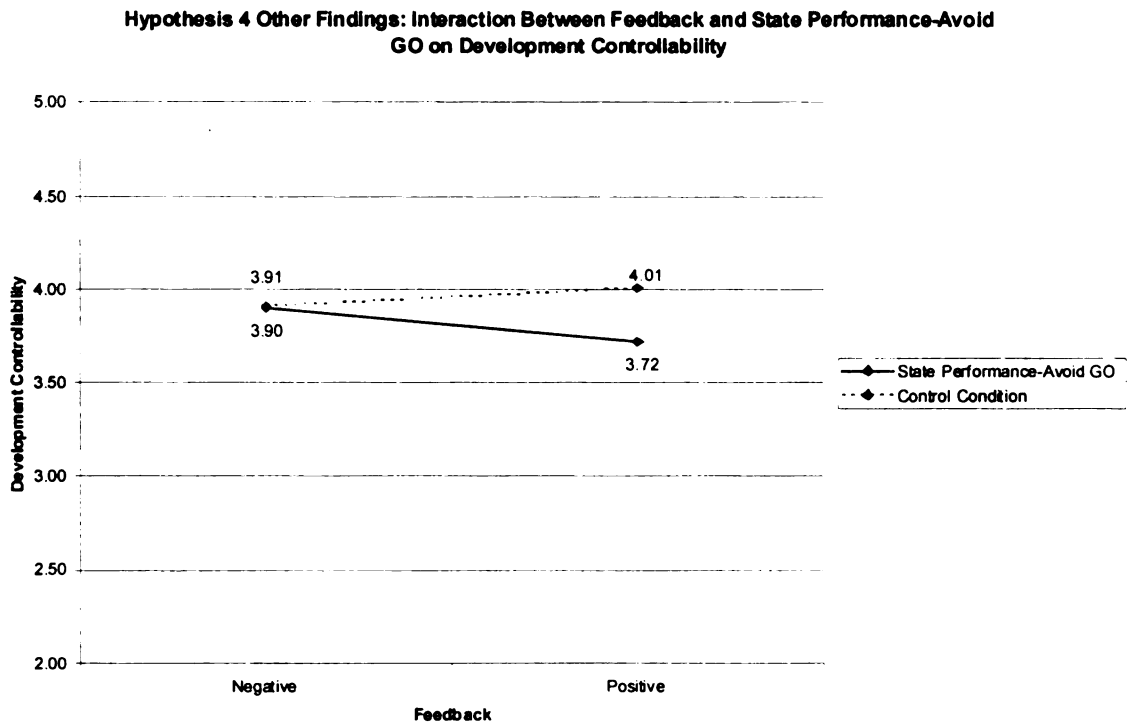


Figure 8. Two-way interaction found in Hypothesis 4 exploratory analyses.

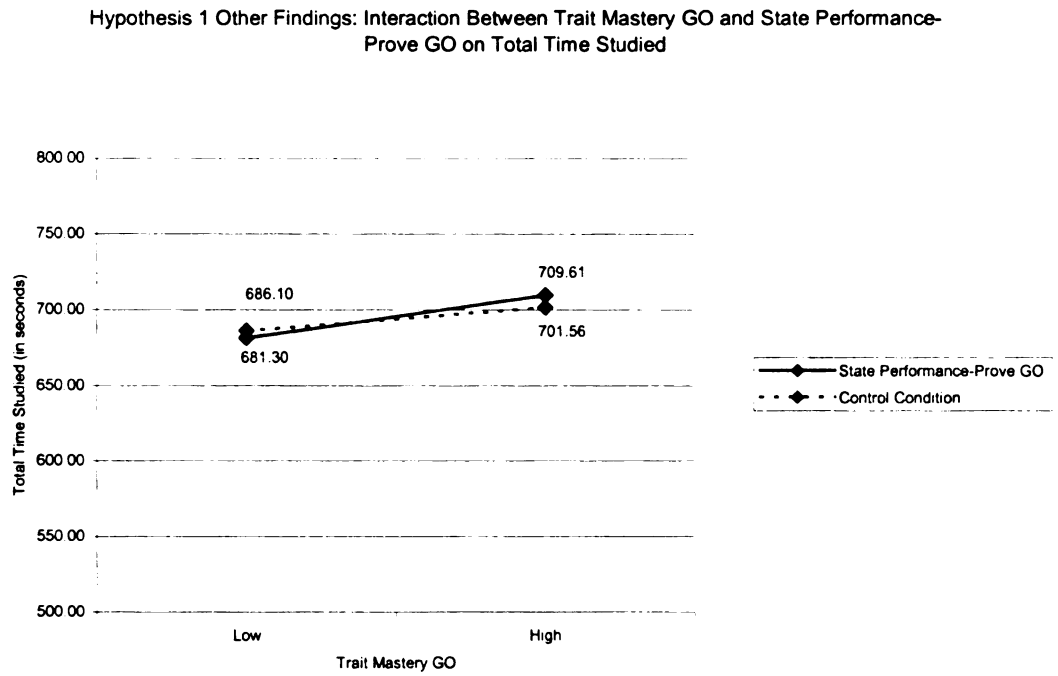


Figure 9. Two-way interaction found in Hypothesis 1 exploratory analyses.

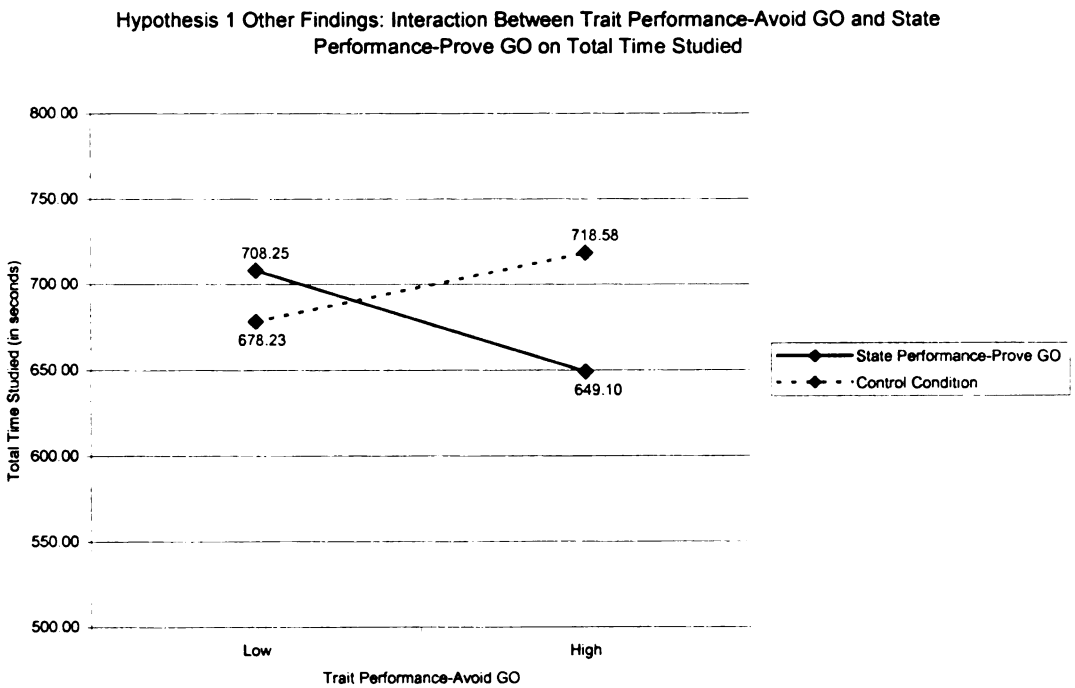


Figure 10. Two-way interaction found in Hypothesis 1 exploratory analyses.

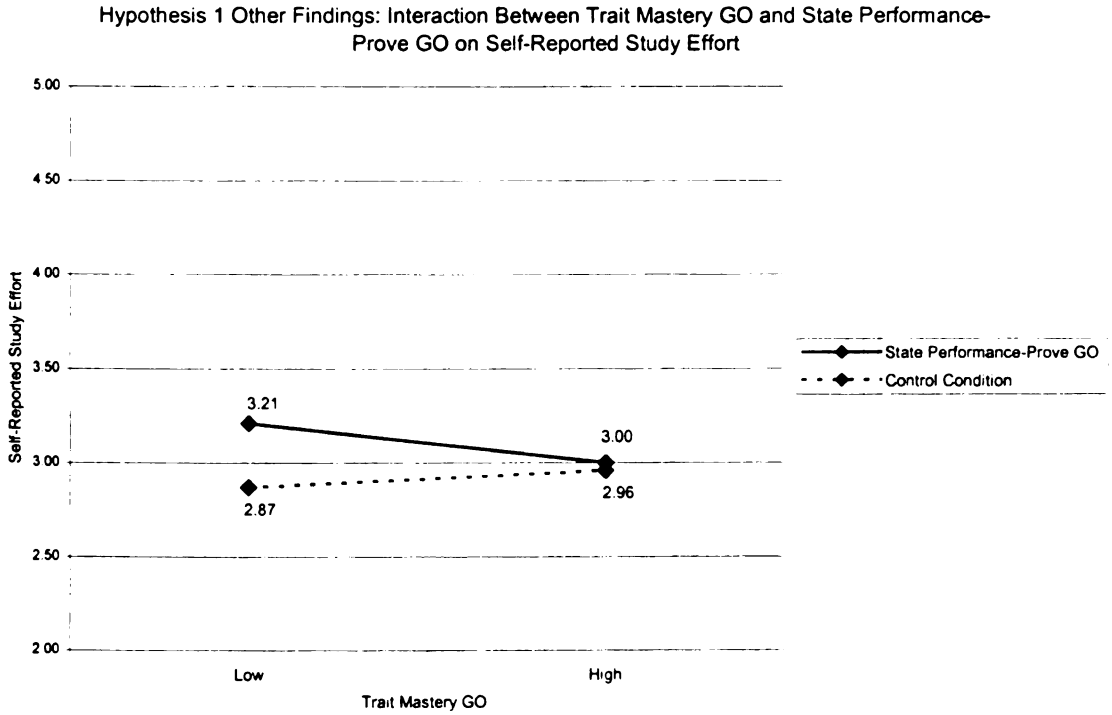


Figure 11. Two-way interaction found in Hypothesis 1 exploratory analyses.

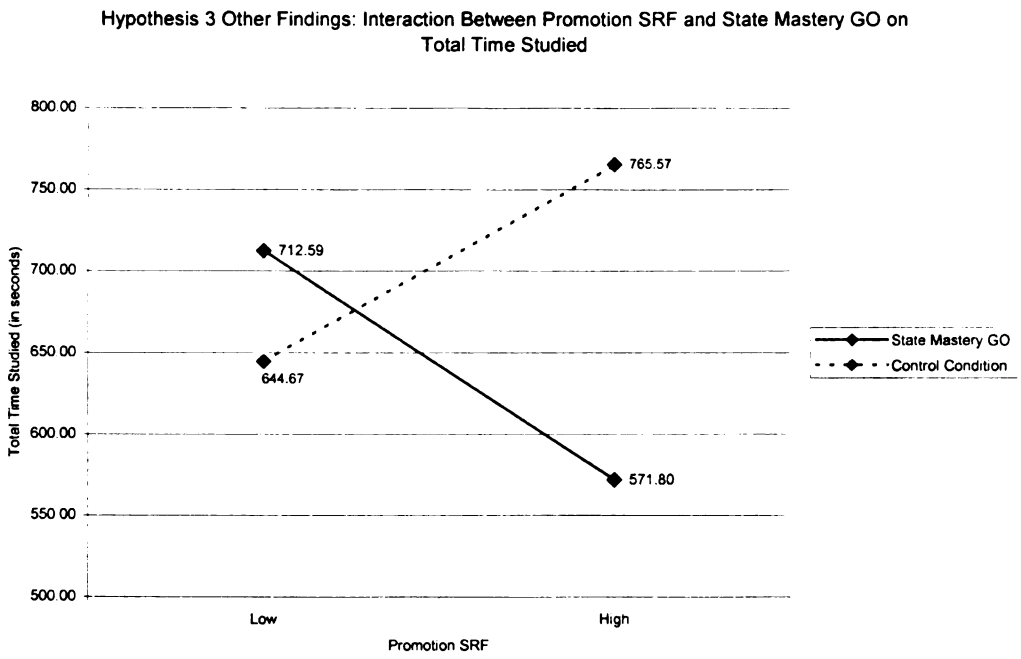
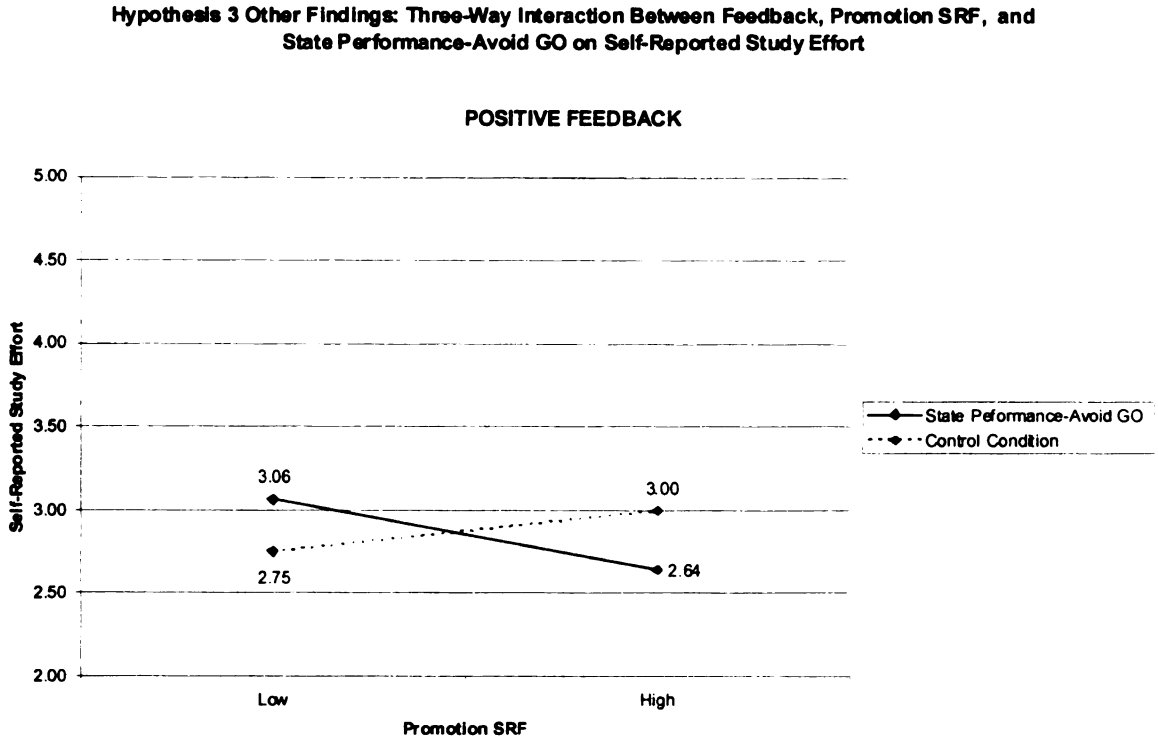


Figure 12. Two-way interaction found in Hypothesis 3 exploratory analyses.



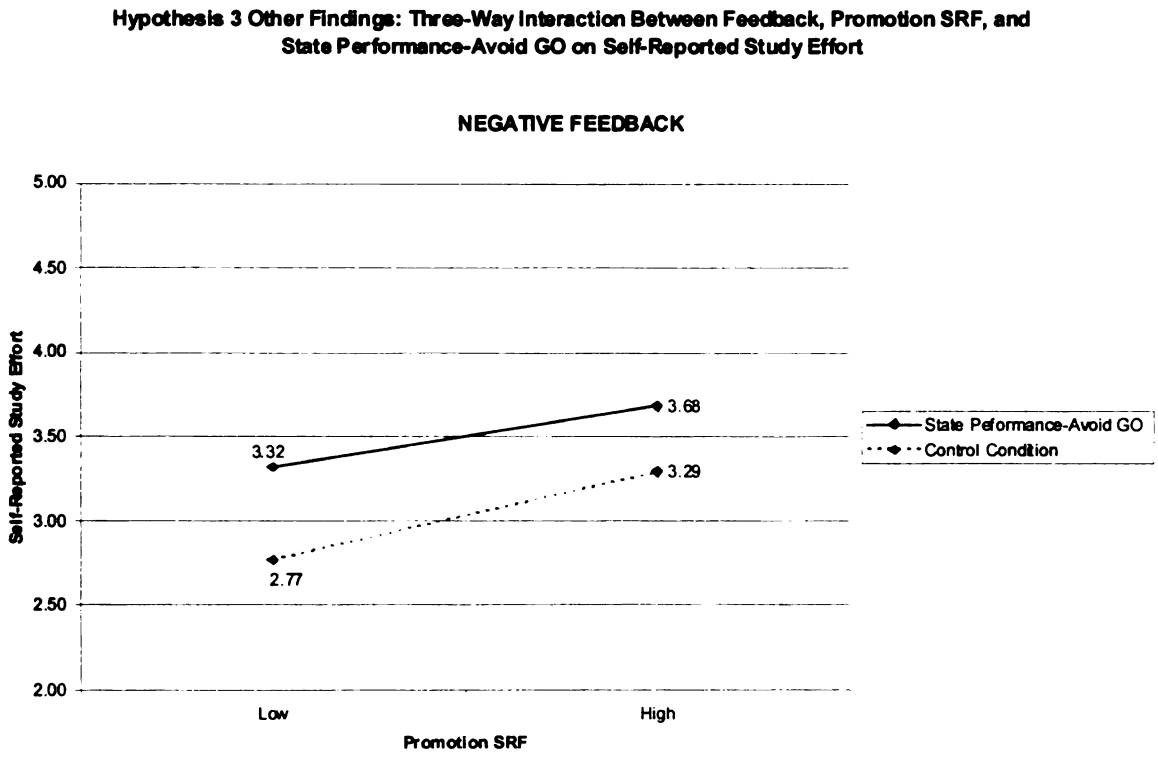
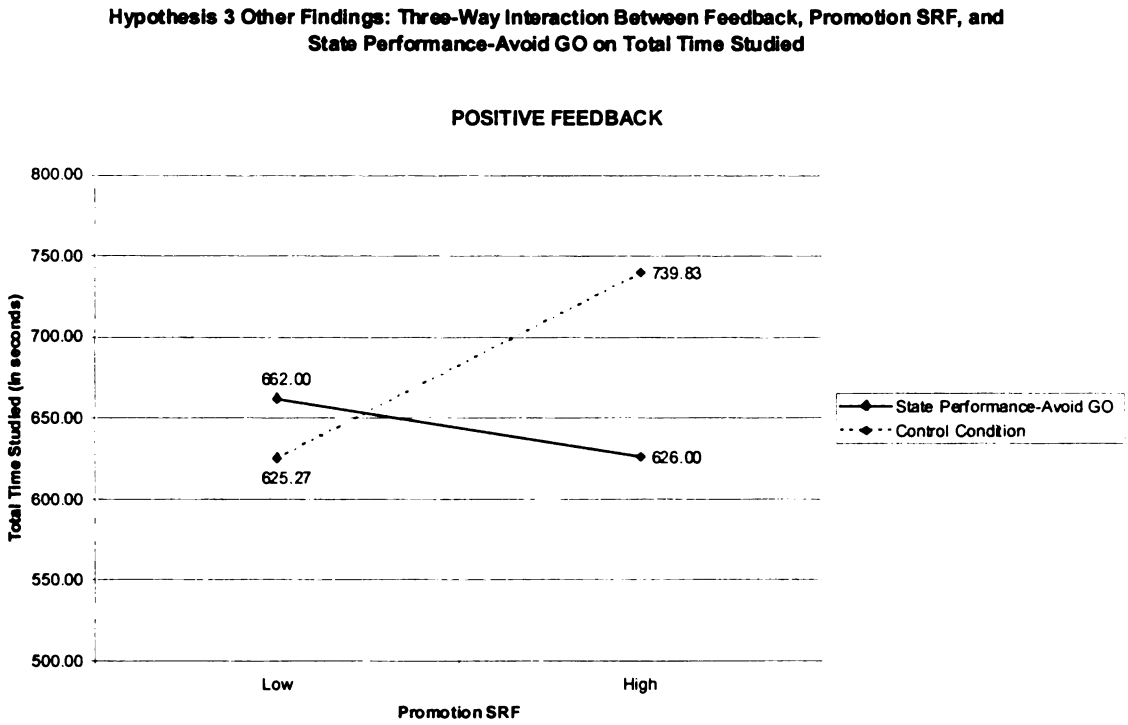


Figure 13. Three-way interaction found in Hypothesis 3 exploratory analyses.



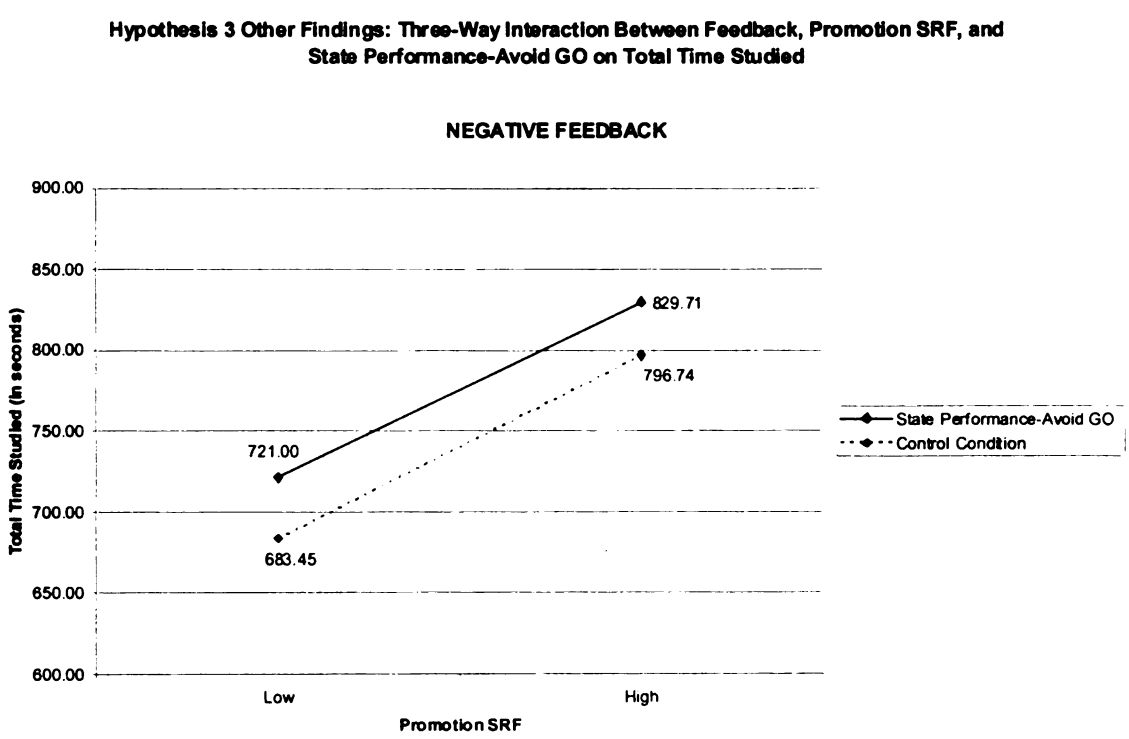


Figure 14. Three-way interaction found in Hypothesis 3 exploratory analyses.

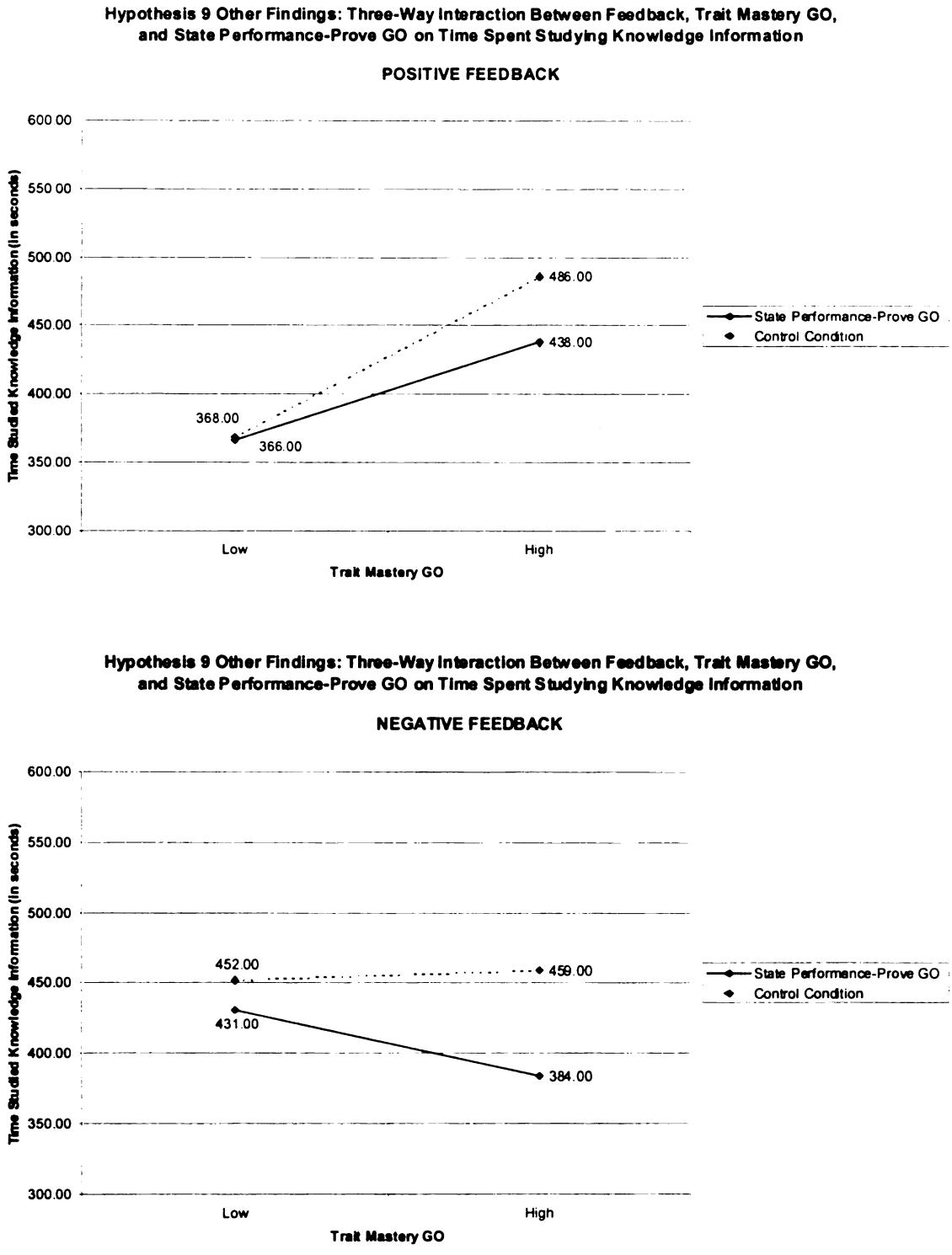


Figure 15. Three-way interaction found in Hypothesis 9 exploratory analyses.

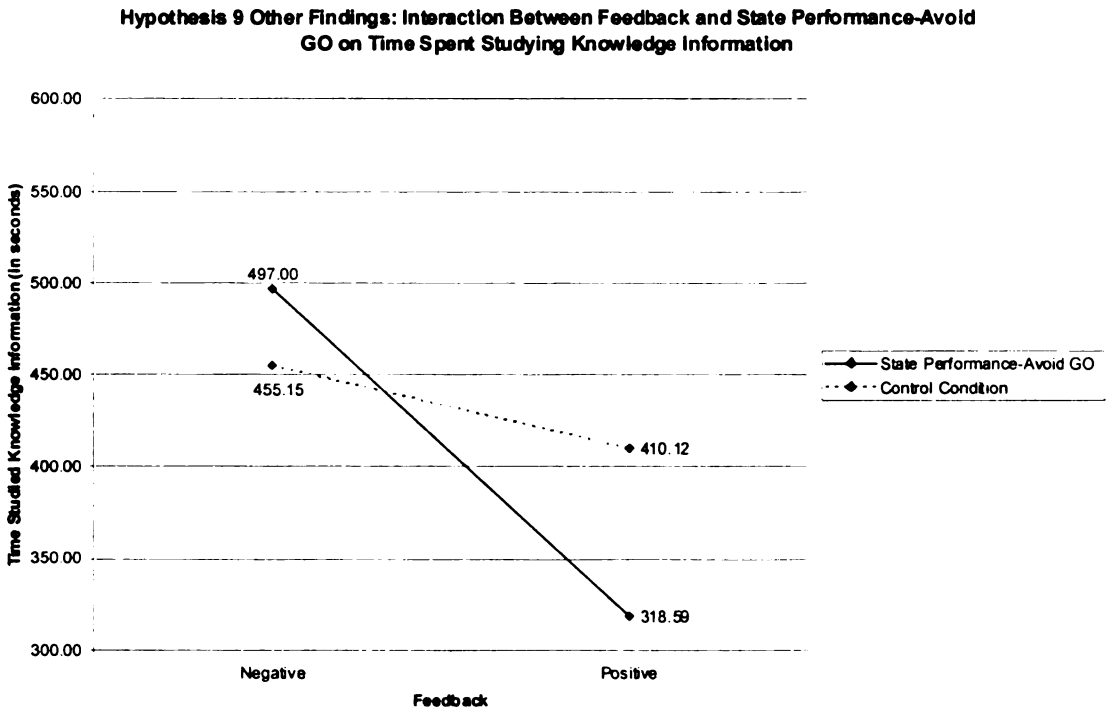


Figure 16. Two-way interaction found in Hypothesis 9 exploratory analyses.

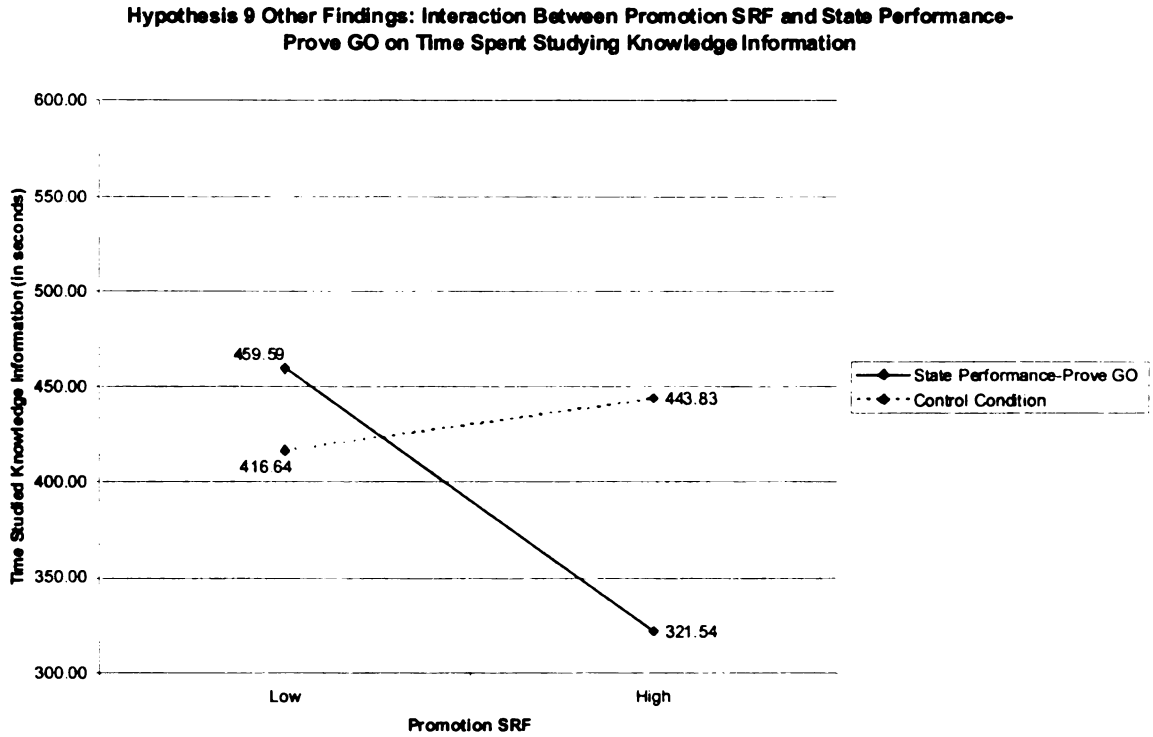


Figure 17. Two-way interaction found in Hypothesis 9 exploratory analyses.

Table 1

Summary of Study Hypotheses and Results

Hypothesis	Independent Variable(s)	Dependent Variable(s)	Result
Hypothesis 1a: Individuals with higher levels of performance-avoid GO will display higher levels of effort when they receive negative feedback and lower levels when they receive positive feedback.	Feedback Condition Trait Perf-Avoid GO State Perf-Avoid GO	Study Time Self-Report Effort	Not Supported
Hypothesis 1b: Individuals with higher levels of performance-prove GO will display higher levels of effort when they receive positive feedback and lower levels when they receive negative feedback.	Feedback Condition Trait Perf-Prove GO State Perf-Prove GO	Study Time Self-Report Effort	Not Supported
Hypothesis 2a: Measures of promotion SRF will be positively correlated with measures of mastery GO.	Promotion SRF	Trait Mastery Mastery Manip. Check	Supported
Hypothesis 2b: Measures of promotion SRF will be positively correlated with measures of performance-prove GO.	Prevention SRF	Trait Perf-Prove Perf-Prove Manip. Check	Partially Supported
Hypothesis 2c: Measures of prevention SRF will be positively correlated with measures of performance-avoid GO.	Prevention SRF	Trait Perf-Avoid Perf-Avoid Manip. Check	Partially Supported

Table 1 (continued)

Summary of Study Hypotheses and Results

Hypothesis	Independent Variable(s)	Dependent Variable(s)	Result
Hypothesis 3a: Individuals with higher levels of prevention SRF will display higher levels of effort when they receive negative feedback and lower levels when they receive positive feedback.	Feedback Condition Prevention SRF	Study Time Self-Report Effort	Not Supported
Hypothesis 3b: Individuals with higher levels of promotion SRF will display higher levels of effort when they receive positive feedback and lower levels when they receive negative feedback.	Feedback Condition Promotion SRF	Study Time Self-Report Effort	Not Supported
Hypothesis 4a: Individuals with higher levels of mastery GO will make attributions to more controllable causes in positive and negative feedback conditions.	Trait Mastery GO State Mastery GO	Outcome Controllability Development Controllability	Partially Supported
Hypothesis 4b: Individuals with higher levels of performance-prove GO will make attributions to more controllable causes in positive feedback conditions.	Feedback Condition Trait Perf-Prove GO State Perf-Prove GO	Outcome Controllability Development Controllability	Not Supported

Table 1 (continued)

Summary of Study Hypotheses and Results

Hypothesis	Independent Variable(s)	Dependent Variable(s)	Result
Hypothesis 5: As attributions are made to more controllable causes, the level of positive affect will be higher.	Controllability Outcome Control. Development Control.	Satisfaction Elation Depression Anxiety	Not Supported
Hypothesis 6: As attributions are made to more controllable causes, the level of effort will be higher.	Controllability Outcome Control. Development Control.	Study Time Self-Report Effort	Partially Supported
Hypothesis 7a: Individuals with higher levels of mastery GO will display higher levels of elation-type affect when feedback is positive, and higher levels of anxiety-type affect when feedback is negative.	Trait Mastery GO State Mastery GO	Elation Anxiety	Not Supported
Hypothesis 7b: Individuals with higher levels of performance-prove GO (and promotion SRF) will display higher levels of elation-type affect when feedback is positive, and higher levels of depression-type affect when feedback is negative.	Trait Perf-Prove GO State Perf-Prove GO Promotion SRF	Elation Depression	Not Supported
Hypothesis 7c: Individuals with higher levels of performance-avoid GO (and prevention SRF) will display higher levels of satisfaction-type affect when feedback is positive, and higher levels of anxiety-type affect when feedback is negative.	Trait Perf-Avoid GO State Perf-Avoid GO Prevention SRF	Satisfaction Anxiety	Not Supported

Table 1 (continued)

Summary of Study Hypotheses and Results

Hypothesis	Independent Variable(s)	Dependent Variable(s)	Result
Hypothesis 8: Arousal (elation/anxiety) will be positively correlated with effort.	Elation Anxiety	Study Time Self-Report Effort	Not Supported
Hypothesis 9a: Mastery GO will be positively correlated with the amount of effort invested in reviewing knowledge information.	Trait Mastery GO State Mastery GO	Time Studied (knowledge)	Not Supported
Hypothesis 9b: Performance-prove GO will be positively correlated with the amount of effort invested in reviewing test-taking heuristics.	Trait Perf-Prove GO State Perf-Prove GO	Time Studied (test tips)	Not Supported
Hypothesis 9c: Performance-avoid GO will be positively correlated with the amount of effort invested in reviewing test-taking heuristics.	Trait Perf-Avoid GO State Perf-Avoid GO	Time Studied (test tips)	Not Supported

Table 2

Means, Standard Deviations, Intercorrelations, and Reliabilities for Variables Included in the Analyses

Variable		Mean	SD	1	2	3	4	5	6	7	8
1. Cognitive Ability (ACT/SAT)		24/ 1161	3.58/ 172.14	--							
2. Feedback Condition		.54	.50	.57**	--						
	N			256							
3. Mastery Manip. (vs. All)[a]		.21	.41	-.02	-.03	--					
	N			256	300						
4. Mastery Manip. (vs. Control)[b]		.37	.48	-.04	-.10	1.00	--				
	N			145	172	172					
5. Prove Manip. (vs. All)[a]		.22	.41	-.01	-.08	-.27**	--	--			
	N			256	300	300					
6. Prove Manip. (vs. Control)[b]		.38	.49	-.01	-.15*	--	--	1.00**	--		
	N			147	173			300			
7. Avoid Manip. (vs. All)[a]		.21	.41	-.02	-.03	-.27**	--	-.27**	--	--	
	N			256	300	300		300			
8. Avoid Manip. (vs. Control)[b]		.37	.48	-.04	-.11	--	--	--	--	1.00*	--
	N			142	171					171	
9. Control Condition (vs. All)[a]		.36	.48	.03	.12*	-.39**	-1.00**	-.39**	-1.00**	-.39**	-1.00**
	N			256	300	300	172	300	173	300	171
10. Mastery (trait)		3.94	.56	.04	.02	.01	-.03	-.05	-.08	-.02	-.05
	N			256	300	300	172	300	173	300	171

*p<.05, **p<.01; [a]=These were the actual dummy codes used in the analysis, however, when shown in a correlation matrix they represent the difference between the mean of that group compared to the mean of all of the other groups combined (group=1, all other groups=0). [b]=These variables were not included in analysis, but when shown in a correlation matrix they represent difference between the mean of the group, and the mean of the control group (group=1, control group=0, and all other groups=missing data).

Table 2 (continued)

Means, Standard Deviations, Intercorrelations, and Reliabilities for Variables Included in the Analyses

Variable		Mean	SD	1	2	3	4	5	6	7	8
11. Prove (trait)		3.52	.58	.20**	.23*	.08	.04	-.06	-.09	-.07	-.09
	N			256	300	300	172	300	173	300	171
12. Avoid (trait)		2.73	.65	-.06	.08	.11*	.13	.00	.02	-.06	-.03
	N			256	300	300	172	300	173	300	171
13. Mastery Manip. Check		3.60	1.01	-.13*	-.16*	.03	.05	-.01	.01	.01	.03
	N			256	300	300	172	300	173	300	171
14. Prove Manip. Check		3.12	1.04	.10	.07	.00	.08	.10	.16*	.03	.10
	N			256	300	300	172	300	173	300	171
15. Avoid Manip. Check		3.14	1.11	.10	.09	.09	.15	.07	.13	-.04	.03
	N			256	300	300	172	300	173	300	171
16. Promotion SRF		3.92	.77	.10	.10	-.03	.00	.01	.03	.05	.07
	N			256	300	300	172	300	173	300	171
17. Prevention SRF		2.93	1.16	-.12	-.05	.08	.11	-.02	.02	.01	.05
	N			256	300	300	172	300	173	300	171
18. Controllability		3.81	.65	.10	.04	.04	.01	.01	-.01	-.09	-.10
	N			256	300	300	172	300	173	300	171
19. Outcome Controllability		3.65	.80	.20**	.09	-.06	-.08	.04	.01	-.04	-.07
	N			256	300	300	172	300	173	300	171

*p<.05, **p<.01

Table 2 (continued)

Means, Standard Deviations, Intercorrelations, and Reliabilities for Variables Included in the Analyses

Variable	Mean	SD	1	2	3	4	5	6	7	8
20. Development Controllability	3.97	.83	.00	-.03	.11*	.11	-.02	-.03	-.10	-.09
N			256	300	300	172	300	173	300	171
21. Satisfaction	3.29	.97	.03	--[c]	.06	.05	-.11	-.11	.03	.01
N			142		162	100	162	97	162	99
22. Elation	2.74	.97	.02	--[c]	-.02	-.03	-.08	-.09	.05	.03
N			142		162	100	162	97	162	99
23. Depression	2.97	1.13	.04	--[c]	.01	.16	.06	.21	.13	.27*
N			114		138	72	138	76	138	72
24. Anxiety	2.47	1.15	-.15	--[c]	.00	.13	.01	.14	.18*	.30*
N			114		138	72	138	76	138	72
25. Study Effort (self-report)	3.03	1.13	.00	-.17**	-.03	.03	.06	.11	.07	.13
N			256	300	300	172	300	173	300	171
26. Time Studied (total)	688.20	234.71	-.01	-.20**	-.07	-.07	.00	-.01	.05	.04
N			256	300	300	172	300	173	300	171
27. Time Studied (knowledge)	419.79	247.94	.02	-.12*	.03	.02	-.03	-.05	-.03	-.04
N			256	300	300	172	300	173	300	171
28. Time Studied (test tips)	268.42	200.67	-.04	-.09	-.12*	-.11	.04	.05	.10	.10
N			256	300	300	172	300	173	300	171

*p<.05, **p<.01; [c]=Affect measures were fixed by feedback level.

Note: Means and standard deviations for the time studied variables are in seconds.

Table 2 (continued)

Means, Standard Deviations, Intercorrelations, and Reliabilities for Variables Included in the Analyses

Variable		9	10	11	12	13	14	15	16	17	18
10. Mastery (trait)		.05	**.74**								
	N	300									
11. Prove (trait)		.05	.17**	**.60**							
	N	300	300								
12. Avoid (trait)		-.04	-.38**	.23**	**.71**						
	N	300	300	300							
13. Mastery Manip. Check		-.03	.20**	.05	-.13*	**.87**					
	N	300	300	300	300						
14. Prove Manip. Check		-.11	.08	.30**	.06	.42**	**.70**				
	N	300	300	300	300	300					
15. Avoid Manip. Check		-.11*	-.02	.28**	.23**	.37**	.71*	**.82**			
	N	300	300	300	300	300	300				
16. Promotion SRF(trait)		-.03	.17**	.01	-.06	.21**	.12*	.09	**.90**		
	N	300	300	300	300	300	300	300			
17. Prevention SRF(trait)		-.06	-.03	.09	.08	.10	.15*	.22**	-.18**	**.86**	
	N	300	300	300	300	300	300	300	300		
18. Controllability		.04	.21**	.21**	-.05	.31**	.19**	.10	.06	.04	**.70**
	N	300	300	300	300	300	300	300	300	300	

*p<.05, **p<.01

Note: Reliabilities are in bold.

Table 2 (continued)

Means, Standard Deviations, Intercorrelations, and Reliabilities for Variables Included in the Analyses

Variable		9	10	11	12	13	14	15	16	17	18
19. Outcome Controllability		.05	.16**	.25**	-.09	.18**	.21**	.10	.04	.03	.79**
	N	300	300	300	300	300	300	300	300	300	300
20. Development Controllability		.01	.18**	.10	.01	.31**	.10	.05	.06	.03	.80**
	N	300	300	300	300	300	300	300	300	300	300
21. Satisfaction		.02	.09	-.06	-.06	.04	-.01	-.10	.07	-.12	.04
	N	162	162	162	162	162	162	162	162	162	162
22. Elation		.03	.14	-.03	-.23**	.18*	.16*	.00	.13	-.08	.03
	N	162	162	162	162	162	162	162	162	162	162
23. Depression		-.20*	.04	.11	.18*	.26**	.41**	.42**	.25**	.24**	.13
	N	138	138	138	138	138	138	138	138	138	138
24. Anxiety		-.17*	-.02	-.02	.00	.20*	.17*	.29**	.17*	.18*	.14
	N	138	138	138	138	138	138	138	138	138	138
25. Study Effort (self-report)		-.09	.08	.01	-.07	.43**	.26**	.19**	.14*	.04	.19**
	N	300	300	300	300	300	300	300	300	300	300
26. Time Studied (total)		.01	.05	-.05	.04	.28**	.14*	.13	.10	.03	.04
	N	300	300	300	300	300	300	300	300	300	300
27. Time Studied (knowledge)		.02	.09	-.08	-.05	.27**	.05	.06	.05	.01	.01
	N	300	300	300	300	300	300	300	300	300	300
28. Time Studied (test tips)		-.01	-.05	.04	.10	-.02	.10	.07	.05	.02	.03
	N	300	300	300	300	300	300	300	300	300	300

*p<.05, **p<.01

Table 2 (continued)

Means, Standard Deviations, Intercorrelations, and Reliabilities for Variables Included in the Analyses

Variable		19	20	21	22	23	24	25	26	27
19. Outcome Controllability		**.78**								
20. Development Controllability		.26**	**.80**							
	N	300								
21. Satisfaction		.05	.01	**.85**						
	N	162	162							
22. Elation		.02	.03	.49**	**.91**					
	N	162	162	162						
23. Depression		.05	.15	--[c]	--[c]	**.92**				
	N	138	138							
24. Anxiety		.10	.13	--[c]	--[c]	.63**	**.89**			
	N	138	138			138				
25. Study Effort (self-report)		.09	.21**	-.02	.04	.29**	.09	**.77**		
	N	300	300	162	162	138	138			
26. Time Studied (total)		-.03	.08	-.04	.10	.30**	.12	.54**	--	
	N	300	300	162	162	138	138	300		
27. Time Studied (knowledge)		-.06	.07	-.01	.10	.16	.05	.35**	.66**	--
	N	300	300	162	162	138	138	300	300	
28. Time Studied (test tips)		.05	.00	-.03	-.01	.11	.06	.20**	.36**	-.47**
	N	300	300	162	162	138	138	300	300	300

*p<.05, **p<.01; [c]=These variables were not measured within the same feedback conditions, therefore correlations cannot be computed.

Note: Reliabilities are in bold.

Table 3

Hypotheses 1a-1b: Hierarchical Regression Results of the Impact of Feedback Condition, Trait GO, State GO, and Their Two-Way Interactions on Time Studied When Controlling for Cognitive Ability

Hyp	Variable	N	β	R^2	ΔR^2
	STEP 1:	256		.07*	
	Cognitive Ability (ACT/SAT Scores)		.16*		
	Feedback (1=positive, 0=negative)		-.28**		
	Trait Avoid		.16*		
	State Avoid (dummy coded vs. control)		.04		
	Trait Prove		-.03		
	State Prove (dummy coded vs. control)		-.06		
	Trait Mastery		.10		
	State Mastery (dummy coded vs. control)		-.10		
	STEP 2:	256		.13	.06
1a	Feedback x Trait Avoid		-.02		
1a	Feedback x State Avoid		-.02		
1b	Feedback x Trait Prove		-.14		
1b	Feedback x State Prove		-.05		
Other	Feedback x Trait Mastery		.26		
Other	Feedback x State Mastery		.03		
Other	Trait Avoid x State Avoid		-.16		
Other	Trait Avoid x State Prove		-.95*		
Other	Trait Avoid x State Mastery		.50		
Other	Trait Prove x State Avoid		-.31		
Other	Trait Prove x State Prove		-.15		
Other	Trait Prove x State Mastery		-.81		
Other	Trait Mastery x State Avoid		.25		
Other	Trait Mastery x State Prove		-1.23*		
Other	Trait Mastery x State Mastery		.20		

Note: β is the standardized regression coefficient associated with each step of the hierarchical regression. Increments for variables entered at the ΔR^2 significance levels are based on the F tests for that step. *p<.05, **p<.01

Table 4

Hypotheses 1a-1b: Hierarchical Regression Results of the Impact of Feedback Condition, Trait GO, State GO, and Their Two-Way Interactions on Self-Report Effort When Controlling for Cognitive Ability

Hyp	Variable	N	β	R^2	ΔR^2
	STEP 1:	256		.07*	
	Cognitive Ability (ACT/SAT Scores)		.14		
	Feedback (1=positive, 0=negative)		-.27**		
	Trait Avoid		.02		
	State Avoid (dummy coded vs. control)		.10		
	Trait Prove		.06		
	State Prove (dummy coded vs. control)		.05		
	Trait Mastery		.06		
	State Mastery (dummy coded vs. control)		-.02		
	STEP 2:	256		.14	.07
1a	Feedback x Trait Avoid		-.15		
1a	Feedback x State Avoid		-.19		
1b	Feedback x Trait Prove		-.25		
1b	Feedback x State Prove		-.04		
Other	Feedback x Trait Mastery		-.54		
Other	Feedback x State Mastery		-.02		
Other	Trait Avoid x State Avoid		-.39		
Other	Trait Avoid x State Prove		-.67		
Other	Trait Avoid x State Mastery		.14		
Other	Trait Prove x State Avoid		.74		
Other	Trait Prove x State Prove		.70		
Other	Trait Prove x State Mastery		-.27		
Other	Trait Mastery x State Avoid		.40		
Other	Trait Mastery x State Prove		-1.15*		
Other	Trait Mastery x State Mastery		.17		

Note: β is the standardized regression coefficient associated with each step of the hierarchical regression. Increments for variables entered at the ΔR^2 significance levels are based on the F tests for that step. *p<.05, **p<.01

Table 5

Hypotheses 3a-3b: Hierarchical Regression Results of the Impact of Feedback Condition, Self-Regulatory Focus, State GO, and Their Interactions on Time Studied When Controlling for Cognitive Ability

Hyp	Variable	N	β	R^2	ΔR^2
	STEP 1:	256		.07**	
	Cognitive Ability (ACT/SAT Scores)		.14		
	Feedback (1=positive, 0=negative)		-.27**		
	Prevention SRF		.06		
	Promotion SRF		.12		
	State Mastery (dummy coded vs. control)		-.09		
	State Prove (dummy coded vs. control)		-.05		
	State Avoid (dummy coded vs. control)		.02		
	STEP 2:	256		.14**	.08*
3a	Feedback x Prevention SRF		.02		
3b	Feedback x Promotion SRF		-.65		
Other	Feedback x State Mastery		.05		
Other	Feedback x State Prove		-.11		
Other	Feedback x State Avoid		-.08		
Other	Prevention SRF x State Mastery		.37		
Other	Prevention SRF x State Prove		-.03		
Other	Prevention SRF x State Avoid		.18		
Other	Promotion SRF x State Mastery		-1.16**		
Other	Promotion SRF x State Prove		-.80		
Other	Promotion SRF x State Avoid		-.23		
	STEP 3:	256		.17**	.03
Other	Feedback x Promotion SRF x State Mastery		-.67		
Other	Feedback x Promotion SRF x State Prove		-1.11		
Other	Feedback x Promotion SRF x State Avoid		-1.26*		

Note: β is the standardized regression coefficient associated with each step of the hierarchical regression. Increments for variables entered at the ΔR^2 significance levels are based on the F tests for that step. *p<.05, **p<.01

Table 6

Hypotheses 3a-3b: Hierarchical Regression Results of the Impact of Feedback Condition, Self-Regulatory Focus, State GO, and Their Interactions on Self-Report Effort When Controlling for Cognitive Ability

Hyp	Variable	N	β	R^2	ΔR^2
	STEP 1:	256		.10**	
	Cognitive Ability (ACT/SAT Scores)		.15*		
	Feedback (1=positive, 0=negative)		-.28**		
	Prevention SRF		.08		
	Promotion SRF		.20**		
	State Mastery (dummy coded vs. control)		-.03		
	State Prove (dummy coded vs. control)		.04		
	State Avoid (dummy coded vs. control)		.08		
	STEP 2:	256		.15**	.05
3a	Feedback x Prevention SRF		.09		
3b	Feedback x Promotion SRF		-.67		
Other	Feedback x State Mastery		-.01		
Other	Feedback x State Prove		-.05		
Other	Feedback x State Avoid		-.124		
Other	Promotion SRF x State Mastery		-.55		
Other	Promotion SRF x State Prove		.62		
Other	Promotion SRF x State Avoid		.09		
Other	Prevention SRF x State Mastery		.23		
Other	Prevention SRF x State Prove		.12		
Other	Prevention SRF x State Avoid		-.11		
	STEP 3:	256		.19**	.04
Other	Feedback x Promotion SRF x State Mastery		-.17		
Other	Feedback x Promotion SRF x State Prove		-.24		
Other	Feedback x Promotion SRF x State Avoid		-1.21*		

Note: β is the standardized regression coefficient associated with each step of the hierarchical regression. Increments for variables entered at the ΔR^2 significance levels are based on the F tests for that step. *p<.05, **p<.01

Table 7

Hypotheses 4a-4b: Hierarchical Regression Results of the Impact of Feedback Condition, Trait GO, State GO, and Their Two-Way Interactions on Outcome Controllability When Controlling for Cognitive Ability

Hyp	Variable	N	β	R^2	ΔR^2
	STEP 1:	256		.07**	
	Cognitive Ability (ACT/SAT Scores)		.16*		
	Feedback (1=positive, 0=negative)		-.03		
4a	Trait Mastery		.05		
4a	State Mastery (dummy coded vs. control)		-.05		
	Trait Prove		.21**		
	State Prove (dummy coded vs. control)		.03		
	Trait Avoid		-.13		
	State Avoid (dummy coded vs. control)		-.01		
	STEP 2:	256		.13**	.06
4b	Feedback x Trait Prove		.02		
4b	Feedback x State Prove		.04		
Other	Feedback x Trait Mastery		.19		
Other	Feedback x State Mastery		.06		
Other	Feedback x Trait Avoid		.57		
Other	Feedback x State Avoid		-.05		
Other	Trait Prove x State Prove		-.28		
Other	Trait Prove x State Mastery		.02		
Other	Trait Prove x State Avoid		.31		
Other	Trait Mastery x State Prove		-.28		
Other	Trait Mastery x State Mastery		.84		
Other	Trait Mastery x State Avoid		-.46		
Other	Trait Avoid x State Prove		.68		
Other	Trait Avoid x State Mastery		.56		
Other	Trait Avoid x State Avoid		-.01		
	STEP 3:	256		.15**	.02
Other	Feedback x Trait Prove x State Prove		.75		
Other	Feedback x Trait Prove x State Mastery		-.15		
Other	Feedback x Trait Prove x State Avoid		1.74*		

Note: β is the standardized regression coefficient associated with each step of the hierarchical regression. Increments for variables entered at the ΔR^2 significance levels are based on the F tests for that step. *p<.05, **p<.01

Table 8

Hypotheses 4a-4b: Hierarchical Regression Results of the Impact of Feedback Condition, Trait GO, State GO, and Their Two-Way Interactions on Development Controllability When Controlling for Cognitive Ability

Hyp	Variable	N	β	R^2	ΔR^2
	STEP 1:	256		.05	
	Cognitive Ability (ACT/SAT Scores)		.00		
	Feedback (1=positive, 0=negative)		-.04		
4a	Trait Mastery		.16*		
4a	State Mastery (dummy coded vs. control)		.09		
	Trait Prove		.07		
	State Prove (dummy coded vs. control)		-.02		
	Trait Avoid		.03		
	State Avoid (dummy coded vs. control)		-.05		
	STEP 2:	256		.17**	.12**
4b	Feedback x Trait Prove		-.46		
4b	Feedback x State Prove		-.22*		
Other	Feedback x Trait Mastery		-.35		
Other	Feedback x State Mastery		-.19		
Other	Feedback x Trait Avoid		.91**		
Other	Feedback x State Avoid		-.33**		
Other	Trait Prove x State Prove		-.86		
Other	Trait Prove x State Mastery		.66		
Other	Trait Prove x State Avoid		.37		
Other	Trait Mastery x State Prove		-.27		
Other	Trait Mastery x State Mastery		-.56		
Other	Trait Mastery x State Avoid		-.89		
Other	Trait Avoid x State Prove		.63		
Other	Trait Avoid x State Mastery		-.02		
Other	Trait Avoid x State Avoid		-.41		

Note: β is the standardized regression coefficient associated with each step of the hierarchical regression. Increments for variables entered at the ΔR^2 significance levels are based on the F tests for that step. *p<.05, **p<.01

Table 9

Hypotheses 9a: Hierarchical Regression Results of the Impact of Feedback Condition, Trait GO, State GO, and Their Two-Way Interactions on Time Spent Studying Knowledge Information When Controlling for Cognitive Ability

Hyp	Variable	N	β	R^2	ΔR^2
	STEP 1:	256		.04	
	Cognitive Ability (ACT/SAT Scores)		.15*		
	Feedback (1=positive, 0=negative)		-.22**		
9a	Trait Mastery		.09		
9a	State Mastery (dummy coded vs. control)		.01		
	Trait Prove		-.10		
	State Prove (dummy coded vs. control)		-.09		
	Trait Avoid		.07		
	State Avoid (dummy coded vs. control)		-.02		
	STEP 2:	256		.12	.07
Other	Feedback x Trait Mastery		.80		
Other	Feedback x State Mastery		.00		
Other	Feedback x Trait Prove		-.48		
Other	Feedback x State Prove		.02		
Other	Feedback x Trait Avoid		-.10		
Other	Feedback x State Avoid		-.18		
Other	Trait Mastery x State Mastery		-.50		
Other	Trait Mastery x State Prove		-1.23*		
Other	Trait Mastery x State Avoid		.25		
Other	Trait Prove x State Mastery		-.34		
Other	Trait Prove x State Prove		-.18		
Other	Trait Prove x State Avoid		-.38		
Other	Trait Avoid x State Mastery		.38		
Other	Trait Avoid x State Prove		-.34		
Other	Trait Avoid x State Avoid		.01		
	STEP 3:			.14	.02
Other	Feedback x Trait Mastery x State Mastery		-.27		
Other	Feedback x Trait Mastery x State Prove		-1.83*		
Other	Feedback x Trait Mastery x State Avoid		-.21		

Note: β is the standardized regression coefficient associated with each step of the hierarchical regression. Increments for variables entered at the ΔR^2 significance levels are based on the F tests for that step. *p<.05, **p<.01

Table 10

Hypotheses 9a: Hierarchical Regression Results of the Impact of Feedback Condition, Self-Regulatory Focus, State GO, and Their Two-Way Interactions on Time Spent Studying Knowledge Information When Controlling for Cognitive Ability

Hyp	Variable	N	β	R^2	ΔR^2
	STEP 1:	256		.04	
	Cognitive Ability (ACT/SAT Scores)		.15		
	Feedback (1=positive, 0=negative)		-.22**		
9a	Promotion SRF		.07		
	Prevention SRF		.04		
	State Mastery (dummy coded vs. control)		.01		
	State Prove (dummy coded vs. control)		-.09		
	State Avoid (dummy coded vs. control)		-.03		
	STEP 2:	256		.10	.06
Other	Feedback x Promotion SRF		-.04		
Other	Feedback x Prevention SRF		.00		
Other	Feedback x State Mastery		.01		
Other	Feedback x State Prove		.01		
Other	Feedback x State Avoid		-.23*		
Other	Promotion SRF x State Mastery		-.59		
Other	Promotion SRF x State Prove		-.97*		
Other	Promotion SRF x State Avoid		.29		
Other	Prevention SRF x State Mastery		.31		
Other	Prevention SRF x State Prove		.12		
Other	Prevention SRF x State Avoid		.24		

Note: β is the standardized regression coefficient associated with each step of the hierarchical regression. Increments for variables entered at the ΔR^2 significance levels are based on the F tests for that step. *p<.05, **p<.01

APPENDIX A

Informed Consent

The study in which you are about to participate investigates your performance on a simulated Graduate Record Examination (GRE) task. This task is a shortened version of the paper and pencil GRE. This experiment consists of three major stages. First, you will be asked to complete a brief (15 minute) test containing questions like those found on the GRE. You will be given feedback about how you performed on the test. Next, you will have an opportunity to study material intended to help you improve your performance. Finally, you will take a second test.

In addition to completing the above tasks, you will be asked some general questions about how you approach tasks and why you think you performed the way you did. You will also be asked to report some basic demographic information including your ACT or SAT scores. Your ACT or SAT scores may be verified against scores on file in the registrars office. All of your responses will be kept confidential and your privacy will be protected to maximum extent allowable by law, so we ask that you answer all of the questions carefully and honestly.

The entire experiment will take approximately one and a half hours. The top two performers on the second test will get $25 at the end of this semester. Incentive winners will be notified by e-mail. Please keep in mind that this simulation is NOT a real GRE. Also, please remember that your scores on these two tests are true for these tests only, and not indicative of how you would perform on the real GRE.

Participation in this study is voluntary. By clicking on "CONTINUE" below, you are indicating that you agree to participate in this study. You are also indicating that you were free to refuse to participate in this project or any part of the project. You may refuse to answer some of the questions and/or may discontinue your participation at any time without penalty by typing the keys "CTRL + F12."

If you have any concerns or questions about your participation in this project, or would like a copy of the results, you can contact Cori Davis at 517-355-2171 (daviscor@msu.edu) or Dan Ilgen at 517-355-7503 (ilgen@msu.edu).

If you have any questions or concerns regarding your rights and involvement in this research you may contact:

The University Committee on Research Involving Human Subjects (UCRIHS)
246 Administration Building, Michigan State University
East Lansing, MI 48824-1046
Phone: (517)355-2180 Fax: (517)353-2976
Email: UCRIHS@msu.edu Web Site: http/www.msu.edu/unit/vprgs/ucrihs

APPENDIX B

Introduction to the Study

Thank you for agreeing to participate in the GRE Experiment. During this experiment, you will be presented with various screens. Some have questions for you to answer, and others just contain information for you to read. You will need a pen/pencil and scratch paper for this study. Please keep the following instructions in mind:

1) You must answer every question before the computer will allow you to continue to the next screen. Also, if you make a mistake answering a question, finish answering the rest of the questions on that screen, and THEN go back to correct your answer. Please answer each question honestly.

2) Once you have hit "CONTINUE," you will not be able to go back to the previous screen.

3) You may use scratch paper during this study, however, please do not use a calculator.

4) Please do not talk, use other computer programs, do homework, or leave the room during this study unless instructed otherwise.

Now we would like to ask you some questions, please hit "CONTINUE."

APPENDIX C

Measures

Demographics

Please answer the following questions. We need information about who you are, so that we can keep track of you data and contact you if you win an award. Also, if you are a college freshman, please enter you high school GPA when prompted. Thanks.

1. Please enter your pilot login ID.

2. What is your gender?
   1 = Male
   2 = Female

3. What is your age?
   1 = less than 18
   2 = 18 - 19
   3 = 20 - 21
   4 = 22 - 23
   5 = greater than 23

4. What is your year in college?
   1 = First-Year
   2 = Sophomore
   3 = Junior
   4 = Senior
   5 = Other

5. What is your race?
   1 = African-American
   2 = Asian
   3 = Hispanic/Latino (Non-white)
   4 = White
   5 = Other

6. What is your major, or area of interest?

Demographics (continued)

7. What was your grade point average (GPA) as of the end of your last full semester in college (either at MSU or elsewhere)?
   1 = less than 2.50
   2 = 2.50 to 2.79
   3 = 2.80 to 3.19
   4 = 3.20 to 3.59
   5 = 3.60 or greater

8. What was your ACT or SAT total test score? If you took both exams, please enter your score on the ACT exam.

9. Have you taken or prepared for the Graduate Record Examination (GRE)?

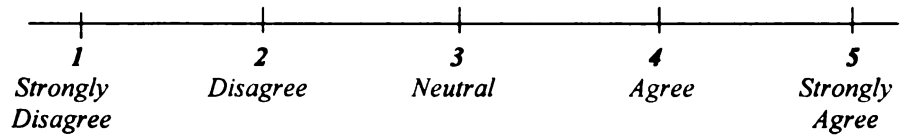
1 = Yes
2 = No

10. Have your participated in this study before?

1 = Yes
2 = No

Goal-Orientation Measure

Next, we need you to answer the following questions about yourself using the 5-point scale below.

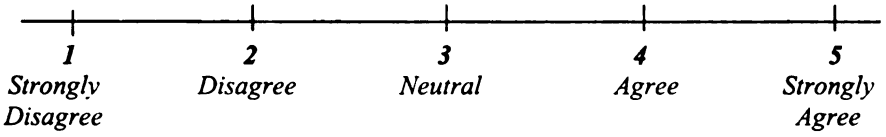


1. I prefer to work on projects where I can prove my abilities to others. (*prove*)
2. I often look for opportunities to develop new skills and knowledge. (*mastery*)
3. I'm concerned with showing that I can perform better than others. (*prove*)
4. I prefer to avoid situations where I might perform poorly. (*avoid*)
5. For me, development of my ability is important enough to take risks. (*mastery*)
6. Avoiding a show of low ability is more important to me than learning a new skill. (*avoid*)
7. I am willing to accept a challenging assignment that I can learn a lot from. (*mastery*)
8. I prefer to work in situations that require a high level of ability and talent. (*prove*)*
9. I would avoid taking on a new task if there was a chance that I would appear incompetent to others. (*avoid*)
10. I try to figure out what it takes to prove my ability to others. (*prove*)
11. I enjoy challenging and difficult tasks where I'll learn new skills. (*mastery*)
12. I'm concerned about taking on a task if my performance would reveal that I had low ability. (*avoid*)
13. I enjoy it when others at work are aware of how well I am doing. (*prove*)

*This item loaded with the mastery items in an exploratory factor analysis. However, for the purposes of this study it was kept as part of the prove scale in order to maintain consistency with other studies using this scale.

Self-Regulatory Focus Measure

We are interested in why you decided to take the psychology course(s) you are enrolled in. Please use the following scale to indicate your reasons for choosing this course.



1. It is a requirement for me. (*prevention*)
2. I thought it would be fun. (*promotion*)
3. I thought it would be interesting. (*promotion*)
4. I was told I should take it. (*prevention*)
5. I need it because it is a prerequisite for other classes. (*prevention*)
6. I thought it would be challenging. (*promotion*)*
7. I wanted to take this course. (*promotion*)
8. I thought it would be easy. (*prevention*)*
9. I had to take this course. (*prevention*)
10. I thought I would enjoy this course. (*promotion*)
11. I like psychology. (*promotion*)
12. I had to take a psychology course. (*prevention*)

*Dropped from the final analyses due to poor factor loading and/or internal consistency.

Selves Questionnaire

In the following three screens, you will be asked to list the attributes of the type of person you think you ACTUALLY, IDEALLY, and OUGHT to be. Please read and answer the following questions carefully.

Your ACTUAL attributes refer to the characteristics you believe you ACTUALLY possess. Please list 8 words that describe your ACTUAL attributes.

1)_____

2)_____

3)_____

4)_____

5)_____

6)_____

7)_____

8)_____

Selves Questionnaire (continued)

Your OUGHT attributes refer to the characteristics you believe you SHOULD or OUGHT to possess. These represent your normative rules or prescriptions for yourself. Please list 8 words that describe your OUGHT attributes. (It is okay to use words from the last screen if they apply here.)

1)_____

2)_____

3)_____

4)_____

5)_____

6)_____

7)_____

8)_____

Selves Questionnaire (continued)

Your IDEAL attributes refer to the characteristics you would IDEALLY like to possess. They represent the ultimate goals for yourself. Please list 8 words that describe your IDEAL attributes. (It is okay to use words from the last 2 screens if they apply here.)

1)_____

2)_____

3)_____

4)_____

5)_____

6)_____

7)_____

8)_____

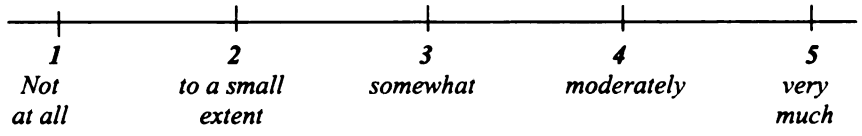
Affect Measure

The next two screens deal with how you feel about your performance on the first test.

If your score was ABOVE the 65th percentile...please put 1's in the blanks for the first screen (questions 1-12), and then answer questions on the second screen (questions 13-24) honestly.

If your score was BELOW the 65th percentile...please answer questions on the first screen (questions 1-12) honestly, and put 1's in the blanks for the second screen (questions 13-24).

A number of statements people have used to describe themselves are given below. Read each statement and fill in the appropriate box to the left of the statement to indicate how you feel about how you performed on the test. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer that seems to describe your feelings the best.



Negative feedback:

1. I feel agitated (*arousal*)*
2. I feel disappointed (*non-arousal*)
3. I feel frustrated (*non-arousal*)
4. I feel anxious (*arousal*)
5. I feel tense (*arousal*)
6. I feel on edge (*arousal*)
7. I feel disheartened (*non-arousal*)
8. I feel discontent (*non-arousal*)
9. I feel uneasy (*arousal*)*
10. I feel discouraged (*non-arousal*)
11. I feel stressed (*arousal*)
12. I feel dissatisfied (*non-arousal*)

Positive feedback:

13. I feel eager (*arousal*)
14. I feel cheerful (*arousal*)
15. I feel self-confident (*non-arousal*)*
16. I feel satisfied (*non-arousal*)*
17. I feel happy (*arousal*)
18. I feel excited (*arousal*)
19. I feel secure (*non-arousal*)
20. I feel calm (*non-arousal*)
21. I feel enthusiastic (*arousal*)
22. I feel delighted (*arousal*)
23. I feel relaxed (*non-arousal*)
24. I feel content (*non-arousal*)

*Dropped from the final analyses due to poor factor loading and/or internal consistency.

Causal Dimension Scale

The following questions are asking about the cause of your performance on this test. Please answer these questions on a scale of one to five:

1) Is the cause(s) something that reflects an aspect of: *(locus – reverse coded)*

YOURSELF	1	2	3	4	5	THE SITUATION

2) Is the cause(s) something that is: *(stability – reverse coded)*

PERMANENT	1	2	3	4	5	TEMPORARY

3) Is the cause(s) something that is: *(locus)*

OUTSIDE of you	1	2	3	4	5	INSIDE of you

4) Is the cause(s) something that is: *(stability)*

VARIABLE over time	1	2	3	4	5	STABLE over time

5) Is the cause(s) something about: *(locus – reverse coded)*

YOU	1	2	3	4	5	OTHER PEOPLE

6) Is the cause(s) something that is: *(stability)*

CHANGEABLE	1	2	3	4	5	UNCHANGING

7) Is the cause(s): *(controllability – reverse coded)*

CONTROLLABLE by you or other people	1	2	3	4	5	UNCONTROLLABLE by you or other people

8) Is the cause(s) something: *(controllability – reverse coded)*

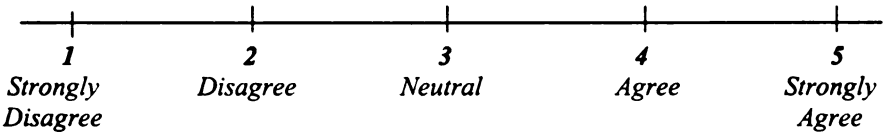
INTENDED by you or other people	1	2	3	4	5	UNINTENDED by you or other people

9) Is the cause(s) something for which: *(controllability)*

NO ONE is responsible	1	2	3	4	5	SOMEONE is responsible

Controllability Measure

Please answer the following questions using the 5-point scale below

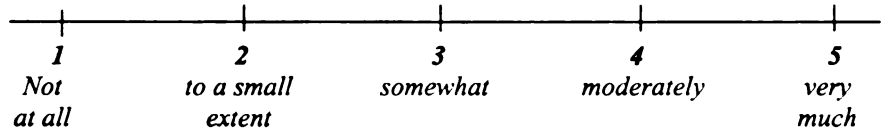


1. I can influence my score on the next test. (*outcome factor*)
2. I can do better on the next test. (*outcome factor*)
3. I typically don't do well on these kinds of tests. *(reverse coded)**
4. My score will be the same on the next test no matter what I do. *(reverse coded)**
5. Studying can improve my score. (*development factor*)
6. I can improve my score with practice. (*development factor*)

*Dropped from the final analyses due to poor factor loading and/or internal consistency.

Goal Orientation Manipulation Check

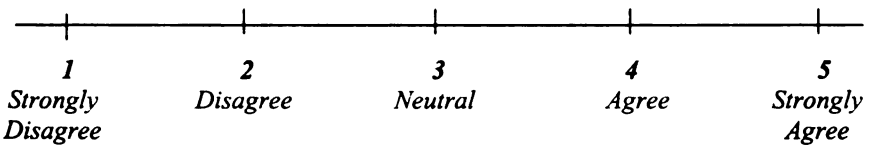
How important to you are the following things?



1. Getting a high score on Test 2 (*prove*)
2. Learning math and verbal information (*mastery*)
3. Doing as well as other students (*avoid*)
4. Improving verbal and math skills (*mastery*)
5. Not looking bad compared to others (*avoid*)
6. Scoring better than others on Test 2 (*prove*)

Motivation Questions

Please answer the following questions using the 5-point scale below.

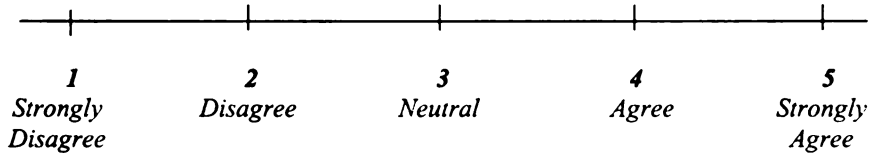


1. I was motivated to perform well on the second test by the chance to win money.
2. I wanted to perform well on the second test.
3. I tried to be one of the top performers on the second test.
4. I put forth my best effort when taking Test 1.
5. I put forth my best effort when taking Test 2.
6. If I would have been given more time to study, I would have studied longer.*
7. I put forth my best effort while studying.*

*These two items made up the self-report study effort scale.

Difference Between Screens and Score Believability Questions

Please answer the following questions using the 5-point scale below.



1. I could tell the difference between the types of information on the VERBAL KNOWLEDGE study screen and the VERBAL TEST TIPS study screen.
2. I could tell the difference between the types of information on the MATH KNOWLEDGE study screen and the MATH TEST TIPS study screen.
3. The verbal and math KNOWLEDGE screens were best for learning math and verbal information.
4. The verbal and math TEST TIPS screens were best for learning math and verbal information.
5. The verbal and math KNOWLEDGE screens were best for improving your score.
6. The verbal and math TEST TIPS screens were best for improving your score.
7. I think the score I received for TEST 1 accurately described my performance.
8. I believe the score I received for TEST 1 was correct.
9. My percentile score for TEST 1 (i.e., my score compared to others) was believable.
10. I think the score I received for TEST 2 accurately described my performance.
11. I believe the score I received for TEST 2 was correct.

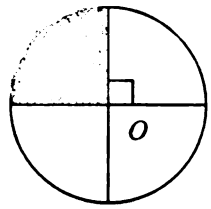
Performance Test 1

1.

Column A	Column B
$\frac{3 \cdot 3 \cdot 3}{6 \cdot 6 \cdot 6}$	$(1/2)^3$

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

2.



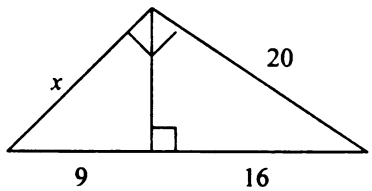
The circle has center O and radius 1.

Column A	Column B
The area of the shaded region	$\pi/2$

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are the same;
D. if the relationship cannot be determined from the information given.

3. DOOR:ROOM ::
A. rudder:anchor
B. boat:ship
C. patio:terrace
D. hatch:hold
E. basement:attic

4. CHOREOGRAPHY:DANCE ::
A. ceremony:sermon
B. agenda:advertisement
C. poetry:recitation
D. instrumentation:conductor
E. plot:story

5. 

What is the value of x in the figure above?

A. 12
B. 12.5
C. 15
D. $9\sqrt{3}$
E. 18

6. If the circumference of a circle is less than 10π, which of the following could be the area of the circle?

A. 20π
B. 25π
C. 36π
D. 81π
E. 100π

7. It is puzzling to observe that Jones's novel has recently been criticized for its ------- structure, since commentators have traditionally argued that its most obvious ------- is its relentlessly rigid, indeed schematic, framework.

A. attention to..preoccupation
B. speculation about..characteristic
C. parody of..disparity
D. violation of..contradiction
E. lack of..flaw

8. The painting was larger than it appeared to be, for, hanging in a darkened recess of the chapel, it was ------- by the perspective.

A. improved
B. aggrandized
C. embellished
D. jeopardized
E. diminished

9. A student has test scores of 85, x, and y, respectively, and an average (arithmetic mean) score of 95 on the three tests.

Column A	Column B
The average (arithmatic mean) of x and y	100

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

10. x and y are positive integers

$x > 1$

$y < 2$

Column A	Column B
x	2y

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal:
D. if the relationship cannot be determined from the information given.

11. POTTERY:SHARD ::
A. symphony:musician
B. bread:crumb
C. wall:brick
D. shoe:heel
E. building:architect

12. ENZYME:CATALYST ::
A. vaccine:allergy
B. bacterium:microbe
C. gland:muscle
D. vein:organ
E. neuron:corpuscle

13. If $3 < x < 8$ and $5 < y < 11$, which of the following represents all the possible values of xy?

A. $3 < xy < 11$
B. $8 < xy < 19$
C. $15 < xy < 88$
D. $24 < xy < 55$
E. $33 < xy < 40$

14. If $x \neq 0$, then $\frac{x+7}{7x} - \frac{1}{x} =$

A. $\frac{x+6}{6x}$
B. $\frac{x+6}{7x}$
C. $\frac{-6x+7}{7x}$
D. $\frac{1}{7}$
E. $-\frac{1}{7}$

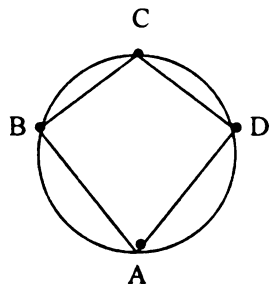
15. After thirty years of television, people have become "speed watchers"; consequently, if the camera lingers, the interest of the audience -------.

A. broadens
B. begins
C. varies
D. flags
E. clears

16. Biologists ------- isolated oceanic islands like the Galapagos, because in such small, laboratory-like settings, the rich hurly-burly of continental plant and animal communities is reduced to a scientifically ------- complexity.

A. explore..diverse
B. desert..manageable
C. exploit..intimidating
D. reject..intricate
E. prize..tactable

17.

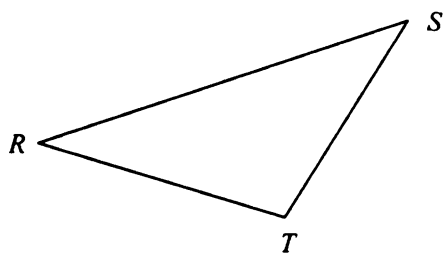


The diameter of the circle is 10.

Column A	Column B
The area of the region enclosed by quadrilateral ABCD	40

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

18.



Column A	Column B
ST + TR	RS

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

19. ABACUS:CALCULATE ::
A. organ:worship
B. patent:invent
C. calipers:regulate
D. manuscript:edit
E. sextant:navigate

20. ESCAPE:CAPTURE ::
    A. warn:danger
    B. immerse:dampness
    C. feint:thrust
    D. dodge:blow
    E. invest:bankruptcy

21. If the average (arithmetic mean) of two numbers is 20 and one of the numbers is x, what is the other number in terms of x?

    A. $40 - x$
    B. $40 - 2x$
    C. $20 + x$
    D. $20 - x$
    E. $20 - 2x$

22. If $x + y = n$, then $x^2 + 2xy + y^2 =$

    A. $2n$
    B. n^2
    C. $n(x - y)$
    D. $n^2 + 2y(n - y)$
    E. $n^2 + xn - x^2$

23. Crosby's colleagues have never learned, at least not in time to avoid embarrassing themselves, that her occasional -------air of befuddlement ------- a display of her formidable intelligence.

    A. genuine..dominates
    B. alert..contradicts
    C. acute..precludes
    D. bogus..presages
    E. painstaking..succeeds

24. That many of the important laws of science were discovered during experiments designed to ------- other phenomena suggests that experimental results are the ------- of inevitable natural forces rather than of planning.

    A. analyze..foundations
    B. disprove..predecessors
    C. alter..adjuncts
    D. illuminate..consequence
    E. verify..essence

25.

Column A	Column B
$4+2\sqrt{2}$	$2+4\sqrt{2}$

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

26.

$3x = 4y$

$xy \neq 0$

Column A	Column B
The ratio of x to y	The ratio of y to x

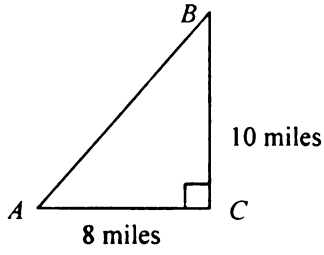
A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

27. MIMICRY:CAMOUFLAGE ::
A. photosynthesis:pollination
B. territoriality:migration
C. hibernation:generation
D. mutation:variation
E. digestion:rumination

28. WAFT:PLUMMET ::
A. skim:glide
B. dream:captivate
C. toss:catch
D. flail:assault
E. meander:dash

29. If $a+b=10$, then $(a+\frac{b}{2})+(b+\frac{a}{2})=$
A. 5
B. 10
C. 15
D. 20
E. 25

30.



According to the figure above, traveling directly from point A to point B, rather than from point A to point C and then from point C to point B, would save approximately how many miles?

A. 1
B. 2
C. 3
D. 4
E. 5

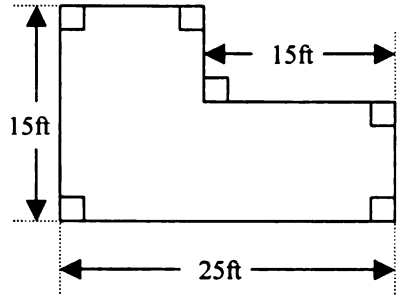
31. Compared mathematically to smoking and driving, almost everything else seems relatively risk-free, ------- almost nothing seems worth regulating.

A. yet
B. since
C. so
D. even though
E. as long as

32. It was not only the ------- of geologists that ------- earlier development of the revolutionary idea that the Earth's continents were moving plates; classical physicists, who could not then explain the mechanism, had declared continental movement impossible.

A. indecisiveness..challenged
B. radicalism..deterred
C. conservatism..hindered
D. assumptions..hastened
E. resistance..mandated

33.



The figure represents the floor of a certain room.

Column A	Column B
The area of the floor	350 square feet

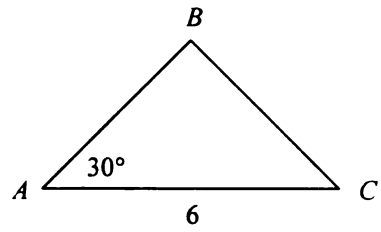
A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

34. If $3x + 1$ represents an odd integer, which of the following represents the next larger odd integer?

A. $3(x + 1)$
B. $3(x + 2)$
C. $3(x + 3)$
D. $3x + 2$
E. $3(x + 2) + 1$

Performance Test 2

1.



Column A	Column B
AB	*BC*

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

2. $750 < n < 1{,}500$

Column A	Column B
$1{,}500 - n$	$n - 750$

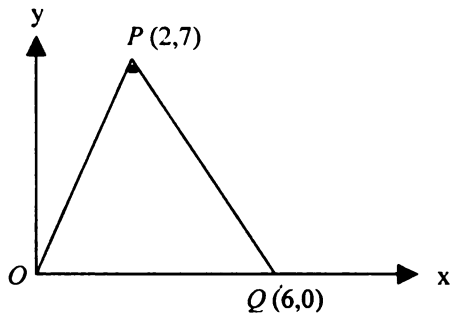
A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

3. HYMN:PRAISE ::
A. waltz:joy
B. liturgy:rite
C. lullaby:child
D. dirge:grief
E. prayer:congregation

4. STRAY:GROUP ::
A. miscalculate:solution
B. improvise:suggestion
C. slur:pronunciation
D. delete:change
E. digress:subject

5. If x can have only the values –3, 0, and 2, and y can have only the values –4, 2, and 3, what is the greatest possible value for $2x + y$?

A. 13
B. 15
C. 16
D. 20
E. 22

6. 

The area of ΔOPQ in the figure above is

A. 6
B. 12
C. 14
D. 21
E. 42

7. Politeness is not a ------- attribute of human behavior, but rather a central virtue, one whose very existence is increasingly being ------- by the faddish requirement to "speak one's mind."

A. superficial..threatened
B. pervasive..undercut
C. worthless..forestalled
D. precious..repudiated
E. trivial..affected

8. People frequently denigrate books about recent catastrophes as morally ------- attempts to profit from misfortune, but in my view our desire for such books, together with the venerable tradition to which they belong, ------- them.

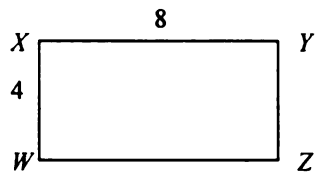
A. inopportune..encourages
B. fortuitous..fosters
C. treacherous..safeguards
D. despicable..legitimizes
E. corrupt..generates

9. On a turntable, a record of radius 6 inches is rotating at the rate of 45 revolutions per minute.

Column A	Column B
The number of inches traveled per minute by a point on the circumference of the record	The number of inches traveled per minute by a point on the record five inches from the center of the record

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

10.



Column A	Column B
The area of a square region with a perimeter equal to the perimeter of rectangular region *WXYZ*	36

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined with the information given.

11. LOGIC:REASONING ::
    A. sensitivity:morality
    B. arrogance:leadership
    C. ethics:behavior
    D. creativity:enthusiasm
    E. bravery:charisma

12. LIEN:CLAIM ::
    A. brief:investigation
    B. mortgage:interest
    C. foreclosure:pleading
    D. garnishment:presumption
    E. subpoena:command

13. If x is positive and y is 1 less than the square of x, which of the following expresses x in terms of y?

    A. $x = y^2 - 1$
    B. $x = y^2 + 1$
    C. $x = \sqrt{y} + 1$
    D. $x = \sqrt{1 - y}$
    E. $x = \sqrt{1 + y}$

14. $\frac{1}{\frac{1}{2}} + \frac{2}{\frac{2}{3}} + \frac{3}{\frac{3}{4}} =$

    A. $\frac{1}{9}$
    B. $\frac{13}{12}$
    C. $\frac{29}{12}$
    D. 8
    E. 9

15. Du Bois' foreign trips were the highlight, not the -------, of his travels; he was habitually on the go across and around the United States.

A. idiosyncrasy
B. result
C. precursor
D. culmination
E. totality

16. Nurturing the Royal Ballet's artistic growth while preserving its institutional stability has been difficult, because the claims of the latter seem inescapably to ------- development; apparently, attaining artistic success is simpler than ------- it.

A. ensure..promoting
B. inhibit..perpetuating
C. undermine..resurrecting
D. modify..appreciating
E. supplement..confining

17. Triangular regions T_1 and T_2 have equal areas and have heights h_1 and h_2, respectively.

Column A	Column B
The area of T_1 / h_1	The area of T_2 / h_2

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

18. $x^2y>0$
$xy^2<0$

Column A	Column B
X	y

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

19. TANGO:DANCE ::
    A. arabesque:theme
    B. tonality:instrumentation
    C. rhyme:pattern
    D. stanza:line
    E. elegy:poem

20. PLANT:SOIL ::
    A. germ:bacterica
    B. organism:medium
    C. sample:growth
    D. nutrient:liquid
    E. tree:root

21. On the number line, 1.4 is halfway between which of the following pairs of numbers?

    A. −1.4 and 2.4
    B. −1 and 2
    C. –0.3 and 3.1
    D. 0.15 and 1.55
    E. 0.4 and 1

22. What is the circumference of a circle with radius 8?

    A. $8/\pi$
    B. $16/\pi$
    C. 8π
    D. 16π
    E. 64π

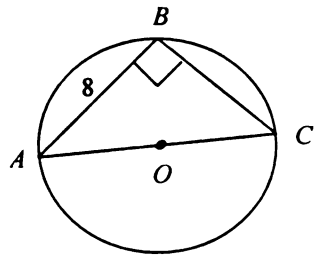
23. Prudery actually draws attention to the vice it is supposed to -------; the very act that forbids speech or prohibits sight ------- what is hidden.

    A. condemn..distorts
    B. monitor..signals
    C. repress..dramatizes
    D. obviate..fosters
    E. divulge..conceals

24. Although often extremely critical of the medical profession as a whole, people are rarely willing to treat their personal doctors with equal -------.

A. impetuosity
B. sarcasm
C. mockery
D. contempt
E. condescension

25.



The circle with center O has a radius of 5.

Column A	Column B
The perimeter of ΔABC	24

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

26.

Column A	Column B
$\dfrac{1}{4+\dfrac{1}{3+\dfrac{1}{2}}}$	$\dfrac{1}{2+\dfrac{1}{3+\dfrac{1}{4}}}$

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

27. FIDGET:NERVOUSNESS ::

A. cringe:dread
B. stall:frustration
C. regale:amusement
D. doubt:consternation
E. nag:annoyance

28. DORMANT:INACTIVITY ::

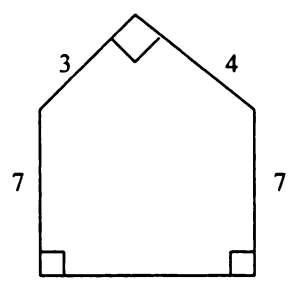
A. stark:ornateness
B. malleable:placticity
C. prone:uprightness
D. infuriating:tedium
E. slack:excess

29. If a and b are both positive even integers, which of the following must be even?

I. a^b
II. $(a + 1)^b$
III. $a^{(b + 1)}$

A. I only
B. II only
C. I and II only
D. I and III only
E. I, II, and III

30.



What is the perimeter of the pentagon above?

A. 21
B. 26
C. 28
D. 31
E. 41

31. Despite claims that his philosophy can be traced to ------- source, the philosophy in fact draws liberally on several traditions and methodologies and so could justifiably be termed -------.

A. a particular..consistent
B. a schematic..multifaceted
C. a dominant..cogent
D. an authoritative..derivative
E. a single..eclectic

32. The startling finding that variations in the rate of the Earth's rotation depend to an ____ degree on the weather has necessitated a complete ____ of the world's time-keeping methods.

A. unexpected..overhaul
B. anticipated..recalibration
C. indeterminate..rejection
D. unobservable..review
E. estimated..acceptance

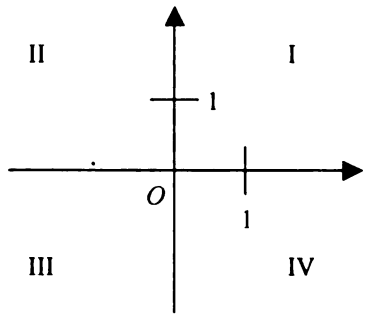
33.

$$\frac{\frac{1}{r}}{\frac{1}{t}} = \frac{3}{5}$$

Column A	Column B
$\frac{r}{t}$	$\frac{t}{r}$

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

34.



Points $(x,-3)$ and $(-2,y)$, not shown in the figure above, are in quadrants IV and II, respectively. If $xy \neq 0$, in which quadrant is point (x,y)?

A. **I**
B. II
C. III
D. IV
E. It cannot be determined from the information given.

APPENDIX D

Introduction to Test 1

In a few minutes, you will be taking the first test. Here is some general information about the test you are about to take.

1) You will have 15 minutes to answer as many questions as you can. The questions are taken from the verbal and quantitative (math) sections of past GRE exams.

2) There are two types of verbal questions: sentence completions and analogies. There are also two types of quantitative questions: problem solving and quantitative comparisons.

3) You are not expected to be familiar with the GRE, simply follow the instructions for answering each question. You are allowed to use scratch paper, however, PLEASE DO NOT USE CALCULATORS.

Before you begin the test, please review the following example questions. There are four examples, one for each type of question. Please click CONTINUE to see the example questions.

APPENDIX E

Example Test Questions

Sentence Completion Example Question

Directions: Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five lettered works or sets of words. Choose the word or set of words for each blank that best fits the meaning of the sentence as a whole.

Because it is -----to -----all the business costs related to employee discontent, an accurate estimate of the magnitude of these costs is not easily calculated.

A) difficult...measure
B) impossible...justify
C) improper...overlook
D) useless...discover
E) necessary...pinpoint

Answer to Sentence Completion Example Question

Because it is -----to -----all the business costs related to employee discontent, an accurate estimate of the magnitude of these costs is not easily calculated.

A) difficult...measure – ***the correct answer is A***
B) impossible...justify
C) improper...overlook
D) useless...discover
E) necessary...pinpoint

Analogies Example Question

Directions: In each of the following questions, a related pair of words or phrases is followed by five lettered pairs of words or phrases. Select the lettered pair that best expresses a relationship similar to that expressed in the original pair.

APPREHENSION:TERROR::
A) interest: conspiracy
B) affection: adoration
C) indifference: animosity
D) reluctance: termination
E) anxiety: faith

Answer to Analogies Example Question

APPREHENSION:TERROR::
F) interest: conspiracy
G) affection: adoration – ***the correct answer is B***
H) indifference: animosity
I) reluctance: termination
J) anxiety: faith

Quantitative Comparison Example Question

Directions: Each question consists of two quantities, one in Column A and one in Column B. You are to compare the two quantities and choose:

A. if the quantity in Column A is greater;
B. if the quantity in Column B is greater;
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

Note: Since there are only four choices, NEVER MARK "E"

Example:

Column A	Column B
$2\frac{1}{2}$ percent of 1,120	$2^2 \bullet 7$

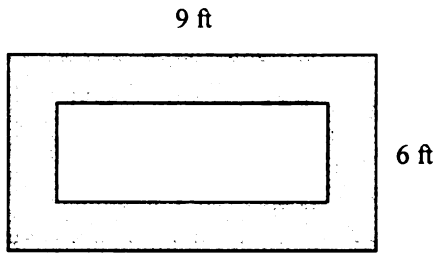
Answer to Quantitative Comparison Example Question

Column A	Column B
$2\frac{1}{2}$ percent of 1,120	$2^2 \bullet 7$

- the correct answer is C

Problem Solving Example Question

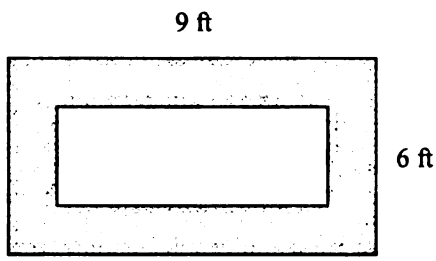
Directions: The following question has five answer choices. Select the best of the answer choices given.



The rectangular rug shown in the figure above has a floral border 1 foot wide on all sides. What is the area, in square feet, of that portion of the rug that excludes the border?

A) 28
B) 40
C) 45
D) 48
E) 53

Answer to Problem Solving Example Question



The rectangular rug shown in the figure above has a floral border 1 foot wide on all sides. What is the area, in square feet, of that portion of the rug that excludes the border?

F) 28 – ***the correct answer is A***
G) 40
H) 45
I) 48
J) 53

APPENDIX F

Test 1 Feedback Message

Positive feedback

Compared with scores from people who have answered these questions on past GRE exams, your score is: ABOVE THE 80th PERCENTILE.

Negative feedback

Compared with scores from people who have answered these questions on past GRE exams, your score is: BELOW THE 50th PERCENTILE.

APPENDIX G

Goal Orientation Manipulation 1

Mastery Manipulation 1

IMPORTANT !!! IMPORTANT !!! IMPORTANT !!!

Your score reflects your knowledge of math and verbal concepts. Your goal in this study should be to LEARN information in order to IMPROVE YOUR MATH AND VERBAL SKILLS. Your score is provided as a gauge for you to measure subsequent learning. Your score should not be used to compare your performance to others'.

Performance-Prove Manipulation 1

IMPORTANT!!! IMPORTANT!!! IMPORTANT !!!

Your score reflects your performance relative to others'. Your goal in this study should be to SCORE BETTER THAN THE OTHER STUDENTS by getting the HIGHEST SCORE you can. Using your performance on Test 1 as a gauge, focus on maximizing your score on Test 2.

Performance-Avoid Manipulation 1

IMPORTANT !!! IMPORTANT !!! IMPORTANT !!!

Your score reflects your performance relative to others'. Your goal in this study should be to score AT LEAST AS WELL AS OTHER STUDENTS participating in this experiment (at the 65^{th} percentile). Using your performance on Test 1 as a gauge, focus on scoring AT LEAST IN THE 65^{th} PERCENTILE on Test 2.

APPENDIX H

Study Task Instructions

Now that you have received feedback about how you performed, you will be given an opportunity to study before taking another test. You will have 15 minutes to study:

*For the first 5 minutes, you will have the option to study different types of information. You can study verbal and math KNOWLEDGE material, or verbal and math TEST TAKING TIPS. KNOWLEDGE screens contain information about word definitions and math rules commonly used in the GRE. TEST TAKING TIPS screens contain information about the types of test questions found in the GRE.

*After the first 5 minutes, a screen will pop-up letting you know that you have 10 minutes left. At that point, you will have two more options in addition to studying. One new option will be to read information on Ethics in Psychology. Another new option will be watch a timer that counts down the minutes to Test 2. If you chose the timer option, you are welcome to surf the internet. HOWEVER, PLEASE KEEP YOUR EYE ON THE TIMER so that you are aware when your time is up...and you can continue with the experiment at the proper time. PLEASE DO NOT ACCESS THE INTERNET UNLESS YOU HAVE CHOSEN THE TIMER OPTION!

APPENDIX I

Goal Orientation Manipulation 2

Mastery Manipulation 2

IMPORTANT !!! IMPORTANT !!! IMPORTANT !!!

Remember that your goal in this study is to LEARN. Studying math and verbal information can help you accomplish this goal. During the study time, focus on information that will help you further DEVELOP YOUR MATH AND VERBAL SKILLS.

You now have 15 minutes to study for the next test. Remember, you must study for at least the first 5 minutes. Then, during the last 10 minutes, you will have the option of studying, reading about Ethics in Psychology, or watching the timer and surfing the net.

Performance-Prove Manipulation 2

IMPORTANT!!! IMPORTANT!!! IMPORTANT !!!

Remember that your goal in this study is to get the HIGHEST SCORE. Studying math and verbal information can help you accomplish this goal. During the study time, focus on information that will help you PERFORM BETTER THAN OTHER STUDENTS and get the highest score on Test 2.

You now have 15 minutes to study for the next test. Remember, you must study for at least the first 5 minutes. Then, during the last 10 minutes, you will have the option of studying, reading about Ethics in Psychology, or watching the timer and surfing the net.

Performance-Avoid Manipulation 2

IMPORTANT !!! IMPORTANT !!! IMPORTANT !!!

Remember that your goal in this study is to PERFORM AT LEAST IN THE 65th PERCENTILE. Studying math and verbal information can help you accomplish this goal. During the study time, focus on information that will help you PERFORM AT LEAST AS WELL AS OTHER STUDENTS.

You now have 15 minutes to study for the next test. Remember, you must study for at least the first 5 minutes. Then, during the last 10 minutes, you will have the option of studying, reading about Ethics in Psychology, or watching the timer and surfing the net.

APPENDIX J

Study Task

Verbal Knowledge Information

The VERBAL KNOWLEDGE screens contain definitions of the types of words likely to be found on the GRE.

The following categories of words commonly found on the GRE. The general meaning of the words in each list are in ALL CAPS.

DIFFICULT TO UNDERSTAND
Abstruse
Arcane
Enigmatic
Esoteric
Inscrutable
Obscure
Opaque
Rarefied
Recondite
Turbid

CRITICIZE/CRITICISM
Aspersion
Belittle
Berate
Calumny
Castigate
Diatribe
Tirade

DEBAUCHED/DEBAUCHERY
Depraved
Dissipated
Salacious
Sordid
Turpitude

FUNERAL/DEATH
Bereave

FALSEHOOD
Chicanery
Dirge
Dissemble
Equivocate
Feint
Feigned
Guile

BITING (AS IN WIT OR TEMPERAMENT)
Caustic

PRAISE
Aggrandize
Eulogize
Fawn
Laud/Laudatory
Venerate/Veneration

HARMFUL/TO HARM
Baneful
Perfidious
Jeopardize

TIMID
Diffident
Trepidation

BORING
Banal
Hackneyed
Mundane
Tedium
Trite

RENDER USELESS/WEAKEN
Envervate
Inhibit
Obviate

OVERBLOWN/WORDY
Bombastic
Garrulous
Loquacious
Verbose

IMPULSIVE
Impetuous
Rash

HOSTILE
Malevolent
Misanthropic
Vindictive

STUBBORN
Obdurate
Obstinate
Vexing

GENEROUS/KIND
Altruistic
Magnanimous
Philanthropic

GREEDY
Avaricious
Miserly
Penurious

TERSE
Laconic
Tactiturn

LAZY/SLUGGISH
Indolent
Languid
Lethargic
Phlegmatic
Quiescent
Slothful

PACIFY
Mitigate
Placate
Propitiate

POOR
Destitute
Disingenuous
Dissemble
Indigent

ECCENTRIC/DISSIMILAR
Anomalous
Eclectic
Iconoclast
Radicalism

BACK OUT, OFF
Abate
Abjure
Recant
Rescind

HIGHEST POINT
Climax
Culmination

BEGINNING
Engender
Indigenous
Nascent

LAW
Codicil
Culpable
Exculpate
Litigation

POLITICS & GOVERNMENT
Abdicate
Anarchy
Bourgeois
Matriarchy
Oligarchy

The following is a list of words and definitions commonly used in GRE questions.

Abase (v): cast down, bring low, humble, degrade, disgrace. abassare (to lower)

Abash (v): dismay, confound, disconcert, discomfit, make ashamed. esbahir (to make ashamed)

Abdicate (v): renounce, abandon or relinquish a position, right, power, or trust. ab (from, away) + dicare (to proclaim)

Aberration (n): wandering, straying from the right way; deviation, esp. from what is

right, normal or natural; mental disorder. ab (from, away) + errare (wander)

Acumen (n): acuteness of mind, judgment, sagacity, perspicacity, shrewdness, discernment

Admonish (v): (a) warn, caution, reprove, rebuke, reprimand
(b) inform or remind by way of a warning
(c) advise, exhort. ad (to) + monere (to warn)

Baleful (adj): sinister, harmful, evil, calamitous, deadly, pernicious, destructive. bealu (an evil), from balw (evil) + full

Bane (n): that which causes death, destruction; the cause of injury, mischief or destruction. bana (murderer)

Beneficient (adj): bringing about or doing acts of kindness or charity; resulting in benefit; charitable, munificent, kindly. bene (well) + facere (to do)

Bombast (n): high-sounding but silly or meaningless language; pomposity, grandiloquence; an inflated style; fustian. From bombasium, a cotton doublet (orig. meaning = cotton stuffing, padding)

Cacophony (n): jarring or disagreeable combination of sounds, words, tones, or musical notes; any harsh, jarring sound; discord. kakos (bad) + phone (voice)

Cajole (v): flatter, coax, persuade, wheedle, deceive by flattery. cajoler (to coax)

Chicanery (n): trickery, especially legal; deceit, guile, unfair artifice used in contest or discussion.

Condescension (n): a patronizing manner or behavior

Consternation (n): great fear or shock that makes one feel helpless or bewildered

Divulge (v): to make known; disclose; reveal

Fortuitous (adj): accidental, by chance. fortis (chance)

Immerge (v): to plunge or disappear, as in a liquid

Meander (v): wander aimlessly, ramble, peregrinate.

Perpetuate (v): make perpetual, preserve, cause to endure, save from oblivion.

Repudiate (v): reject or disown as having no validity

Below is a list of word roots. Learning these can help you to determine the meaning of words you are unfamiliar with.

ABLE, IBLE: CAPABLE OF, WORTHY OF. changeable, durable, laudable, indubitable, inevitable, infallible, irreducible, tolerable, variable.

AD, A: TO. adapt, adequate, adumbrate, advocate, accede, adduce, affiliate, aggregate, allocate, annunciation, appall, arrest, assiduous, attract.

ANTI, ANT: AGAINST, OPPOSITE. anticlimax, antidote, antipathy, antiphony, antipodes, antithesis, antagonism.

AUTO, AUT: SELF. autobiography, autocracy, autograph, automation, autonomous, autopsy, autism.

BEL, BELL: BEAUTIFUL. belle, embellish.

CO, COM, CON: WITH, TOGETHER. coeducation, coefficient, coincide, communicate, communist, compare, concert, concubine, conflict, cooperate, correspond.

CONTRA, CONTRO, COUNTER: AGAINST. contradict, contrary, controversy, counter, counteract, counterattack, counterfeit, countermand, counterpart, counterpoint, encounter.

CULP: FAULT, BLAME. culpable, culprit, inculpate, exculpate.

DI, DIS: AWAY, APART. disagreeable, discard, discern, disdain, dismay, dismiss, distant, diverge.

E, EX, EC: OUT. eliminate, emanate, eradicate, erase, evade, evict, evince, exact, excavate, except, excerpt, excise, excite, exclusive, excommunicate, exile, exit.

FUG: FLEE. centrifuge, fugitive, fugue, refuge, refugee, subterfuge.

GEN: BIRTH, CLASS, KIN. gender, gene, general, generation, generosity, genesis, genetics, genial, genital, genius, gentle, gentile, gentility, gentry, congenital, degenerate, engender, eugenics, ingenious, ingenuity, ingenuous, progeny, progenitor, regenerate.

HEMI: HALF. hemiptera, hemisphere, hemistich

IM, IN: NOT. immature, immutable, imperfect, improvident, indigestible, inhospitable, innocuous, intolerant.

IN, IM, I: IN, ON. (often N is dropped and the first letter to which I is prefixed is doubled) illuminate, incantation, induct, infer, imbibe, immigrate, impact, irrigate.

JUNCT, JUG: JOIN. adjunct, conjugal, conjunction, injunction, junction, junta, subjugate, subjunctive.

LUX, LUC: LIGHT. elucidate, lucid, lucubrate, luster, pellucid, translucent.

MAL: BAD. maladroit, malady, malediction, malefactor, malevolence, malice, malinger.

MUT: CHANGE. commute, immutable, mutability, mutation, mutual, permutation, transmute.

OMNI: ALL. omnibus, omnipresent, omnipotent, omniscient, omnivorous.

ONER: BURDEN. exonerate, onerous, onus.

POST: BEHIND, AFTER. posterior, posterity, postern, posthumous, postmeridian, post-mortem, postpone.

RE: BACK, AGAIN. recline, refer, regain, remain, reorganize, repent, request.

SEX: SIX. sextuplets, sextile, sextet

SOPH: WISDOM. philosopher, sophism, sophist, sophisticated, sophistry, sophomore.

TACIT: SILENT. reticent, tacit, taciturn.

UN: NOT. unaccustomed, unruly, unseen, untold, unusual.

Verbal Test Tips Information

The verbal TEST TIPS screens contain information about the types of GRE verbal questions.

SENTENCE COMPLETIONS

Make sure you memorize the instructions for sentence completions:

Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five lettered words or sets of words. Choose the word or set of words for each blank that best fits the meaning of the sentence as a whole.

Here are some strategies for answering sentence completions:

- Read the sentence strategically, using you knowledge of scope and structure to see where the sentence is heading.
- In your own words, anticipate the answer.
- Look for answers close in meaning to yours. (Eliminate tempting wrong answers using the clues.)
- Read your choice back into the sentence to be sure it fits.

There are elements in the sentence that limit the possible answers. Finding these elements will guide you to the correct answer. Here are some important "roadsigns" to look for:

"Straight Ahead" signs are used to make one part of the sentence support or elaborate another part.

A. The winning argument was ------- *and* persuasive. (cogent, flawed)

and	thus	since
similarly	because	consequently
in addition	likewise	also
therefore		

"Detour" signs change the direction of the sentence.

B. The winning argument was ------- but persuasive. (cogent, flawed)

but	despite	unless
yet	however	rather
although	while	unfortunately
nonetheless		

On the GRE, a semicolon by itself always connects two closely related clauses.

C. The play's script lacked depth and maturity; likewise, the acting was altogether ------. (sublime, amateurish)

In two-blank sentences, look for the roadsigns for each blank. Notice that sometimes the second blank is easier to work with.

5. Unfortunately, there are some among us who equate tolerance with immorality; they feel that the ------- of moral values in a permissive society is not only likely, but -------.

A. decline...possible
B. upsurge...predictable
C. disappearance...desirable
D. improvement...commendable
E. deterioration...inevitable

TECHNIQUES FOR THE HARDEST QUESTIONS

- For the hardest problems, always rephrase the sentence in your own terms to get the gist.
- Eliminate any choice in which one word doesn't fit the sentence.
- Eliminate any choice in which words don't fit with each other.

STRATEGIES FOR ANALOGIES

Make sure you memorize the instructions for analogies:

In each of the following questions, a related pair of words or phrases is followed by five lettered pairs of words or phrases. Select the lettered pair that best expresses a relationship similar to that expressed in the original pair.

Every Analogy question consists of two words which are separated by a colon. Below them are five answer choices.

There will always be a logical and necessary relationship between the words in the stem pair. You express this relationship by making a short sentence called the bridge. Always try to make a bridge before looking at the answer choices.

STRONG AND WEAK BRIDGES

A weak bridge expresses a relationship that isn't necessary or direct. Some signs of weak bridges are: "usually," "can," "seldom," or "sometimes."

Weak bridges:

A. Some MAPS are put in ATLASES.
B. A MAP is usually smaller than an ATLAS.
C. MAPS and ATLASES have to do with geography.
D. A MAP is a page in an ATLAS.

A strong bridge expresses a logical and necessary relationship.

The sign of a strong bridge: It contains (or can contain) a definite word like "always," "never," or "must."

The best bridge is a strong bridge that fits exactly one answer choice.

Strong bridges:

E. MAPS are what an ATLAS contains.
F. MAPS are the unit of reference in an ATLAS.
G. An ATLAS is an organized collection of MAPS.

Never fall for Same Subject Analogies-pairs of words that are not related to each other, but only to a third word.

Same-subject Analogies:

H. Necklace : Bracelet
I. Temperature : Humidity
J. Relay : Marathon

THE FOUR-STEP SOLUTION TO ANALOGIES

1. Find a strong bridge between the stem words.
2. Plug the answer choices into the bridge
3. Adjust the bridge as necessary
4. If stuck, make bridges out of the answer choices and work backwards.

Eliminate choices with weak bridges, or two choices that have the same bridge.

Look at the answer choices to determine the parts of speech.

Try matching positive or negative connotations in the stem words with those in the answer choices.

Even when you don't know all the words, elimination and intelligent guessing will earn you more points.

FIVE CLASSIC BRIDGES

ETS uses some kinds of bridges over and over on the GRE. You don't have to memorize these, but exposing yourself to them will give you a feel for the sort of bridge that will get you the right answer.

1. Definition ("is always" or "is never")

13. PLATITUDE : TRITE ::
    A. riddle : unsolvable
    B. axiom : geometric
    C. omen : portentous
    D. syllogism : wise
    E. canard : concise

2. Function / Purpose

14. AIRPLANE : HANGAR ::
    A. music : orchestra
    B. money : vault
    C. finger : hand
    D. tree : farm
    E. insect : ecosystem

3. Lack

15. LUCID : OBSCURITY ::
    A. ambiguous : doubt
    B. provident : planning

C. furtive : legality
D. economical : extravagance
E. secure : violence

4. Degree (sometimes to the point of excess)

16. ATTENTIVE : RAPT ::
A. loyal : unscrupulous
B. critical : derisive
C. inventive : innovative
D. jealous : envious
E. kind : considerate

5. Characteristic Actions / Items

17. SCALPEL : SURGEON ::
A. palette : artist
B. stage : dancer
C. dictionary : poet
D. lock : burglar
E. chisel : sculptor

Math Knowledge Information

The MATH KNOWLEDGE screens contain information about the types of math rules likely to be needed for answering GRE questions.

NUMBER OPERATIONS

I. ORDER OF OPERATIONS

PEMDAS = Please Excuse My Dear Aunt Sally – this mnemonic will help you remember the order of operations

P = Parentheses
E = Exponents
M = Multiplication (in order from left to right)
D = Division (in order from left to right)
A = Addition (in order from left to right)
S = Subtraction (in order from left to right)

II. FRACTIONS

- Canceling and Reducing Fractions

  Generally speaking, when you work with fractions on the GRE, you'll need to put them in lowest terms. That means that the numerator and the denominator are not divisible by any common integer greater than 1. For example, the fraction $\frac{1}{2}$ is in lowest terms, but the fraction $\frac{3}{6}$ is not, since 3 and six are both divisible by 3. The method we use to take such a fraction and put it in lowest terms is called reducing. That simply means to divide out any common multiples from both the numerator and denominator. This process is also commonly called canceling.

  Ex: Reduce $\frac{15}{35}$ to lowest terms.

  First, determine the largest common factor of the numerator and denominator. Then, divide the top and bottom by that number to reduce.

  $$\frac{15}{35}=\frac{3\times5}{7\times5}=\frac{3\times5\div5}{7\times5\div5}=\frac{3}{7}$$

- Multiplication of Fractions

  Ex: $\frac{10}{9}\times\frac{3}{4}\times\frac{8}{15}$

  First, reduce (cancel) diagonally and vertically. $\frac{{}^{2}\cancel{10}}{{}_{3}\cancel{9}}\times\frac{{}^{1}\cancel{3}}{{}_{1}\cancel{4}}\times\frac{\cancel{8}^{2}}{\cancel{15}_{3}}$

Then multiply numerators together and denominators together.

$$\frac{2\times1\times2}{3\times1\times3}=\frac{4}{9}$$

- Division of Fractions

Dividing is the same as multiplying by the reciprocal of the divisor. To get the reciprocal of a fraction, just invert it by interchanging the numerator and the denominator. For example, the reciprocal of the fraction $\frac{3}{7}$ is $\frac{7}{3}$.

Ex: $\frac{4}{3}\div\frac{4}{9}$

To divide, invert the second term (the divisor), and then multiply as above.

$$\frac{4}{3}\div\frac{4}{9}=\frac{4}{3}\times\frac{9}{4}=\frac{{}^{1}\cancel{4}}{{}_{1}\cancel{3}}\times\frac{\cancel{9}^{3}}{\cancel{4}_{1}}=\frac{1\times3}{1\times1}=3$$

- Mixed Numbers

Mixed Numbers are numbers consisting of an integer and a fraction. For example, $3\frac{1}{4}$, $12\frac{2}{5}$ and $5\frac{7}{8}$ are all mixed numbers. Fractions whose numerators are greater than their denominators may be converted into mixed numbers, and vice-versa.

Ex: Convert $\frac{23}{4}$ to a mixed number.

$$\frac{23}{4}=\frac{20}{4}+\frac{3}{4}=5\frac{3}{4}$$

Ex: Convert $2\frac{3}{7}$ to a fraction.

$$2\frac{3}{7}=2+\frac{3}{7}=\frac{14}{7}+\frac{3}{7}=\frac{17}{7}$$

III. POWERS AND ROOTS

In the term $3x^2$, 3 is the coefficient, x is the base, and 2 is the exponent. The exponent refers to the number of times the base is multiplied by itself, or how many times the base is a factor. For instance, in 4^3, there are 3 factors of 4: $4^3 = 4 \bullet 4 \bullet 4 = 64$.

A number multiplied by itself twice is called the square of that number, e.g. x^2 is x squared.
A number multiplied by itself three times is called the cube of that number, e.g. 4^3 is 4 cubed.

To multiply two terms with the same base, keep the base and add the exponents.

Ex: $2^2 \bullet 2^3 = (2 \bullet 2)(2 \bullet 2 \bullet 2)$ or $2^2 \bullet 2^3 = 2^{2+3}$

$= (2 \bullet 2 \bullet 2 \bullet 2 \bullet 2)$ $= 2^5$

$= 2^5$

Ex: $x^4 \bullet x^7 = x^{4+7} = x^{11}$

To divide two terms with the same base, keep the base and subtract the exponent of the denominator from the exponent of the numerator.

Ex: $4^4 \div 4^2 = \frac{4 \bullet 4 \bullet 4 \bullet 4}{4 \bullet 4}$ or $4^4 \div 4^2 = 4^{4-2}$

$= \frac{4 \bullet 4}{1}$ $=4^2$

$= 4^2$

Ex: If $p \neq 0$, $\frac{p^3}{p^2} = p^{3-2} = p^1 = p$

To raise a power to another power, multiply the exponents.

Ex: $(3^2)^4 = (3 \bullet 3)^4$ or $(3^2)^4 = 3^{2 \times 4}$

$= (3 \bullet 3)(3 \bullet 3)(3 \bullet 3)(3 \bullet 3)$ $= 3^8$

$= 3^8$

Any non zero number raised to the zero power is equal to 1. $a^0 = 1$, if $a \neq 0$. 0^0 is undefined.

A negative exponent indicates a reciprocal. To arrive at an equivalent expression, take the reciprocal of the base and change the sign of the exponent.

$a^{-n} = \frac{1}{a^n}$ or $(\frac{1}{a})^n$

Ex: $2^{-3} = (\frac{1}{2})^3 = \frac{1}{2^3} = \frac{1}{8}$

A fractional exponent indicates a root.

$(a)^{\frac{1}{n}} = \sqrt[n]{a}$ (read "the nth root of a." If no "n" is present, the radical sign means square root.)

Ex: $8^{\frac{1}{3}} = \sqrt[3]{8} = 2$

On the GRE, you will probably only see the square root. The square root of a non-negative number x is equal to the number which when multiplied by itself gives you x. Every positive number has two square roots, one positive and one negative. The positive square root of 25 is 5; and the negative square root of 25 is –5, since $(-5)^2 = 25$ also.

Other types of roots have appeared on the test (cube root, or $\sqrt[3]{\ }$, is an example), but they tend to be extremely rare.

Note: In the expression $3x^2$, only the x is being squared, not the 3. In other words, $3x^2 = 3(x^2)$. If we wanted to square the 3 as well, we would write $(3x)^2$. (Remember in the order of operations we raise to a power before we multiply, so in $3x^2$ we square x and then multiply by 3.)

IV. RULES OF OPERATIONS WITH ROOTS

By convention, the symbol $\sqrt{\ }$ (radical) means the positive square root only.

Ex: $\sqrt{9} = +3; -\sqrt{9} = -3$

Even though there are two different numbers whose square is 9 (both 3 and –3) we say that $\sqrt{9}$ is the positive number 3 only.

When it comes to the four basic arithmetic operations, we treat radicals in much the same way we would treat variables.

- Addition and Subtraction of Roots

  Only like radicals can be added to or subtracted from one another.

  Ex: $2\sqrt{3} + 4\sqrt{2} - \sqrt{2} - 3\sqrt{3} = (4\sqrt{2} - \sqrt{2}) + (2\sqrt{3} - 3\sqrt{3})$ [Note: $\sqrt{2} = 1\sqrt{2}$

  $= 3\sqrt{2} + (-\sqrt{3})$

  $= 3\sqrt{2} - \sqrt{3}$

- Multiplication and Division of Roots

  To multiply or divide one radical by another, multiply or divide the numbers outside the radical signs, then the numbers inside the radical signs.

  Ex: $(6\sqrt{3}) \times (2\sqrt{5}) = (6 \times 2) \bullet (\sqrt{3} \times \sqrt{5}) = 12\sqrt{3 \times 5} = 12\sqrt{15}$

  Ex: $12\sqrt{15} \div 2\sqrt{5} = (12 \div 2) \bullet (\sqrt{15} \div \sqrt{5}) = 6(\sqrt{\frac{15}{5}}) = 6\sqrt{3}$

  Ex: $\frac{4\sqrt{18}}{2\sqrt{6}} = (\frac{4}{2})(\frac{\sqrt{18}}{\sqrt{6}}) = 2(\sqrt{\frac{18}{6}}) = 2\sqrt{3}$

  If the number inside the radical is a multiple of a perfect square, the expression can be simplified by factoring out the perfect square.

  Ex: $\sqrt{72} = \sqrt{36 \times 2} = \sqrt{36} \times \sqrt{2} = 6\sqrt{2}$

V. BASIC ALGEBRA

OPERATIONS WITH POLYNOMIALS

All of the laws of arithmetic operations, such as the associative, distributive, and commutative laws, are also applicable to polynomials.

- Communitative Law

$2x+5y=5y+2x$

$5a\times 3b=3b\times 5a=15ab$

- Associative Law

$2x-3x+5y+2y=(2x-3x)+(5y+2y)=-x+7y$

$(-2x)(\frac{1}{2}x)(3y)(-2y)=(-x^2)(-6y^2)=6x^2y^2$

- Both Laws

$2x+3x^2-6x+4x^2=2x-6x+3x^2+4x^2$ (commutative law)

$=(2x-6x)+(3x^2+4x^2)$ (associative law)

$=-4x+7x^2$

Note: This process of simplifying an expression by subtracting or adding together those terms with the same variable component is called combining like terms.

- Distributive Law

$3a(2b-5c)=(3a\times 2b)-(3a\times 5c)=6ab-15ac$

Note: The product of two binomials can be calculated by applying the distributive law twice.

Ex: $(x+5)(x-2)=x\bullet(x-2)+5\bullet(x-2)$

$=x\bullet x-x\bullet 2+5\bullet x-5\bullet 2$

$=x^2-2x+5x-10$

$=x^2+3x-10$

LINEAR EQUATIONS

An equation is an algebraic sentence that says that two expressions are equal to each other. The two expressions consist of numbers, variables, and arithmetic operations to be performed on these numbers and variables. To solve for some variable we can

manipulate the equation until we have isolated that variable on one side of the equal sign, leaving any numbers or other variables on the other side. Of course, we must be careful to manipulate the equation only in accordance with the equality postulate: whenever we perform an operation on one side of the equation we must perform the same operation on the other side. Otherwise, the two sides of the equation will no longer be equal.

A linear or first-degree equation is an equation in which all the variables are raised to the first power (there are no squares or cubes). In order to solve such an equation, we'll perform operations on both sides of the equation in order to get the variable we're solving for all alone on one side. The operations we can perform without upsetting the balance of the equation, are addition and subtraction, and multiplication or division by a number other than 0. Typically, at each step in the process, we'll need to use the reverse of the operation that's being applied to the variable in order to isolate the variable. In the equation $n + 6 = 10$, 6 is being added to n on the left side. To isolate the n, we'll need to perform the reverse operation, that is, to subtract 6 from both sides. That gives us $n + 6 - 6 = 10 - 6$, or $n = 4$.

Let's look at another example.

Ex: If $4x - 7 = 2x + 5$, what is x?

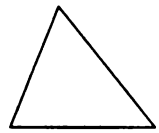
1. Get all the terms with the variable on one side of the equation. Combine the terms.	$4x - 7 = 2x + 5$ $4x - 2x - 7 = 2x - 2x + 5$ $2x - 7 = 5$
2. Get all constant terms on the other side of the equation.	$2x - 7 + 7 = 5 + 7$ $2x = 12$
3. Isolate the variable by dividing both sides by its coefficient.	$\frac{2x}{2} = \frac{12}{2}$ $x = 6$

We can easily check our work when solving this kind of equation. The answer we arrive at represents the value for the variable in the original equation. If the equation holds true, we've found the correct answer. In the above example, we got a value of 6 for x. Replacing x with 6 in our original equation gives us $4(6) - 7 = 2(6) + 5$, or $17 = 17$. That's clearly true, so our answer is indeed correct.

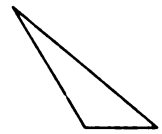
TRIANGLES

GENERAL TRIANGLES

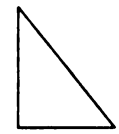
A triangle is a closed figure with three angles and three straight sides. An acute triangle is a triangle with three acute angles. An obtuse triangle is a triangle with an obtuse angle. A right triangle is a triangle with a right angle. In a right triangle, we call the side opposite the right angle the hypotenuse and the other two sides the legs.



Acute



Obtuse

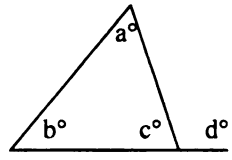


Right

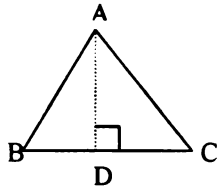
THE SUM OF THE INTERIOR ANGLES
OF ANY TRIANGLE IS 180 DEGREES.

Each interior angle is supplementary to an adjacent exterior angle. The degree measure of an exterior angle is equal to the sum of the measures of the two non-adjacent (remote) interior angles, or 180° minus the measure of the interior angle.

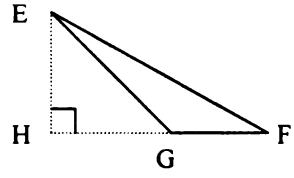
In the figure below, *a*, *b*, and *c* are interior angles. Therefore $a + b + c = 180$. In addition, *d* is supplementary to *c*; therefore $d + c = 180$. And since *d* is an exterior angle, it is equal to the sum of the two remote interior angles: *a* and *b*.



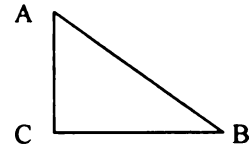
The altitude (or height) of a triangle is the perpendicular distance from a vertex to the side opposite the vertex. The altitude can fall inside the triangle, outside the triangle, or on one of the sides.



Altitude=*AD*
Altitude=*AC*



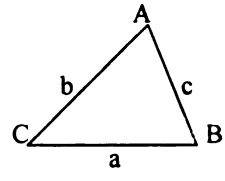
Altitude=*EH*



- Sides and Angles of Triangles

  The length of any side of a triangle is less than the sum of the lengths of the other two sides, and greater than the difference of the lengths of the other two sides.

b+c>a>b-c
a+b>c>a-b
a+c>b>a-c



If the lengths of two sides of a triangle are unequal, the greater angle lies opposite the longer side and vice versa. In the figure above, if $\angle A > \angle B > \angle C$, then $a > b > c$.

- Area of a Triangle

  The area of a triangle is
  $\frac{1}{2}$ base × height.

  Remember that the height (or altitude) is perpendicular to the base. Therefore, when two sides of a triangle are perpendicular to each other, the area is easy to find. In a right triangle, we call one leg the base and the other leg the height. Then the area is one half the product of the legs, or

  $$A = \frac{1}{2}bh$$
  $$= \frac{1}{2}l_1 \times l_2$$

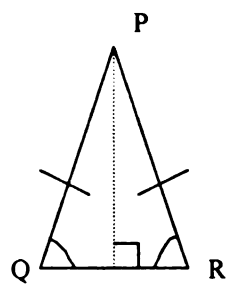
- Perimeter of a Triangle

  The perimeter of a triangle is the distance around the triangle. In other words, the perimeter is equal to the sum of the lengths of the sides.

- Isosceles Triangles

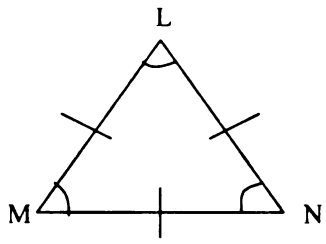
  An isosceles triangle is a triangle that has two sides of equal length. The two equal sides are called legs and the third side is called the base.

  Since the two legs have the same length, the two angles opposite the legs must have the same measure. In the figure at right, $PQ = PR$, and $\angle Q = \angle R$.



- Equilateral Triangles

An equilateral triangle has three sides of equal length and three 60° angles.



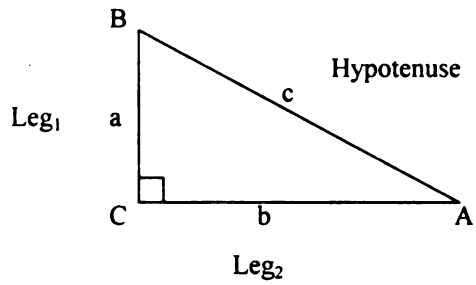
LM=MN=LN

$\angle L = \angle M = \angle N = 60°$

- Right Triangles

As we stated in the previous section, the longest side (which lies opposite the right angle, the largest angle) of a right triangle is called the hypotenuse. The other two sides are called the legs.

PYTHAGOREAN THEOREM



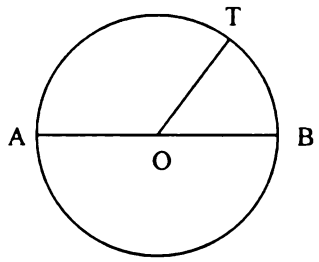
$(\text{Leg}_1)^2 + (\text{Leg}_2)^2 = (\text{Hypotenuse})^2$ or $a^2 + b^2 = c^2$

The Pythagorean theorem holds for all right triangles, and states that the square of the hypotenuse is equal to the sum of the squares for the legs.

Some sets of integers happen to stisfy the Pythagorean theorem. These sets of integers are commonly referred to as "Pythagorean triplets." One very common set that you might remember is 3, 4, and 5. Since $3^2 + 4^2 = 5^2$, you can have a right triangle with legs of lengths 3 and 4, and hypotenuse of length 5. This is probably the most common kind of right triangle on the GRE. You should be familiar with the numbers, so that whenever you see a right triangle with legs of 3 and 4, you will immediately know the hypotenuse must have length 5. In addition, any multiple of these lengths makes another Pythagorean triplet; for instance, $6^2 + 8^2 = 10^2$, so 6, 8, and 10 also make a right triangle. One other triplet that appears occasionally is 5, 12, and 13.

The Pythagorean theorem is very useful whenever you're given the lengths of two sides of a right triangle; you can find the length of the third side with the Pythagorean theorem.

CIRCLES



CIRCLE
The set of all points in a plane at the same distance from a certain point. This point is called the center of the circle.

A circle is labeled by its center point: circle O means the circle with center point O. Two circles of different size with the same center are called concentric.

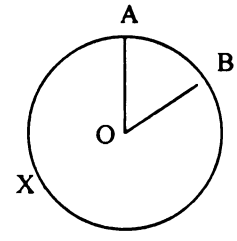
DIAMETER
A line segment that connects two points on the circle and passes through the center of the circle. In circle O, AB is a diameter.

RADIUS
A line segment from the center of the circle to any point on the circle. The radius of a circle is one-half the length of the diameter. In circle O, OA, OB, and OT are radii.

CIRCUMFERENCE AND ARC LENGTH
The distance around a circle is called the circumference. The number π ("pi") is the ratio of a circle's circumference to it's diameter. The value of π is 3.1415926..., usually approximated 3.14. For the GRE, it is usually sufficient to remember that π is a little more than 3.

Since π equals the ratio of the circumference to the diameter, a formula for the circumference is

$$C = \pi d$$
or
$$C = 2\pi r$$



An arc is a portion of the circumference of a circle. In the figure to the right, AB is an arc of the circle, with the same degree measure as central angle AOB. The shorter distance

between A and B along the circle is called the minor arc; the longer distance AXB is the major arc. An arc which is exactly half the circumference of the circle is called a semicircle (in other words, half a circle).

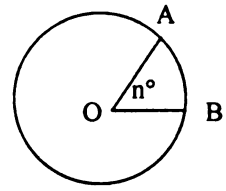
The length of an arc is the same fraction of a circle's circumference as its degree measure is of the degree measure of the circle (360°). For an arc with a central angle measuring n degrees,

$$\text{Arc length} = \left(\frac{n}{360}\right)(circumference)$$
$$= \frac{n}{360} \times 2\pi r$$

AREA OF A CIRCLE

The area of a circle is given by the formula

$$\text{Area} = \pi r^2$$



A sector is a portion of the circle, bounded by two radii and an arc. In the circle to the right with center O, OAB is a sector. To determine the area of a sector of a circle, use the same method we used to find the length of an arc. Determine what fraction of 360° is in the degree measure of the central angle of the sector, and multiply that fraction by the area of the circle. In a sector whose central angle measures n degrees,

$$\text{Area of sector} = \left(\frac{n}{360}\right) \times (\text{Area of circle})$$
$$= \frac{n}{360} \times \pi r^2$$

Math Test Tips Information

The MATH TEST TIP screens contain information about types of GRE math questions

PROBLEM SOLVING STRATEGIES

FIVE STEPS FOR SOLVING MATH PROBLEMS

1. Read the problem.

   By this, we mean read THE WHOLE PROBLEM, including the answer choices. Some people work on the problem one piece at a time before reading all the way through, and end up doing extra calculations or solving for variables they never needed to know. This is not an efficient way to proceed. Approach math problem solving like reading comprehension (although perhaps not with the same dread): since you don't stop after each detail in a reading passage to digest what you've read, you shouldn't do so with a math problem either. Read through the whole problem, so you get the "big picture." Also, keep in mind the difficulty level of the problem: if it's one of the first few multiple choice questions, it will probably be rather straightforward. If, on the other hand, it's one of the last questions on the exam, then it's a good bet that the phrasing is intentionally confusing or the problem takes an unexpected turn.

   "Fine," you say, "that makes sense, but why should I read the answer choices? I'll only need those at the end." Actually, if you wait until you've finished solving the problem to look at the answer choices, you'll have missed some of the most important clues the GRE gives you. Look at the answer choices and ask yourself:

   - Are the answer choices close together or far apart? Can I approximate?
   - What form are the answer choices in? Are they variables? Fractions? Radicals? Exponents?
   - Can I plug the answer choices back into the problem?
   - Can I eliminate some answer choices using common sense?

   Looking at the answer choices and asking yourself these questions can save time.

2. Determine what the question is.

   This isn't as easy (or as obvious) as it sounds. You must know what the question specifically asks you to find. Sometimes, a question is set up to lead you to think they're going to ask for the value of some particular quantity, but instead they ask for something different. Here's an example:

   > Every week, John spends 20 percent of his paycheck on groceries, 40 percent on

clothing, and saves the remainder. If in one week he spends $35 on groceries, how much does he spend on clothing?

If you don't pay attention to what this question is asking, you may assume you need to find his total income for the week-and chances are that that will be a answer choice! In fact, you don't need to find his total income anywhere in the solution: since the 40 percent he spends on clothing is twice the 20 percent he spends on groceries, he'll spend twice $35, or $70 a week on clothing.

3. Determine what you're given

What you're given can be stated explicitly in the problem or in an accompanying diagram. Often this will be all you need, especially in the easier problems. But also look for information that is stated IMPLICITLY. For instance, if you're given one side of an isosceles right triangle, you can find the length of any other side. (Now we're not saying that you should as a matter of course figure out the other side lengths; wait and see whether you need to find them. But keep in mind that you are given the lengths.) Chances are that this implicitly offered information will prove useful in solving many problems. At the same time, be careful. Don't get caught up in every little detail; occasionally, some are designed to throw you off.

4. Identify a path for getting from what you are given to the answer.

Often one path will appear to you immediately. It may not be the fastest way, however, and it may be worth spending a few seconds looking for another method if it will save you a minute of test time. Sometimes you must invest time to save time. If your method looks like it will take five minutes of calculations, then you KNOW that there has to be a shortcut.

Also remember: you are looking for the ANSWER, not the SOLUTION. There's a big difference. The GRE is a multiple-choice test, so the ANSWER is either A, B, C, D, or E, (except for quantitative comparison questions where the answer is A, B, C, or D). If a shortcut lets you pick out the answer without going through all the math, all the better. At times you don't need to solve anything; you can

- Plug in the answer choices;
- Pick numbers to stand in for variables;
- Eliminate answer choices using common-sense approximation, and the like.

5. Select an answer choice.

You may find at this point that the path you have chosen does not work. Unpleasent, but we must face reality. You will have several choices: you can try a different method, you can leave the question until later, or you can guess. Your

decision should depend on how much time you've already spent on the question, how far you are in the section, how much time you have left, and your own "gut" instinct.

ALTERNATIVE METHODS AND GUESSING

There are a number of common techniques that are useful in solving many types of questions. That is why we introduce them here, rather than in any particular section. Remember, these techniques are often faster and simpler than solving the question using traditional math, so bear them in mind when trying to find a path to solve a problem. They will be covered in more detail throughout the text, particularly in the discussion of question types that lend themselves to these alternative techniques. And, of course, alternative methods will be discussed occasionally in the solutions to homework problems. The examples used here are strictly for demonstrative purposes; these questions are fairly straightforward and can be best answered in the conventional way. Focus you attention on the method introduced, not the specific problem.

ALTERNATIVE METHODS

Backsolving

This technique takes advantage of an important feature of the GRE: you're always given the correct answer. The task at hand is merely deciding which answer of the five choices is the correct one. One way to do that is simply to try each possibility. In other words, use the answer choices to work back through the question stem. What makes this technique of backsolving expecially useful is that, in general, you only need to check at most two choices to find the answer.

Numerical answer choices on the GRE are nearly always listed in ascending or descending order. Therefore, when you're checking numerical choices, you should always start with answer choice C, the middle choice. Then if choice C is not correct, move to either answer choice B or D, depending on whether the result you got with choice C was higher or lower than what you wanted. And, generally speaking, those are all the choices you'll need to check.

Picking Numbers

In the algebra section, we'll review how algebra is tested on the GRE. Problems that involve variables can sometimes be tricky and time-consuming. One way around that is to pick simple numbers to stand in for variables. Substitute a number for a variable into the question stem and find that value the question is asking for. Then, substitute the same number for that variable in the answer choices, and the answer choice which gives the same result will be correct. If two answer choices give the same result, try another number just on those two choices.

When picking numbers, it's important to check every answer choice, and if two choices give the desired result, pick an additional number to narrow things down further.

This method is generally most useful on problems with variables and complicated algebraic expressions. Problems that involve percents, particularly percent word problems, and be simplified greatly by picking number.

Guessing

You should never leave anything blank on the GRE. Even if you have absolutely no time to attempt a problem, you should still select an answer choice. In some instances, you will find that either you don't have enough time to complete a problem or you're unable to find a problem's solution. In either case, the natural option is to make a guess. In both cases, though, how you guess can make a difference. It's often the case that , even if you don't have the time or the knowledge to find the answer, you can still use logic and common sense to eliminate some answer choices and guess among what remains. And, of course, the more wrong choices you're able to eliminate, the better your chances of guessing correctly.

Logical Elimination

Sometimes you can eliminate answer choices by logic; you might discover that the correct answer must lie in a certain range, or it must be even, or it must be negative, etc. Use any information like this to eliminate choices which don't fit the bill and guess among what remains.

Obvious answer choices

On the hardest questions the obvious answer choice is almost never correct. This simple statement raises two important questions: 1. Which are the hardest questions? And 2. What is an obvious answer choice? First, the hardest questions are the ones that the testmakers expect the vast majority of people to get wrong. Specifically, the last few Quantitative Comparisons and the last couple of multiple choice questions. Second, the obvious answer choice is the one that leaps out at you as correct-the answer choice that seems immediately to be the answer, with virtually no use of math at all. So why is that choice generally wrong on the hardest questions? Because if it were correct, then most people would pick it (it's obvious, right?) and so most people would get the question right. But the testmaker knows ahead of time most people will get that question wrong (since it's a hard one), and hence the obvious answer choice is not correct.

QUANTITATIVE COMPARISON STRATEGIES

Problem solving questions are pretty straightforward and self-explanatory – you're given a question and five answer choices. Quantitative comparisons, on the other hand, can seem perplexing at first. It's not immediately apparent what you're supposed to do – you're given two columns, with numbers or variables in the columns.

A Quantitative Comparison question presents two numbers, expressions, variables, whatever, in two columns: one labeled Column A and one labeled Column B. Your job is to determine which column has the greater amount. QC's are an example of what is called a "fixed-format" question; the answer choices are the same for all QC's. You should answer:

A. if the quantity in Column A is greater
B. if the quantity in Column B is greater
C. if the two quantities are equal;
D. if the relationship cannot be determined from the information given.

QC's are meant to be done about twice as fast as problem solving questions; this is because you do not actually have to solve anything for most QC's, you only need to make a comparison.
DO I HAVE TO FIND ACTUAL VALUES?

No. What's very important to understand about these questions is that being asked to compare amounts doesn't mean you have to know exactly what the amounts are. You only have to know their relative values. This has some important implications, the most important being that

QC's require insight

It is crucial that you understand this for a number of reasons. First, as we said, it means that QC questions should take less time to answer than a regular problem solving question. You should not spend more than about thirty seconds on a QC problem on your first run through the section. Second, your objective on these questions is to find a way to make a comparison that **doesn't require a lot of work.** With time's winged chariot galloping at the heels of even the best student, it is unlikely that anybody will see the best method for every problem immediately. If you don't see a fast method immediately, and it seems like the problem will take forever, skip it, and come back to it later.

Avoid computation: look for the shortcut

As we just said, QC questions rely on insight, not on computation or brute force. They have to be designed that way, if they expect you to do them in about 30 seconds each. Many QC questions will look at first as if you have to multiply, divide, whatever; but if they look that way to you, then you are missing something. They're not interested in

seeing whether you know how to multiply two numbers, they want to see if you understand the basic principles of arithmetic.

Ex. 5.

Column A	Column B
$24\times56\times39$	$12\times112\times35$

A lot of people's first thoughts with this problem would be to multiply the numbers out. If you did that here, though, you probably would not have that much time left for the rest of the section – it could take a couple of minutes to multiply these numbers out. You have to use your time *efficiently* on the GRE. It is a timed test, and your goal is to answer as many questions as you can (correctly, of course) *in the time allotted.* The clever way to do this problem, and the way you are supposed to do it is to realize that you can factor the numbers in Column A, and rewrite them this way.

$$24\times56\times39 = 12\times2\times56\times39 = 12\times112\times39$$

Now we've got two of the same factors in both columns. We can cancel then from each, and just compare 35 to 39. Since 39 is bigger, the answer is A.

Do the same thing to both sides

Usually, if you do the same thing to both sides, you won't change the answer, but you can make you job much easier. Always remember: you're not interested in the *actual* values of the columns, only in the *relative* values – how they compare to each other. We used this principle in our last example: we cancelled 12×112 from both columns, and just compared what was left. Look at this example:

Ex. 6.

Column A	Column B
$\frac{6}{13}$	$\frac{27}{65}$

We can't make the comparison easily this way, so let's make the fractions look more alike. Multiply the numerator and the denominator in column A by 5, and we end up with $\frac{30}{65}$. Since this is larger than column B, A must be the answer.

Many QC questions will have more than one term in a column. Our advice here is

Compare one piece at a time

Ex. 11.

Column A	Column B
$\sqrt{41}+\sqrt{59}$	$6+7$

What you can't do here is just add the numbers under the square roots in column A, and decide that $\sqrt{41}+\sqrt{59}=\sqrt{100}$. Math isn't quite so easy. But you can compare each piece in column A to each piece in column B. How does $\sqrt{41}$ compare to 6? Well, 36 is 6^2, so $\sqrt{41}$ must be bigger than 6. Similarly, since $49 = 7^2$, $\sqrt{59}$ must be bigger than 7. Since we're adding two larger terms in column A, the answer is A.

Make the columns look similar

What we mean by this somewhat ineffable statement is to look at the *form* of the columns – sometimes that can give you an idea of how to proceed. If one column has a square root, and the other doesn't, try squaring both columns to eliminate the square root. If one is a percent, and the other is a fraction, try converting.

Sometimes it can be very difficult (or time-consuming) to compare the columns directly, but each can be compared to a third number. That's our next tip:

Compare to a third value (such as 0 or 1)

It can be very easy on QC questions to make foolish assumptions, for instance, assuming that a variable represents an integer, or assuming that when they say "number," they don't really mean zero. That's our next tip:

Never make assumptions

Column A	Column B
John's weight	Bob's weight

Ex. 14. John is taller than Bob.

Very often, one of the first few questions on a GRE QC section will look like this. Here, they obviously hope that you will think "Well, if John is taller, then he must weigh more." That's a foolish assumption. There's no absolute correlation between height and weight. Fortunately, problems like this can be relatively easy to spot.

You usually can't find the values of the columns in algebra questions, but this doesn't necessarily mean that you can't make a comparison. One tip that can work very well with algebra QC's is

Try picking numbers

Remember that what we're interested in is the relative values of the columns. Picking values for variables can give us some idea of that. Picking numbers will not immediately tell you what the answer is: after all, if you pick a number and find that column A is bigger, that doesn't mean that column A will always be bigger. For that reason, it's usually best to pick a couple of different numbers. Of course if you get different relationships depending on what you pick, you know that D must be the answer. When you pick numbers, however, you must keep in mind what limitations have been given for the variables. Must they be negative? Positive? Can one of them be zero? If you do pick values, try unusual values: negative numbers, fractions, negative fractions, zero. Often, especially with the later questions, one relationship will be obvious, and you should try to think of a number that will *change* the relationship, to prove that the answer is choice D.

If a geometry problem doesn't have a diagram, draw one

This tip applies everywhere on the GRE math sections, not just QC's. It can be expecially helpful on QC's, however. Now we don't mean that you should carry a ruler and compass into the test with you – you're not allowed to anyway. All we mean is that drawing a quick sketch can make an otherwise esoteric question concrete.

Try setting the columns equal

Many QC's will involve comparing a variable, or something vague, to a number. At times, the only concrete thing you'll have will be one of the columns – so why not start with that?

Ex. 17. $\frac{4}{7}$ of the people in the room are men. There are 68 men in the room.

Column A	Column B
Number of people in the room	105

Working backwards from the numbers in the centered information can be time-consuming. What is much easier here is go start with the value in column B. Suppose there were 105 people in the room. Then how many men would there be? If there were 105 people, and $\frac{4}{7}$ of them were men, then $\frac{4}{7} \times 105$ or 60 people are men. Since this is less than the actual number of men, we know that the total number of people must be *greater* than 105. Therefore, column A is bigger, the answer is A.

GUESSING ON QC QUESTIONS

As we've said before, even if you have no idea what the answer to a GRE question is, guess something.

- It can't hurt, and it might help. The good thing about guessing on QC questions is that it is so easy.
- You can almost always eliminate at least one choice on a QC. For instance, look at the following:

Ex. 18. $x=2$

A. Column A	B. Column B
x^{56}	$x^{55}+x^{55}$

Even if you have no idea of what to do here, you know that the answer *can't* be D. After all, we have a definite value for x; we could always figure out the values of the columns; raising 2 to the 55^{th} power. We're not suggesting that you should do this, or even that you should consider multiplying 2^{55} out, but you should realize that it is possible to make the comparison. Therefore, D can't be the answer, and you can guess among A, B, and C. The answer to this question, by the way, is C; we can rewrite column B as $2(2^{55})$ or 2^{56}, and see that it is equal to column A.

In certain cases, you will be able to eliminate D from consideration on a QC, but what is more common are questions where you can eliminate everything but D and another choice. This can be one of your most powerful strategies on this section.

APPENDIX K

Debriefing Form

Thank you for participating in the GRE Experiment!

If you are an incentive winner, you will be notified by e-mail. If your e-mail address changes before the end of the semester, please contact one of the investigators below.

If you have any concerns or questions about your participation in this project, or would like a copy of the results, you can contact Cori Davis at 517-355-2171 (daviscor@msu.edu) or Dan Ilgen at 517-355-7503 (ilgen@msu.edu).

If you have any questions or concerns regarding your rights and involvement in this research you may contact:

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