Self-awareness theory and decision theory: a theoretical and empirical integration

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SELF-AWARENESS THEORY AND DECISION THEORY: A THEORETICAL AND EMPIRICAL INTEGRATION

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by

Karen Marie Bradburn Williams

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INTRODUCTION

A recent article in a Japanese newspaper reported a rare instance of violence on a Tokyo subway. A man had reportedly sent another man to the hospital with a severe blow to the head. When the police asked the young man why he had committed such an act, he replied, "I found the man particularly disgusting." While this sort of aggressive behavior may be unusual, answering questions about why we behave as we do is not.

In fact, most individuals can easily give accounts of the underlying reasons why they behaved the way they did in particular situations. For instance, in a series of studies on bystander intervention, Latané and Darley (1970) found that individuals gave a variety of reasons for why they failed to intervene in emergency situations. When accounting for their reasons not to report smoke in a smoke-filled room, subjects gave rationales such as: the smoke was smog purposely piped into the experiment to create an urban environment; it was a truth gas used to insure that they would accurately complete their questionnaires; or it was just steam from air conditioning vapors. In all cases, those subjects who remained sitting in the room reported they did so because they did not interpret the smoke as a dangerous situation (Latané & Darley, 1968). Examples such as these are abundant and need not be restricted to the
explanation of overt behaviors.

With relative ease, people can also describe the processes underlying their affective states (Schachter & Singer, 1962; Storms & Nisbett, 1970; Zajonc, 1980), and their attitudes (Aronson & Mills, 1959). In this dissertation, the focus will be on yet another aspect of self-knowledge: the way in which people describe their decisions, judgments, and preferences, and how this self-knowledge affects their decision making ability. For example, many researchers (Ashton, 1974; McFatter, 1982; Slovic, 1969; Slovic, Fleissner, & Bauman, 1972; Valenzi & Andrews, 1973) have asked subjects to give quantitative estimates indicating how important several factors were in their decision making processes. It appears that subjects have very little difficulty in engaging in such a task. Recently, Williams (1984) asked introductory psychology students to describe how they made an important (high ego-involving) and an unimportant (low ego-involving) decision. It was found that all subjects were able to give reasons or identify factors underlying important decisions. Even more interesting, all subjects were also able to give quite specific accounts of the decision processes that went into such trivial decisions as taking a shower, having breakfast, and even attending the study. Additionally, subjects reported being quite confident that these were the
correct processes underlying both types of decisions. Similar results were reported in Einhorn and Hogarth (1978).

Although these studies have shown that people do give reasons for their behaviors, attitudes, emotions, and decisions, and are quite confident that these reasons are correct, does it necessarily follow that these reasons are accurate? Do people really have true access to their cognitive processes? Questions like these have puzzled psychologists for quite some time. In fact, Freud (1923/1962) devoted a great portion of his psychoanalytic theory to an explanation of unconscious motivation. According to Freud, the origin of our thoughts and behaviors is unavailable to our conscious awareness. Only through special training and effort can anyone come to an understanding of the motives behind behavior and thought. Cognitive psychologists (Mandler, 1975; Miller, 1962; Neisser, 1967) have addressed these notions theoretically and have also suggested that people have no direct access to the cognitive processes underlying their behaviors, thoughts, and emotions. These theorists proposed that it is the outcome of our thoughts, not the processes, of which we are aware.

Examining these propositions, Nisbett and Wilson (1977) first evaluated research in many areas of psychology. They found that indeed there are many instances in which people
do not have accurate insight into their higher order thought processes. For example, researchers in the area of subliminal perception (Wilson, 1975, cited in Nisbett & Wilson, 1977) have demonstrated that people are sometimes not even aware of the actual stimuli or events which influence their thoughts and behaviors. Likewise, Bem and McConnell (1970) found that subjects were unaware of any attitude change that had occurred during a dissonance arousing experiment. Finally, subjects in the Latané and Darley (1970) bystander intervention studies were not aware that their behavior had been influenced by the number of other bystanders that were present. Instead they provided incorrect reasons such as those previously discussed.

Nisbett and Wilson drew three conclusions from these findings. People are: (a) sometimes unaware of a stimulus that causes a response; (b) sometimes unaware of the response itself; and (c) sometimes unaware of the relationship between the stimulus and response.

In a series of empirical studies, Nisbett and Wilson (1977) provided more support for these theoretical notions. Not only did subjects in their studies fail to report the role of effective stimuli, they often attributed their behavior to stimuli that were not influential in their judgment process. In one study, subjects were asked to indicate which of several garments was of the highest
quality. Analysis of their choices uncovered a substantial order-of-presentation effect. None of the subjects, however, reported that order played a significant role in their decision. In fact, when specifically asked about its effects, almost all subjects denied that it had influenced them. Similarly, subjects were asked to rate a documentary film on three dimensions. Some subjects experienced annoying distractions while others did not. While these distractions did not have a significant effect on the ratings, distracted subjects often attributed their low ratings to them. Nisbett and Wilson concluded, "subjects, as it turned out, were virtually never accurate in their reports. If the stimulus component had a significant effect on responses, subjects typically reported that it was noninfluential; if the stimulus component had no significant effect, subjects typically reported that it had been influential" (p. 242).

Is all behavior characterized by such lack of insight? Are there some occasions where we actually have access to the causes of our thoughts and actions? Although Nisbett and Wilson's findings presented convincing evidence that at least under some circumstances individuals lack cognitive insight, there may be some instances in which there is such awareness. Nisbett and Wilson pointed out that in the studies they reviewed, the lack of knowledge may have been a
result of subjects being misled. For example, the Latané and Darley (1970) findings were counterintuitive. People would not expect that the number of others would be a reason for their behavior, nor would it be socially desirable to say that it was. Additionally, recent research on impression management (Cialdini, Petty, & Cacioppo, 1981; Tedeschi, Schlenker, & Bonoma, 1971) offers an alternative explanation for cognitive dissonance findings. It may be that subjects wish to appear consistent, and thus do not report being aware of any attitude change. In other words, incorrectly reporting the causes of behavior may be influenced by factors such as a misleading situation or social desirability rather than from a true lack of insight. In fact, knowing the basis for one's decision seems to be a positive attribute. Subjects in Williams' (1984) study were asked what their impression was of people who were either knowledgeable or unknowledgeable about the reasons for their decisions. It was found that subjects rated those who were knowledgeable as more intelligent, competent, and good than those individuals who were not knowledgeable.

Nisbett and Wilson suggested, however, that the empirical studies they conducted supported their hypothesis without being misleading. To evaluate this claim, it is necessary to examine several of their studies in greater detail. First, in the consumer rating study, individuals
were asked to rate and compare the quality of several garments. When asked to make such ratings, it seems likely that the individual would assume that garments differed in quality (for what other reason would they be asked to compare them?), and as a result may base the explanation for their choice on a quality dimension rather than an order of presentation dimension. Even if the subject was aware of order, how likely would he or she be to say that the sequence of exposure was what influenced his or her decision? Making a decision regarding quality on the basis of order would make one look ridiculous, if not simple-minded.

Second, misleading situations and social desirability may also have played a role in subjects attributing influence to an uninfluential stimulus. For example, subjects were asked to describe the emotional impact of passages read from a novel. In some cases, subjects read additional passages. These subjects reported that the additional passage did have some influence on the impact they experienced. This impact, however, was not any greater than that experienced by subjects who did not read the additional passage. Again, such a situation seems misleading. If subjects are asked how an emotionally-packed passage influenced the impact they felt, it seems likely that the passage should have been of some influence.
Likewise, reporting that they consider many facets of the story seems to suggest intelligence and competence. Again, this may have been merely a socially desirable response. Moreover, the subjects may have been at least partially correct. It is reasonable to assume that the subjects were actually influenced by the passage, but a ceiling effect took place. That is, in and of themselves all factors were influential, but when combined they quickly reached a point of maximum impact.

These criticisms are not meant to suggest that Nisbett and Wilson's concern with self-reports are without merit. Instead, it is suggested that their concerns may have been exaggerated by the types of empirical studies they reviewed and conducted. Demonstrating that self-reports of decisions can be inaccurate does not demonstrate that they are never accurate. At this point, two crucial questions arise: Are there occasions when we are accurate in our self-reports; and if so, how can the frequency of these occasions be increased?

In addressing the first question, Nisbett and Wilson concede that under a few special circumstances people can give accurate self-reports. They cited evidence from the decision theory literature which suggested that at times individuals do report their decision strategies with moderate accuracy (Slovic & Lichtenstein, 1971). According
to Nisbett and Wilson, however, this accuracy will only prevail in situations in which the decision maker has been taught a very explicit strategy of how factors should be weighted and combined in formulating a final decision. For example, clinical psychologists undergo very intensive training on how to interpret the Minnesota Multiphasic Personality Inventory (MMPI). They learn specific decision formulas to weight and combine information on the various subscales of the MMPI. Therefore, it is not surprising that they can accurately describe these decision policies.

According to Nisbett and Wilson, self-reports would be correct when the following conditions are met: (a) influential stimuli are available; (b) influential stimuli are plausible causes of the behavior; and (c) noninfluential stimuli are not available.

Thus, two conclusions can be drawn. First, there are occasions when self-reports are accurate (these situations may be rare as suggested by Nisbett and Wilson, or they may be more common as hypothesized previously); and second, increasing the frequency of these situations should increase the accuracy of self-reports. Before making suggestions on how to increase accuracy, however, it is necessary to address how one arrives at an accurate self-report.

According to Nisbett and Wilson, accurately identifying influential stimuli does not necessarily imply cognitive
insight. Instead, they suggested that accuracy is nothing more than a good guess based upon obvious cues in the environment. According to self-perception theory (Bem, 1972), people have a priori theories for why they behave the way they do, and these theories are not much different from those held by observers. Thus, when an individual's self-report is accurate, it would also be expected that an observer display similar accuracy about causes of that individual's response. For example, actors' and observers' guesses should be both similar and fairly accurate in those instances where important stimuli are salient, plausible causes of the response, and noninfluential factors are less noticeable. The individual only gains accuracy in the sense that he or she benefits from past experience. That is, the individual may be more likely to accurately guess the cause of a response only because he or she engaged in the same response in the past. According to this view, people never have true cognitive insight. Accuracy is merely a "verbal report which exceeds in accuracy that obtained from observers provided with a general description of the stimulus and response in question" (Nisbett & Wilson, 1977, p. 251).

While Nisbett and Wilson denied any "special" insight or self-knowledge, Gibbons (1983) and Wright and Rip (1981) suggested that individuals may, under certain circumstances,
have access to the contents of the self. That is, accurate self-reports may reflect an insight into cognitive processes that is not available to observers. No matter how clear the situation is for observers, there may be certain circumstances in which the individual is more accurate than the observer in his or her self-report. If, indeed, this apparent self-insight exists, it is enhanced in situations in which the individual's attention is directed inwardly on the self (Gibbons, 1983). Since this self-knowledge is associated with enhancing the individual's awareness of cognitive processes, including decision rules, self-focused attention can be expected to increase the consistency with which the individual makes decisions. This increase in reliability is proposed to be accompanied by an increase in decision accuracy. This hypothesis follows from the robust findings in the decision theory literature which have suggested that because of their high reliability, mathematical models of decision processes outperform human counterparts (Goldberg, 1968b; Meehl, 1954).

The purpose of this dissertation is twofold. First, the theories and research findings in the area of self-awareness are integrated with the literature in the area of decision theory. While Nisbett and Wilson (1977) made reference to research conducted in the area of decision making, there has been little or no formal integration of
the two areas. In this dissertation, both the areas of self-awareness and decision theory are reviewed (Chapters I and II), and theoretically integrated (Chapter III). Such an integration is valuable in that it provides a means for greater understanding of cognitive insight and the decision making process, and possibly a means for improving decision quality as well.

Second, the vast majority of empirical research on self-awareness has involved accuracy in relation to the self (i.e., knowledge of one's test scores, grade point average, or attitudes). Few studies, however, have looked at self-focused attention and its relationship to accuracy on tasks external to the self, such as decision making. It is proposed that an increase in self-focused attention will be followed by an increase in decision accuracy. Again, the rationale behind this hypothesis is that people who are self-aware should closely follow their rules and strategies used to combine decision information. Because the individual is adhering to these rules he or she should: (a) be more consistent and as a consequence make more reliable decisions; (b) be more accurate since the decision rules may have developed from feedback on the specific task or other similar tasks; and (c) be more motivated to perform well. This dissertation also supplies an empirical test of the
integration in which the relationship between decision accuracy and self-awareness is examined (Chapter IV).
CHAPTER I

SELF-AWARENESS: A REVIEW OF THE LITERATURE

A central theme of self-awareness theory has been to examine the role of self-focus in cognitive awareness. Likewise, many researchers in the area of decision theory have speculated on the role of self-knowledge in judgment. Before integrating the self-awareness and the decision making literature, it is first necessary to review the development and current status of theory and empirical research in each area.

Interest in the self as both a regulator of behavior and an organizer of information has a long history in psychology (Freud, 1923/1962; James, 1890; Mead, 1934). Recently, social psychologists have examined the effects of self-awareness on the regulatory control of behavior. More specifically, many theorists have proposed that self-directed attention may serve to enhance regulatory control, and as a result bring behavior in line with salient behavioral standards. Concepts such as attentional focus, self-focused attention, standards of comparison, and outwardly-focused attention are central to self-awareness theory and regulatory control and will be discussed from a variety of theoretical perspectives. While most of the self-awareness research has been directed toward the self's regulatory functions (that is, bringing behavior in line
with standards), another perspective contends that self-focused attention alters the processing and organization of information. Research focusing on this view will also be presented. Additionally, the benefits and limitations of self-focused attention will be discussed in terms of a number of behavioral outcomes.

The Self as a Regulator of Behavior

A theory of objective self-awareness was proposed by Duval and Wicklund in 1972. Although this theory has undergone some minor modifications (Wicklund, 1975, 1978, 1980; Wicklund & Frey, 1980), and alternative theoretical positions have been proposed (Buss, 1980; Carver, 1979; Carver & Scheier, 1981; Hull & Levy, 1979), its basic tenet remains intact. That is, under conditions of heightened self-awareness, regulatory control of behavior will be enhanced. The following sections will examine this tenet in more detail, addressing each of several major propositions made by the self-awareness theorists.

Attentional focus: Becoming aware of cognitions

A fixed capacity model. One of the basic premises of Duval and Wicklund's (1972) statement of self-awareness theory (as well as a premise of many subsequent theories) is that of a fixed capacity model of attentional focus. Objective self-awareness is a state in which the individual focuses on him or herself as an object of attention (Duval &
Wicklund, 1972). According to the theory, self-focus is one of two possible directions of attentional focus. The individual may focus attention on the self, or he or she may focus attention on the environment. When attentional focus is outwardly directed, attention is drawn to the salient aspects of the environment. When it is inwardly directed, attention shifts to the salient aspects of the self.

Although attention may be focused in either direction, it may not be divided between the two directions. Thus, if an individual focuses on the environment, all of his or her attention is directed to salient aspects of the situation, and no attention is directed inwardly on the self. Conversely, if he or she is focusing on the self, no attention will be focused outwardly on the environment.

An early study by Duval and Ritz (cited in Duval & Wicklund, 1972) provided an empirical test of this proposition. In this study, subjects were asked to maintain steady motor control, while either in the presence or absence of a mirror (self-focus eliciting stimulus). Subjects were given feedback on their task performance and were told that some of their finger movements were caused by movement from a machine. They were then asked to estimate the extent that the machine influenced their motor control. The results indicated that subjects who had an internal focus of attention (mirror condition) believed that the
machine controlled more of their movements than did subjects in the no mirror condition. Duval and Wicklund (1972) interpreted these findings as support for the notion of a fixed capacity attentional dichotomy. That is, subjects who focused their attention inwardly (mirror condition) were less able to monitor the effects of the machine (because they were paying attention to the self), and as a result were not able to focus on the relationship between self and environment. Likewise, Ellis and Holmes (1982) proposed that a general theme has emerged in which self-focus results in cognitive processes incompatible with those used to interpret the external environment, suggesting support for the attentional dichotomy model.

While attention is assumed to be dichotomous, Duval and Wicklund (1972) allowed for it to oscillate rapidly between environment and self. Therefore, hearing a siren may cause an individual to shift momentarily from attending to the self to attending to the environment. After the siren has ceased, the individual may rapidly return to a state of self-focus. While some environmental stimuli, like the siren, may direct our attention outwardly, other stimuli cause the individual to focus inwardly on the self. These later stimuli serve to remind the individual of him or herself, so that a mirror reflecting the individual's image may bring about a heightened state of self-awareness.
Self-awareness manipulations. To test the effects of various stimuli on knowledge of cognitions, early studies of objective self-awareness used devices such as mirrors and cameras to induce states of self-focus (Duval & Ritz, cited in Duval & Wicklund, 1972; Duval & Wicklund, 1972; Wicklund & Duval, 1971). Testing the validity of the camera manipulation, Davis and Brock (1975) demonstrated that subjects used more personal pronouns on a sentence completion blank in the camera conditions than in the no camera conditions. Similarly, others have validated the self-focusing effects of mirrors (Carver & Scheier, 1978; Geller & Shaver, 1976), bodily arousal (Fenigstein & Carver, 1978; Wegner & Giuliano, 1980, 1983), unusualness of task (McDonald, Harris, & Maher, 1983; Wegner & Giuliano, 1983), and the presence of an audience (Carver & Scheier, 1978). Scheier, Fenigstein, & Buss (1974) suggested, however, that audience effects on self-focus are moderated by eye contact. Additionally, other researchers have used interruption (Ovsiankina, cited in Wicklund & Frey, 1980), own-voice feedback (Gibbons & Wicklund, 1976; Ickes, Wicklund, & Ferris, 1973), self on a television monitor (Duval, Duval, & Neely, 1979; Ferris & Wicklund, cited in Duval & Wicklund, 1972), minority status (Duval, 1976; Wegner & Schaefer, 1978), a biographical questionnaire (Duval et al., 1979), and novelty of situation (Edison & Fink, cited in Wicklund &
Frey, 1980) to remind the individual of him or herself, and as a result draw attention inwardly.

**Dispositional focus of attention.** Although many studies have relied on manipulations of self-focus, some have taken a dispositional approach. Fenigstein, Scheier, and Buss (1975) developed a "self-consciousness" scale measuring individual differences in the self-focusing attribute. They suggested that people dispositionally differ in the degree to which they take the self as the center of attention. For instance, Carver and Scheier (1978) demonstrated that individuals who score high on the private self-consciousness scale are more likely to use self-related pronouns in sentence completion tests than are individuals who score low on this attribute. [For a more thorough review of validation studies, see Carver & Scheier, 1981, pp. 45-51.] Additionally, more will be said about this scale (private versus public self-consciousness) in the review of standards.

**Self-focused attention: Effects of awareness of cognitions**

**The comparison process.** The second major proposition made by Duval and Wicklund (1972) was that when an individual becomes self-aware, he or she engages in a critical comparison of actual states with ideal states. More specifically, when the self is the center of attention, the individual becomes aware of his or her most salient
personal and social standards, values, and rules. [A more detailed discussion of standards follows this section.] That is, when the individual becomes self-focused, not all aspects of the self will come into focus. Instead, the individual will focus only on those features of the self that are most salient in the particular situation. Thus, if an individual should become self-focused in a situation in which someone requests his or her help, the aspects of the self related to helping would likely come into attentional focus. For example, Gibbons and Wicklund (1982) demonstrated the power of situational cues in determining whether a helping or a self-concern norm became salient during self-focus.

The awareness of these salient standards results in an evaluation process in which the individual carefully compares these salient rules and standards with his or her present state (i.e., thoughts or behaviors). Empirical support for this proposition comes from a study by Ickes et al. (1973). In this study, subjects were requested to complete a questionnaire describing their ideal selves. Subjects then either listened to a tape recording of their own voice (self-aware condition) or a tape of another's voice (control condition). After this, subjects were asked to fill out the same questionnaire form, this time describing their real selves (the order of the
questionnaires was counterbalanced). The results indicated the self-focused subjects were more aware of discrepancies between their real selves and ideal selves, and that these discrepancies were largest immediately after the self-focus manipulation.

An aversive discrepancy. According to Duval and Wicklund's (1972) original statement of the theory, the comparison process usually results in awareness of a discrepancy (small or large) between aspirations or standards and the individual's present state. This discrepancy is presumed to be exclusively aversive. For instance, Duval and Wicklund (1972) suggested that a consequence of the critical comparison process is lowered self-esteem. This suggestion was supported by Ickes et al. (1973). Self-aware subjects who had been provided with negative discrepancy-producing information showed lowered self-esteem on a self-rating task than did subjects who were not made self-aware. Similarly, Archer, Hormuth, and Berg (1982) reported that self-aware subjects demonstrated discontent by giving lower affect ratings than did those subjects who were not made self-aware. Wicklund (1975) described a study conducted with Ferris which tested this same notion in a within-subject design. They found that subjects' ratings of self were lowest when watching themselves on a television monitor and highest when they had
been distracted from self-focus by watching a television western on the same monitor. Additionally, those individuals who are dispositionally high in self-consciousness tend to be low in self-esteem, suggesting they find many discrepancies between their perceived characteristics and their actual characteristics (Brockner, 1979).

The drive. According to the original theory, the negative affect inherent in the self-focused condition produces a drive to avoid the unpleasant state. The intensity of the drive was proposed to be a function of both the amount of time the individual engaged in self-focus and the size of discrepancy between the current behavior and the ideal self. Duval and Wicklund (1972) proposed that the self-aware person may lessen these aversive feelings by either: (a) directing attention outwardly, away from the self, to avoid the aversive affect; or (b) reducing the discrepancy by bringing the behavior in line with aspirations or standards, providing that avoidance was not possible. For instance, while taking part in a political poll, a respondent may publicly express a pro-attitude for candidate Smith, while his or her true attitude favors candidate Smith's opponent, candidate Jones. If this respondent should become self-focused, self-awareness theory would predict that he or she would experience negative affect as a result of the discrepancy between the real
attitude and the expressed attitude. The self-focused respondent has two behavioral choices at this point. He or she may first attempt to escape the self-awareness provoking stimuli. If, however, the self-focus cannot be avoided, the respondent’s second choice would be to make the self-report more reflective of his or her true feelings regarding the two candidates. Both of these behaviors would result in a reduction of the negative affect inherent in a discrepant state.

A study by Duval, Wicklund, and Fine (cited in Duval & Wicklund, 1972) provided support for the Duval and Wicklund position. In this study, the authors manipulated both the degree of felt discrepancy (by giving subjects bogus feedback on a personality test), and the direction of attentional focus (using both a mirror and a television camera). Subjects were then asked to wait in the testing room for the arrival of another experimenter (by design the experimenter did not arrive). The dependent measure was the duration of time the subject would wait in the room. The authors predicted that the presence of self-awareness-evoking stimuli would draw attentional focus inwardly toward the salient discrepancy. When that discrepancy was large, it would result in heightened negative affect, from which the subject would try to escape. The results of the study supported this notion: those subjects who were given highly
discrepant information in the self-focus condition spent significantly less time in the room than did subjects in any of the remaining three conditions.

Additionally, Gibbons and Wicklund (1976) provided male subjects with bogus information about the impression that they had made on a female confederate. The subjects were asked to listen to a tape recording of their own voice (self-aware condition) or another's voice (control condition). Self-focused subjects who had received highly discrepant information (that is, negative information about themselves), spent significantly less time listening to the tape than did people in any of the remaining conditions. These studies suggest that when people become aware of discrepancies between their actual states and aspirations, they engage in escape behavior. Only if this behavior is unsuccessful will they engage in attempts to bring the current state more in line with salient behavioral standards. Likewise, Brockner & Wallnau (1981) found that both high self-esteem and low self-esteem subjects reported negative affect toward working in front of a mirror and tended to avoid the mirror in subsequent tasks. Thus, according to Duval and Wicklund (1972), a drive to reduce the aversive discrepancy may eventually result in a change in the current behavioral state.
Alternative theoretical positions

It is this position, that self-awareness results exclusively in negative affect, and consequently escape behavior, that has met with much contention. Several studies have demonstrated that self-focus may also result in positive affect. For instance, Ickes et al. (1973) found that subjects who were given extremely positive feedback (suggesting that they had surpassed their previous aspirations), did not demonstrate the decreased esteem effect found in many other self-awareness studies. Additionally, other researchers have produced positive discrepancies and reported similar results (Carver & Scheier, 1978; Davis & Brock, 1975). When a positive discrepancy is made salient during self-focus, there should be no attempt to avoid attending to the discrepancy (Brockner, 1979; Gibbons & Wicklund, 1976; Greenberg & Musham, 1981). In fact, the individual may engage in discrepancy enhancement by seeking out self-focusing situations (Carver & Scheier, 1981; Duval & Wicklund, 1973; Ickes et al., 1973).

Findings such as these led to a minor revision of the original theory. In this revision, Wicklund (1975) stated that under limited circumstances the discrepancy may be positive and not expected to result in a drive aimed at reducing it. In cases where an individual successfully
surpasses some aspiration (i.e., when present performance exceeds an ideal standard of comparison), a reduction in the discrepancy between aspirations and current state would not be expected. In such a case, Wicklund (1975) predicted that the individual would experience positive affect, and may even search out self-focusing stimuli. He suggested that such an instance is short-lived, since people quickly raise their level of aspirations. Thus, Wicklund (1975) conceded that while a few discrepancies are positive and do not result in behavioral change, the majority are negative and lead to avoidance of self-focusing stimuli or discrepancy-reduction changes in behavior.

**Control theory.** Other theoretical positions disagree that a state of discontent is necessary for a parsimonious explanation of the self-awareness phenomenon (Buss, 1980; Carver, 1979; Carver & Scheier, 1981). For instance, Carver and Scheier agreed that attentional focus may be either inwardly or outwardly directed, and when focused inwardly individuals compare their present state with a salient standard. They did not, however, believe that a discrepancy between the two produces an affective state (whether negative or positive). Instead, they proposed that the shift toward the salient standard is nothing more than a natural consequence of engaging in a negative feedback loop. This process also involves reducing discrepancies between an
existing state and a standard; however, no drive component is involved. Thus, "control theory" looks at the phenomenon of self-awareness through an information processing model, rather than a motivational or drive model.

Explaining their position, Carver and Scheier (1981) proposed that people engage in a binary decision process by testing an existing state with some predetermined standard. This means that the individual either decides that the present state and the standard are the same or that they are different. If a discrepancy exists, the individual alters the existing state in some way, bringing it in line with the standard.

Carver (1979) disagreed that self-awareness first led to avoidance of self-focusing stimuli and then discrepancy reduction. Instead, he proposed that the individual engages in a "matching to standard sequence" when self-focused. More specifically, self-focus causes the person to evaluate his or her chances for attaining a favorable outcome (i.e., matching current state with a salient standard). If this outcome expectancy is high (favorable), the individual will engage in discrepancy reduction. In support of this position, McDonald (1980) found that when people could reduce a negative discrepancy, they persisted on the task. If, on the other hand, expectancy for a favorable outcome is low, withdrawal from self-focusing stimuli is likely. In
citing empirical support for his position, Carver (1979) reinterpreted findings supporting the Duval and Wicklund (1972) position. For instance, he suggested that Duval, Wicklund, and Fine's (cited in Duval & Wicklund, 1972) self-aware subjects quickly left the testing room, not merely because they were experiencing negative affect, but because they had low expectancies of bringing behavior in line with the standard. That is, their subjects had already taken the personality test which had resulted in the negative discrepancy, and thus, did not expect to be able to reduce the discrepancy.

Carver, Blaney, and Scheier (1979a), provided empirical support for this position in a study on fear-based behavior. In this study, subjects who had reported being fearful of handling snakes were divided into two groups. One group consisted of individuals who believed that there was a high likelihood that they could overcome this fear (the salient standard). The other group was made up of those who had a low expectancy of this desired outcome. Subjects were to approach a snake either in the presence or absence of a mirror. The results indicated self-aware subjects who had highly favorable expectancies were the most likely to carry out the approach task. Those in the self-aware/low expectancy conditions were most likely to withdraw from the task. These results provided support for Carver's (1979)
position that self-awareness causes the individual to evaluate the situation and then behave accordingly. That is, based on expectancies, the individual would either withdraw or bring behavior in line with salient standards. Additionally, Carver and Blaney (1977), Carver, Blaney, and Scheier (1979b), and Steenbarger and Aderman (1979) reported similar results whereby the outcome of self-focus is determined by the individual's expectancies.

If no difference between the standard and the behavior exists, the existing state is not altered. Discrepancy reduction is analogous to a task performed by a self-monitoring machine. For instance, when the system performs below standard, the machine is programmed to correct the discrepancy. There is no motivational component involved. Like the machine, the individual engages in discrepancy reduction without a corresponding affective state. That is, the function of the self is merely to correct the discrepancy and bring behavior back in line with the standard. Carver and Scheier did not, however, completely disregard the notion of negative affect. The self-focused individual may experience an unpleasant emotional state if a discrepancy exists that cannot be reduced. They contend that self-focus, however, is not aversive in and of itself, as suggested by Duval and Wicklund (1972).
Despite minor inconsistencies, these theorists share a basic theoretical tenet. That is, when self-focused an individual's attention is drawn inwardly toward the self and away from environmental stimuli. This internal focus results in a comparison between a standard and the present state. If a discrepancy exists, the comparison process leads to an attempt to bring current behavior in line with the salient standard, either because of a drive to reduce the aversive affective state or because of engaging in a negative discrepancy-reducing feedback loop. To understand this comparison process and its resulting behavioral change, it is important to first examine the concept of a standard more closely.

Standards

The concept of a standard is central to the theory of self-awareness. It is through the process of comparing an actual state with a standard that perceptual and behavioral changes are proposed to occur. Understanding the nature of standards may allow researchers to better predict the effects that self-focused attention has on behaviors, such as decision making.

Although many of the theorists have addressed the notion of a standard, ambiguity exists as to what constitutes a standard, and what specific standard will be elicited at any given time or in any given situation
Recent studies have demonstrated that the self is multifaceted and complex, and a number of potential standards are available to the self in any particular situation (Scheier & Carver, 1980). Which standard will become salient remains an empirical question. In an attempt to understand the concept of a standard, it is important to review variations in definition of the term, to find commonalities and differences among these viewpoints, and to establish which types of standards become salient under a variety of situational cues. In the following paragraphs, each of these issues will be addressed both in terms of their theoretical rationale and empirical support.

Defining the concept of a standard. Duval and Wicklund (1972) defined a standard as "a mental representation of correct behavior, attitudes, and traits" (p. 3). Thus, according to this position, standards are ideal states characterized by correct social behaviors (i.e., helping someone in need), ideal personality traits (i.e., being an altruistic person), or long-standing attitudes and beliefs (i.e., believing government should support the needy). Many studies have demonstrated that when individuals became self-aware, they exhibited behavioral changes that came closer to attaining standards of correct behavior. For instance, children trick-or-treaters were likely to bring their behavior in line with a salient social standard to
obey instructions while in the presence of self-focusing stimuli (Beaman, Klentz, Diener, & Svanum, 1979). Likewise, self-aware college students were more likely to follow a standard of honesty than were students who were not made self-aware (Diener & Wallbom, 1976). Scheier (1980) reported that subjects who were high in private self-consciousness (dispositionally self-aware) wrote essays which were more in line with previously stated attitudes toward punishment than did subjects who scored low in private self-consciousness. Finally, Gibbons and Wright (1983) found that self-focused subjects were more likely than control subjects to adhere to previously stated attitudes in the face of conformity pressures.

Thus, from Duval and Wicklund's statement, standards appear to be aspirations of ideal states. They represent what is correct in terms of moralistic, social, and personal standards. It is not surprising Wicklund (1975) stated that standards are difficult to attain and usually result in negative discrepancies with actual states. In control theory, the definition of a "standard", takes on a more general meaning. For instance, Carver and Scheier (1981) stated that a standard was "a generic term meaning point of comparison" (p. 120). According to this definition, standards may include standards of excellence or ideals for a correct self. This type of standard is very similar to
that described by Duval and Wicklund (1972). This later
definition does not, however, limit standards to long-
standing rules and attitudes, or types of moral reasoning.
That is, behavioral standards also may encompass short-term
standards, desires, or even instructions from an external
source. A study by Berkowitz (cited in Gibbons & Wicklund,
1982), illustrated this temporary feature of standards. In
the study, subjects' moods were manipulated by asking them
to report either a happy or a sad incident. Berkowitz found
that volunteering increased for those subjects who were
self-aware and in a good mood and decreased for those who
were self-aware and in a bad mood. Likewise, Isen, Shalker,
Clark, and Karp (1978) found that individuals who were in a
bad mood focused on self-concerns rather than on standards
of helping.

Buss (1980) suggested that in situations where no
standard exists, self-awareness intensifies the present
affective state. Thus, if a person is feeling aggressive,
self-awareness will intensify this affect if no standard
exists against aggressing.

The development of standards. According to Duval and
Wicklund (1972), these ideals or standards develop from the
individual's experiences with others and from his or her
reinforcement history. They also suggested that individuals
have a fairly stable set of rules that are used to guide
their behavior under conditions of self-focus. Carver and Scheier (1981) suggested that standards originate from either the way people process information or from comparisons the individual makes with external sources. First, behavioral standards, as well as other kinds of information, are encoded into memory in the form of self-schemata. Self-schemata are cognitive structures that develop from past experience and function to guide the processing of self-relevant information (Marcus, 1983). They make processing new information more efficient by providing the individual with information about what to expect from various situations, objects, or people. For example, schemata provide individuals with expectations for what members of various occupational groups are like. Additionally, schemata aid in the encoding, recall and recognition of any information that is made relevant to the particular schema (Marcus, 1980).

Schemata may also serve as guidelines for correct responses. According to Carver and Scheier (1981), all schemata provide the individual with structural information (i.e., information about what to expect in the situation), but only some schemata provide additional "behavior-specifying" information. This information may include guidelines such as how to behave at a rock concert, at church, or in the courtroom. The schemata often serve as
the standards of comparison used to check the current behavioral state. Thus, when an individual behaves contrary to these regulatory schemata, self-focus will bring behavior back in line with them. For instance, an individual may have a schema which specifies when and where aggression is acceptable. Self-focus would enhance adherence to the behavioral standard specified by the schema, while a state of outward focus may result in contranormative behavior.

Second, behavioral standards may be derived from sources external to self-insight. These sources include instructions, other people's behaviors, and the individual's observation of his or her own behaviors. For example, an individual may compare his or her present behavior with a set of instructions given by the experimenter; he or she may engage in social comparison processes, whereby current behavior is compared against another person's behavior; or he or she may observe his or her own behavior to determine what the standard must be. Deiner and Srull (1979) found that in some instances, self-aware subjects were more likely to adhere to external standards provided by the experimenter than they were to adhere to their own internal standards. Likewise, many researchers have examined the relationship between self-focus and conformity. [This will be discussed in more detail in a following section.] In general, these researchers have found that in cases of uncertainty,
subjects will often adopt the standards of others (Duval, 1976; Wicklund & Duval, 1971). However, Gibbons and Wright (1983) found that while self-focused subjects did adhere to conformity standards, they were less likely to give up personal standards than were control subjects.

Thirdly, behavioral standards may be derived through the process of self-perception (Bem, 1967). In these instances, the individual observes some external aspect of his or her self through overt actions. This results in a previous behavior serving as the standard of comparison for present behavior. Thus, standards may be either internally or externally derived. No matter what their origin, however, self-focus will increase the individual’s adherence to the specific standard in question.

Public versus private standards. One additional theoretical position is worth considering at this point. In Buss’ (1980) statement of self-consciousness theory, he made a distinction between two major types of standards: public and private. [This follows from the Fenigstein et al. (1975) self-consciousness scale, and is also addressed in Wicklund (1978).] Buss suggested that when an individual was self-aware, attention was drawn either to public aspects or private aspects of the self. When the individual was publicly self-conscious, attention was focused on the self as a social object, and he or she became aware of the
salient public aspects of the self (i.e., how others view him or her). For instance, individuals who are made publicly self-aware are more concerned with others' reactions to them than are people who are less self-focused. According to Buss (1980), people who are publicly self-aware are "more likely to go along with group norms, to behave courteously, to be honest, and in general to fulfill role expectations" (p. 75). On the other hand, when the individual's attention is drawn to salient personal standards, private self-consciousness is elicited (i.e., the person becomes aware of his or her own attitudes and standards). In these cases, the individual would be more likely to go along with his or her own personal attitudes and beliefs than with the social standards provided by others (Scheier, 1980).

While oftentimes public and private self-awareness may be elicited from external sources, Buss also suggested that focusing on either public or private aspects of the self consistently reflects the dispositional trait of self-consciousness.

Conflicting standards

All of the above perspectives are in agreement that the self-aware individual has multiple standards with which to compare his or her present behavior. Some of these standards may be internal to the self (i.e., personal
beliefs), while others are derived from external sources (i.e., instructions). When two or more of these standards become salient, a conflict may arise. That is, the self-aware individual is presented with two opposing sets of behavioral specifications, one of which will come to regulate behavior. Which standard will determine the resulting behavior? According to Gibbons (1983), any of these standards (both internal and external) may play a role in behavioral regulation; therefore, no clear distinction can be made regarding their relative strength. Thus, the process of understanding behavioral change during self-focus becomes much more complex than it originally appeared in the Duval and Wicklund (1972) statement (they had suggested that people simply attempt to align their behavior with their most salient standard). It is not enough to state that the most salient standard is followed. Instead, it is necessary to further explore the situations and conditions that promote the saliency of one standard over others. In the following paragraphs, conflicting standards are discussed in terms of several theoretical viewpoints.

**Theoretical explanations.** According to Wicklund and Frey (1980), self-focus may often result in a conflict between two or more existing standards. For example, an individual may be in a situation, such as Asch's (1951) conformity experiment, in which he or she is asked to pick
the line closest in length to a stimulus line. If the individual becomes self-aware, two salient standards may come into focus. First, the salient standard may be accuracy (internal standard), and the individual clearly perceives one of the lines to be the correct response. In this case, the self-aware subject should choose the line that he or she believes is most like the stimulus line (since this brings the present behavior in line with the standard of accuracy). Second, the individual may become aware of a salient standard to be socially accepted (external standard). This may require that the individual conform to a group of individuals who all choose a line that is clearly different from the stimulus line.

Reency. Wicklund and Frey (1980) proposed that in such a situation, the principle of recency determines which of the standards is adhered to during a state of self-focus. Thus, if a social encounter has had the most recent impact on behavior (i.e., the individual has just been ostracized for not conforming to the group), the individual is likely to be more conforming under conditions of self-focus. Likewise, if commitment to one's own standard had the most recent impact (i.e., the person had just stated his or her own attitude), the individual would more likely be committed to that attitude during self-focus. For instance, Lingle and McPeek (cited in Duval & Wicklund,
1972), created a situation in which two salient standards came into conflict: self-concern and other-concern. Subjects in their study were confronted with a request from a confederate to help them hand out a questionnaire. When a self-concern standard had recently been made salient, subjects were less likely to be influenced by the helping standard than were participants in conditions where the self-concern standard was less salient.

Other studies have demonstrated similar effects for conflicting standards. For example, Gibbons and Wicklund (1982) suggested that for a helping norm to become the salient standard, it was necessary for the individual to: (a) feel that the helping request was legitimate, and (b) not have experienced recent self-concern. Additionally, Gotay (cited in Gibbons & Wicklund, 1982) found that when a helping norm had recently been made salient on posters, subjects were more likely to volunteer help than were subjects who were not self-aware or for whom the norm had not recently been made salient.

Similarly, other researchers have demonstrated that emotions may conflict with cognitive rules for behavior (Scheier, 1976; Scheier, Carver, & Gibbons, 1979). In situations where an emotion has recently become aroused, the individual behaves more in line with that emotion than with any other salient standard. For example, if an individual
has been frustrated recently, a state of self-focus will result in a heightened level of frustration, at the cost of adherence to more long-term standards (i.e., patience).

**Dynamic aspects of the self.** Additionally, Wicklund (1980) suggested that some aspects of the self are more powerful determinants of behavior than are other aspects. For example, he stated dynamic components of the self, such as drives, needs, and emotions, overpower more static aspects, such as attitudes and values. He also suggested that unique or ego-involving features of the self are more powerful than those aspects shared with a group (Duval, 1976).

**Complexity.** Carver and Scheier (1981) suggested that standards even vary in their degree of complexity, and can be thought of in hierarchical terms. More specifically, when an individual construes an event at a complex level, it is expected that the response-specifying behavior also be at a complex level. Likewise, if the event is construed at a simpler level, it is expected that the response-specifying behavior also be at a simpler level. This suggests that any given event may evoke a number of different behavioral standards, all existing at different levels of the hierarchy. For instance, an individual who observes a pointillistic painting may perceive only dots of varying colors of paint and simply react to it at that level. On
the other hand, he or she may perceive the picture as an integrated whole (presumably at a higher level on the hierarchy) and react to its subject matter, style, and artistic creativity. Likewise, the level of the behavioral standard on which attention is focused may determine the type of behavior the individual will engage in.

Additionally, Carver and Scheier (1981) pointed out that behavior itself exists in a hierarchy. For instance, playing racquetball consists of many levels of behavior. First, the superordinate standard may involve being a good player. At a lower level, one may focus upon a standard for how to grip the racquet; or at an even lower level, the present tension of muscles could be compared to the standard tension of the muscles. If an individual is operating at the higher levels of the hierarchy, all the lower level behaviors should be automatically matched against their corresponding standards (that is, while attempting to match the superordinate standard of playing well, the racquetball player should automatically engage in comparing his or her racquet grip with the standard, comparing muscle levels with the standard, etc.). Thus, all subordinate behaviors tend to be rather automatic unless attention is specifically directed to them. In such instances, engaging in the comparison process at the lower levels disrupts the smoothness of the behavior; and if the racquetball player
concentrates on his or her grip, the end goal of playing well may be interrupted. In fact, attending to these levels reduces the amount of attention available for focusing on the environment (in this case the racquetball). Finally, Carver and Scheier suggested that some end goals may not contain such a specific program of lower level behaviors which facilitate goal attainment. Instead, the individual must make several intermediate decisions to make sure he or she is approaching the desired standard (i.e., on the basis of social comparison).

Dispositional factors. According to Buss (1980), the standard, public or private, which becomes salient at any given time may depend upon an individual's disposition or the situation. He suggested that public/private self-consciousness was a dispositional factor (measured by the Fenigstein et al., 1975 scale). Some individuals are consistently high or consistently low in public or private self-consciousness. While these states sound mutually exclusive, they are actually independent of each other (the typical correlation being about .30). Thus, it is possible to be high in both public and private self-consciousness, or low in each dimension. Being high in private self-consciousness is associated with following one's own salient attitudes, morals, and beliefs. On the other hand, those who are high in public self-consciousness
are most likely to adhere to salient normative and self-presentational standards. For instance, Greenberg (1983) found that when two opposing standards were made salient, subjects who were high in private self-consciousness were most likely to distribute rewards equitably (a private standard), while those who were high in public self-consciousness were more likely to follow an equality strategy (a public standard).

**Situational factors.** Public and private self-awareness also may be evoked by the situation. That is, stimuli in the environment direct attention to either the public or private aspects of the self. According to Buss, transient states of public self-focus may be the result of such stimuli as an audience, a camera, or a microphone. All of these stimuli should remind the individual of aspects of the self that are important when one interacts with other persons. States of private self-focus may be the result of a small mirror, introspection, diary writing, and meditation. Buss recommended the use of a small mirror to induce private self-focus. The rationale being that people see themselves in small shaving/make-up mirrors everyday. Thus, it is likely that any public self-awareness would be habituated, and the small mirror would cause an individual to only focus attention inwardly on salient dimensions of the true self.
(i.e., actual attitudes, and beliefs). Empirical evidence generally supports the notion that a small mirror produces self-awareness, and results in a transient state similar to the dispositional state of private self-consciousness (Gibbons, 1978; Scheier & Carver, 1977). Likewise, Duval (1976) found that in the presence of an audience, subjects were likely to conform, suggesting that they were concerned with the public aspects of the self. Buss (1980) suggested that such conformity would not occur in the presence of a small mirror.

In summary, while the concept of the standard is an integral part of the process of self-regulation, its character remains somewhat ambiguous. It may take on the form of an ideal state or guideline for correct behavior coming from within the individual, or it may take the form of an external guide derived from comparing the self to others. Whatever its source, the standard is triggered by the nature of the situational context (Scheier & Carver, 1983). Likewise, at any given time, many potential standards are available to the self. Which standard is chosen depends on a number of factors, such as saliency, recency, and importance of the standard. According to the theory, the standard that is chosen will be compared to the existing behavioral state.

Scheier and Carver (1983) provided evidence for this
central postulate. In a series of studies, they demonstrated that both situational and dispositional self-focus resulted in subjects seeking out more concrete information. Scheier and Carver suggested that this was representative of attempts to adhere to a more overt standard (such a good performance). For instance, self-focused subjects were more likely to seek out information in drawing geometric figures and were more likely to compare their performance to a set of norms (both of these comparisons could serve as a concrete standard) than were control subjects. If a negative discrepancy exists (the most likely occurrence), existing behavior will likely be matched to the standard.

Although the preceding section has focused on self-focused attention, actual behavioral consequences have not yet been discussed. After a brief review of the concept of outward focus, the limitations and benefits of attentional focus will be further addressed.

**Outwardly-directed attention: The absence of insight**

When people are not focused internally on the self, their attention is directed toward salient stimuli in the environment. Duval and Wicklund (1972) called this state **subjective self-awareness**. "Subjective self-awareness is a state of consciousness in which attention is focused on events external to the individual's consciousness, personal
history, or body" (Duval & Wicklund, 1972, p. 2). It is exactly the opposite state of objective self-awareness, where an individual's focus is entirely on the self. Although the term "subjective self-awareness" was eventually dropped from future revisions of the theory (Wicklund, 1975), the notion of external focus has remained a part of its many revisions. For instance, Carver and Scheier (1981) suggested that attention may be focused outwardly (on the environment) or inwardly (on stimuli either relevant or not relevant to the self). They suggested that even when an individual focuses on the environment or an internal image not related to the self (i.e., an image of a tree), the self is still involved. Focusing on the environment involves perceptions that are compared with "stored records" existing within the self. Although these latter two perceptions do not play a major role in self-focused behavioral regulation, they may also be used as reference points when the individual is self-aware.

Deindividuation. Duval and Wicklund (1972) stated that when people focus on the environment, they are not aware of their own internal standards and rules, and as a result they feel no drive to bring their existing states in line with them. The more time an individual engages in environmentally-focused attention, the less likely the behavior will be self-regulated, and the more likely the
individual will engage in antinormative acts. In extreme cases of outwardly directed focus, the individual may become deindividuated (Wicklund, 1978, 1980). In a deindividuated state, the individual follows environmental cues to the exclusion of any self-standards. This does not include merely focusing attention outwardly; it involves becoming totally immersed into a group at the expense of any attention switching back to the self (Diener, 1979).

According to Diener (1977), cohesiveness, uniformity, and group roles may all contribute to this state of deindividuation. Additionally, Zimbardo (1969) suggested that the deindividuated state may arise from heightened feelings of anonymity. Thus, if a group attracts all of an individual's attention, he or she may join them in antinormative behavior (i.e., a violent demonstration) without stopping to consider his or her own personal standards or values. According to Wicklund (1980) and Diener (1980), deindividuating situations decrease self-awareness, and are accompanied by antinormative behavior.

Several studies have demonstrated the effects of outwardly directed attention on behavior. In general, the findings support the notion that increases in antinormative behavior follow decreases in the amount of self-directed attention. Thus, self-focused trick-or-treaters in the
Beaman et al. (1979) study were not likely to transgress in conditions where they had given their names and addresses. Children who remained anonymous, however, were more likely to transgress, even in the presence of a mirror. Likewise, Deiner, Lusk, DeFour, and Flax (1980), found that increasing external focus (presumably, increasing focus on the group) resulted in a decrease in the amount of embarrassment subjects reported for engaging in embarrassing tasks (i.e., painting with one's nose, or sucking on a baby bottle). Thus, outwardly-directed attention often results in the loosening-up of long-standing norms and standards; while increases in self-focus bring about a sense of individuality and personal responsibility. The result is the self-focused individual is likely to adhere to personal or normative standards.

**Behavioral changes and self-focus**

The behavioral change that accompanies states of self-focus is often positive and socially desirable, while outward focus is often associated with negative or undesirable behaviors. Self-aware individuals may adhere to standards of high performance, honesty, accuracy, or responsibility. Self-awareness does, however, have limited benefits. It is not a means for improving all types of performance or behaviors. In fact, in some instances self-focus may impair functioning on an external task, or it
may result in a behavior counter to a productive social norm. One purpose of the present research is to apply the postulates of self-awareness theory to the area of decision making in the hope of providing a means for decision enhancement. Before doing this, however, it will be helpful to review the outcomes of other self-awareness research and to isolate factors which are suggestive of moderating the effects of self-focus.

**Performance on self-related tasks.** Many researchers have studied the effects of increasing self-focused attention on the individual's performance on self-knowledge tasks. As discussed in the Introduction, many researchers have suggested that the individual has very little self-insight (Nisbett & Wilson, 1977; Ryle, 1949). This notion is supported by much research reporting low correlations between self-report and actual behavior (Wicker, 1969). One of the most robust findings in the self-awareness literature, however, is a strong link between self-focused attention and accuracy of self-report. In fact, self-focus has consistently been shown to improve the correlation between self-report and actual behavior by .30 to .40 points (Gibbons, 1983).

According to Gibbons (1983), not only do self-focused individuals more accurately report their attitudes, cognitions, affect, and somatic states, but they also tend
to bring their overt behavior more in line with previously expressed attitudes. For instance, Pryor, Gibbons, Wicklund, Fazio, and Hood (1977) demonstrated that self-reports of sociability were more consistent with previous behaviors for subjects in self-focused conditions (mirror and high private self-consciousness) than for subjects in a no mirror condition (or dispositionally low in private self-consciousness). Likewise, self-focused attention has enhanced subjects' accuracy in reporting SAT (Scholastic Achievement Test) scores (Pryor et al., 1977), somatic states such as arousal or absence of arousal (Gibbons, Carver, Scheier, & Hormuth, 1979; Gibbons & Gaeddert, 1984; Scheier, Carver, & Gibbons, 1979), taste (Scheier et al., 1979), religious attitudes (Fazio & Zanna, 1978; Olson & Zanna, cited in Carver & Scheier, 1981), length of hospitalization and participation in treatment programs (Gibbons, Smith, Ingram, Pearce, & Brehm, in press), and emotional states such as fear of shock (Scheier et al., 1981). Although individuals are able to report their feelings more accurately when self-aware, reporting the causes of the feeling may be more difficult (Gibbons & Gaeddert, 1984).

Other researchers have demonstrated that enhancing self-focus in the behavioral state (rather than during self-report) also results in strengthening the link between
self-report and behavior. Gibbons (1978) had subjects complete a scale measuring their sexual attitudes. Later these same subjects were asked to rate erotic stimuli as to the degree it was appealing and arousing. When self-focus was enhanced during these ratings, subjects' ratings were more consistent with their previously stated attitudes. Similarly, Carver (1975) chose subjects on the basis of their attitudes toward the use of punishment. Later these subjects were asked to participate in a learning task, where they were able to choose the level of punishment to administer to a "learner." Only in conditions where subjects were made self-aware did their previously stated attitudes correspond to their actual choices of punishment levels.

While self-focus was manipulated in these studies, other studies have been concerned with the effects of levels of self-consciousness on accuracy of self-report and have found similar results. For example, Scheier, Buss, and Buss (1978) obtained a pre-measure of subjects' attitudes towards aggression. Later these subjects were asked to participate in an experiment where they would be given an opportunity to administer shocks. Those subjects who were high in private self-consciousness were most likely to behave in accordance with their previously stated attitudes. Likewise, Scheier (1980) reported subjects who were high in private
self-consciousness and low in public self-consciousness did not moderate previously stated attitudes, even when they were led to believe they would be discussing the attitude with someone who disagreed.

Performance on nonself-related tasks. Although research on the effects of self-focus deals almost exclusively with accuracy on self-knowledge tasks, some researchers have focused on its facilitating effects for nonself-related tasks. In a recent study, Bowers and Williams (1984) asked subjects to play the role of an eyewitness whose task was to identify a suspect (whom they had previously seen on a videotape) from police photographs. Subjects who were seated in front of a mirror (self-aware condition) were more likely to identify the suspect accurately when his picture was actually present, and less likely to misidentify him when the picture was not present. Self-focus may also facilitate task performance when the task requires speed. For instance, in a study where speed was the salient standard, subjects copied prose faster when in front of a mirror than did subjects in a control condition (Wicklund & Duval, 1971). Likewise, performance was facilitated for self-focused subjects who were asked to make a well-thought-out decision regarding a sex education course. In this study, self-focused subjects requested more information on which to base their decisions than did those
subjects who were not self-aware (Wicklund & Ickes, 1972). Presumably, consideration of relevant information would result in a wiser decision. Why does this facilitation effect occur? What factors are responsible for the effects that self-focus has on performance?

Positive influences of self-awareness. A state of self-awareness may bring about positive behavioral change in two ways. First, from a behavior-regulation stance, self-focused attention causes an individual to act in accordance with salient standards. According to Gibbons (1983), this may be the result of both attentional and motivational factors. That is, when an individual is drawn to a single standard, he or she is preempting possible alternative attentional influences and is motivated to keep behavior in line with the salient standard. If these standards are desirable, so is the resultant behavioral change. Second, self-awareness may change the way in which an individual processes and recalls information (Hull & Levy, 1979). This too has been associated with enhanced performance and will be discussed in greater detail following a discussion on behavioral regulation. Thus, under many circumstances self-focused attention may be a useful tool in improving performance. It would be premature, however, to suggest that all behavior (including a decision) is enhanced by merely directing attention
inwardly. In the following paragraphs the influence of both attentional and motivational aspects of self-focus will be discussed in terms of performance facilitation and inhibition.

**Attentional effects of self-focus**

**Performance and the fixed capacity model.** Duval and Wicklund (1972) proposed a fixed capacity model of attentional focus in which self-directed attention naturally results in a decrease in outwardly-directed attention. Information that is not paid attention to has little influence on the individual's behavior. For example, Ellis and Holmes (1982) found that self-focused subjects were less likely to interpret an interviewer's behavior as feedback about themselves than were control subjects. That is, they were less likely to interpret warm behavior as a positive rating and cold behavior as a negative rating of themselves than were subjects whose attention was not focused on the self. Ellis and Holmes suggested that self-focus results in a type of cognitive process that is incompatible with processes needed to interpret the environment.

**Facilitation of performance.** A reduction in environmental focus can be beneficial and result in performance enhancement since attention is only directed to the aspect of the self that is relevant in the particular situation; and as a result, the effects of distractors are
greatly reduced. In fact, several researchers have reported that self-focus decreases suggestibility and demand cues (Gibbons, 1978; Gibbons et al., 1979; Gibbons & Gaeddert, 1984; Scheier et al., 1979; Scheier, Carver, & Matthews, 1982). In several of these studies, subjects were given placebos, and told that the drug would produce a change in their own physiological state (i.e., arousal). Those subjects who were self-aware were less likely to be influenced by the experimenter's suggestion and were more likely to accurately report their somatic states than those who were not self-aware.

Related to reducing suggestibility, self-focus should decrease the likelihood that the individual will respond in a socially desirable manner (as long as accuracy or truthfulness is a salient standard). Gibbons and Gaeddert (1984) hypothesized that nonself-aware subjects would engage in a self-serving bias when describing the effects of a placebo on their performance. That is, when they were informed that the placebo had performance inhibiting effects they reported more arousal from the drug, and hence, were able to take more credit for good performance. When they were told that the drug resulted in performance facilitation, they reported it influenced them less, again taking more credit for their performance. This suggests the subjects' attention was focused on others' responses to them.
rather than on their own internal states. Self-aware subjects did not use the self-serving bias. They instead reported levels of arousal that approximated their actual somatic states more closely. Similar results are reported in Pryor et al. (1977). Self-aware subjects were less likely to report SAT scores in socially desirable ways.

Inhibition of performance. Dichotomous attentional factors may not, however, exclusively result in performance enhancement. Brockner (1979) suggested that self-focus reduced the amount of attention the individual paid to the task at hand, which, in some cases, resulted in a decrement in performance. Brockner's subjects were individuals who were low in self-esteem and high in self-consciousness. When the subjects were instructed to focus on the task rather than themselves, performance was enhanced. Similar results have been reported concerning test-anxious subjects. Carver and Scheier (1981) suggested that these individuals neglected or failed to pay attention to test relevant cues. They were instead preoccupied with thoughts of self-doubt. Self-focusing may result in focusing more intently on the anxiety surrounding self-doubt and thus result in performance inhibition. Usually, subjects have attempted to withdraw by ignoring the task, or avoiding difficult problems (Carver & Scheier, cited in Carver & Scheier, 1981; Nottelman & Hill, 1977).
subjects were made to have high expectancies for task success, however, self-focus had a facilitating effect (Slapion & Carver, 1981). Likewise, Scheier and Carver (1980) found that self-focus was more likely to result in task persistence rather than task inhibition for nonanxious persons.

Vallacher (1978) also suggested that self-focus was detrimental for tasks where the subject was required to monitor the behavior of another person. In this study, subjects viewed videotapes of women interviewing for a job and were later asked to make several judgments about the job applicants. Self-focused subjects were less able to discriminate among others on several trait dimensions than were subjects for whom self-focus was not induced. This finding appears to place great restrictions on the usefulness of attentional focus for enhancing performance on external tasks. Closer inspection suggests that findings such as Vallacher's are also limited. For instance, in inducing self-focus, Vallacher located subjects in front of a videotape camera and informed them that they would be participating in a study using body language. Additionally, they were told that other individuals would be rating them on several aspects of their own body language, such as attention, relaxation, and interest. By giving these instructions it may be that "good" body language, rather
than a thoughtful decision about the stimulus persons, became the salient standard to which behavior was drawn in line. If this explanation for Vallacher's results is correct, it may be that the detrimental effects of self-focus can be reduced by more carefully controlling what will be the salient standard.

**Performance and attribution to the self.** Attribution theorists (Jones, 1976; Jones & Nisbett, 1971) have proposed that actors and observers have different perspectives on behavior. Actors tend to attribute responsibility for behavior to the situation, whereas observers attribute it to the actor's disposition. These differences in attribution are the result of attentional focus. When an individual observes another's behavior, attention is focused outwardly on that individual, the opposite occurs when the individual observes his or her own behavior. When attentional focus was reversed using videotape monitors, actors who observed their own behaviors were more likely to make dispositional attributions (Storms, 1973).

**Responsibility.** Wicklund (1975) also has suggested that when an individual is made self-aware, he or she is more likely to make a dispositional attribution and take responsibility for an outcome. Increased responsibility can be very beneficial to performance enhancement (Latané & Darley, 1968; Petty, Harkins, Williams, &
Likewise, Wicklund (1975) pointed out that when an individual takes responsibility for a negative outcome, he or she will likely engage in discrepancy-reducing behavior, which would likely result in performance enhancement.

**Conformity.** Duval and Wicklund (1972) suggested that focusing attention on oneself often results in conformity. For example, Duval (1976) led subjects to believe they held either a majority, an average, or a minority opinion on several attitudinal measures. One half of these subjects were then made self-aware with the use of a television monitor. The results indicated that those individuals who were both self-aware and members of the minority were most likely to change their estimates on a visual task to go along with the majority. Duval suggested that the individual, as well as the group, searches for the cause of the error (the discrepancy). Because novel stimuli (such as being a member of the minority) catch attention, it is likely that the minority member becomes the focus of attention, and as a result the perceived cause of the error. The resultant behavioral change on the part of the minority is an attempt to reduce the discrepancy. While conformity results in some positive outcomes (i.e., making a quick, efficient decision or establishing the correct behavior in an ambiguous situation), it is also associated with some
outcomes that are negative such as the effects of group think (Janis, 1982). Although self-focus increases conformity, the effect is limited. According to McCormick (cited in Wegner, & Vallacher, 1980), if an individual is committed to his or her attitude (and this attitude conflicts with the majority's attitude), there is a reduced likelihood that the conformity will occur, since consistency of attitude may be a more salient standard.

Self-focus and emotional states. The saliency of emotional states may also serve to limit the beneficial effects of self-focused attention. Wicklund (1980) stated that dynamic aspects of the self, such as emotions, are more likely to become salient standards than are static aspects, such as cognitions or attitudes. In fact, several studies have demonstrated that in cases where the affective state was salient, self-focus actually impaired accuracy of self-reports, since subjects were more likely to behave consistently with their affective states than with their long-term attitudes. For example, Scheier, Carver, and Gibbons (1981) found that self-focused subjects were less willing to undergo a painful shock treatment. Because the situation was highly arousing, the salient standard for the self-focused individual became fear (and withdrawing from the painful situation the behavioral response), while a more attitudinal standard (one should help science) was followed
by the nonself-focused subjects.

Likewise, self-focus has intensified feelings of anger (Scheier, 1976), sexual arousal (Scheier & Carver, 1977), repulsion (Scheier & Carver, 1977), fear (Carver et al., 1979a), and elation and depression (Scheier & Carver, 1977). Although increasing awareness of emotion can be detrimental to performance, enhancing a positive mood state can be socially very beneficial. For instance, individuals who were in good moods were more likely to pick up a dropped book or papers (Isen, 1970; Isen & Levin; 1972), contribute to the needy (Moore, Underwood, & Rosenhan, 1973), and relay a wrong number (Isen, Clark, & Schwartz, 1976). Berkowitz (cited in Gibbons, & Wicklund, 1982) had subjects talk about a pleasant event that made them either happy or sad, while he manipulated self-awareness using a mirror or no mirror. Subjects who were in a good mood and then made self-aware volunteered more than subjects in any of the remaining conditions. Additionally, subjects who were in a bad mood and then made self-aware volunteered the least.

Self-focus and accuracy of recall. Finally, while self-focused attention seems to enhance accuracy of recall, it is limited in this respect as well. Pryor et al. (1977) found when subjects were asked to recall information that they did not have access to (percentile scores on a psychology test), self-focus did not improve accuracy of
report. That is, directing attention on the self in the recall stage only facilitates performance when the information already has been encoded into memory. While this reduces actual access to knowledge, the motivational aspects of self-awareness may still bring about greater attempts at attaining the necessary knowledge to make a good report.

**Motivational effects of self-focus**

According to Gibbons (1983), the facilitating outcomes associated with self-focused attention are attributable to motivational factors. This follows from a central postulate of the theory which states the individual is motivated to bring behavior in line with salient standards. The nature of the standard, determined by attentional focus and environmental cues, may involve social or cultural norms, personal ideals and values, or more temporary external standards (i.e., instructions). When these standards become salient, the individual is motivated to bring behavior in line with them.

**Adherence to social norms.** Self-focused attention also has a desirable influence on behavior when the salient standard is a desirable social norm. For instance, when attention is focused on a salient helping norm, the individual is motivated to bring behavior in line with this norm, resulting in helping another. If the individual is
self-concerned, however, he or she is motivated to engage in behaviors that would protect or enhance the self. For example, researchers have found that enhanced self-focus results in increased helping when a helping norm is salient (Brockner, Altman, & Chalek, 1982; Duval, Duval, & Neely, 1979; Gibbons & Wicklund, 1982; Gibbons, Wicklund, Karylowski, Rosenfield, and Chase, 1977; Gotay, cited in Gibbons & Wicklund, 1982; Hoover, Wood, & Knowles, 1983), increased honesty in college students (Deiner & Wallbom, 1976) and children (Beaman et al., 1979), greater effort (Wicklund & Duval, 1971; Wicklund & Ickes, 1972), accuracy (Bowers & Williams, 1984; Davis & Wicklund, cited in Wicklund, 1975; Pryor et al., 1977), equity (Greenberg, 1980, 1983), and even aggression when subjects thought that aggressive behavior was normative (Carver, 1974).

Conflicting standards: Protecting the ego. When an individual is personally involved in a situation, the most salient standard may be to protect the self. For instance, if an individual is a member of a crowd in a burning building, the most salient standard may be to help oneself (i.e., by getting out) rather than to be helpful (making sure others get out). Gibbons, et al. (1977) found that helping behavior did increase when individuals were self-focused but only when a helping norm was highly salient. Lingle and McPeek (cited in Gibbons & Wicklund,
1982) found that self-focus decreased helping when individuals were concerned with their own performance outcomes, but they found no decrease in subjects who were not self-concerned. Likewise, if an individual is asked to report scores from an ego-involving test, the most salient standard may be one of self-concern, which would likely motivate the individual to enhance his or her score (becoming less accurate). If, on the other hand, accuracy is the most evident standard, the individual would likely report the scores more truthfully.

In conclusion, there are many instances in which self-focus can enhance or improve behavior. While there are some exceptions to this rule, it appears that if the appropriate standard can be made salient, and the individual's attention is drawn to that particular aspect of the self, self-focus can enhance performance through both attentional and motivational means.

The Self as a Processor of Information

The majority of theoretical and empirical research on self-awareness has focused on the self as a regulator of behavior. Hull and Levy (1979) agreed that comparing present states with standards may be one function of the self, and that self-awareness enhances this aspect of behavioral control. They disagreed, however, that it is the only, or even the most important outcome of self-focused
attention. Instead, they emphasized a second, possibly more important role that the self undertakes: the role of the self as an organizer or processor of information. In this role, the self may engage in the encoding, storing, and retrieving of information, as well as functioning to maintain consistent behavioral responses (Marcus & Sentis, 1982).

The self and its role in the memory process

Before discussing how self-focus can enhance performance via its role in memory processes, it is necessary to consider the relationship between the self and memory. In a series of studies, Rogers and his colleagues (Kuiper & Rogers, 1979; Rogers, 1977, 1981; Rogers, Kuiper, and Kirker, 1977) have demonstrated that when material is encoded by means of a self-reference, it will be better recalled than material encoded by any other means. For instance, subjects who were asked to incidentally recall trait words using self-referents (i.e., did the word describe them?) recalled more of these words than did subjects using structural (i.e., did the word have big letters?), phonemic (i.e., did the word rhyme with another word?), or semantic (i.e., did the word have the same meaning as another word?) references (Rogers et al., 1977). Additionally, self-reference has been demonstrated to produce superior recall in relationship to other referents.
Kuiper and Rogers (1979) found that subjects recalled more trait adjectives when they had made self-referent (describes you?) versus other referent (describes experimenter?) judgments, and Lord (cited in Marcus, 1980) reports superior recall for self-referent versus father, Walter Cronkite, or free referent judgments.

In a recent review by Greenwald and Pratkanis (1984), three self-memory effects, in addition to the self-referent effect, were identified. These included: "the self-generation effect", "the ego-involvement effect", and "the second-generation effect." Briefly, the "self-generation effect" refers to a set of findings which demonstrated that the more actively involved the individual (or self) was in the information gathering processes, the better recall he or she experienced. Studies on ego-involvement have tended to show that material on a persisting task is better remembered than information on a completed task. Finally, the "second-generational effect" suggests that familiar other referents produce better recall than do dissimilar others.

Kuiper and Rogers (1979) suggested that when the self becomes involved in the memory process, a highly organized cognitive schema is used. Thus, the trait adjectives are encoded in relationship to the self-schema. When the subject is asked to recall the trait adjective, the self-schema would guide the process. Greenwald and
Pratkanis (1984) also provided two additional explanations for memory improvement when the self is involved. First, some researchers have suggested that the manner in which information is encoded in relation to the self produces more elaboration (Bower & Gilligan, 1979). The more elaborate the association during the encoding process, the more associations that can be used in attempting to recall the word. Second, Greenwald (1981) has suggested that the improvement in memory may come about because the self-referent acts as a mnemonic device for later recall. Greenwald and Pratkanis (1984) concluded that "relating information to the self is a highly effective strategy for remembering" (p. 5).

The role of self-awareness in the self-memory relationship

According to Hull and Levy (1979), self-focused attention promotes the processing of information in line with a relevant self-schema. In other words, the information would be perceived and encoded in relation to some aspect that is relevant to the self. For instance, the self-focused individual may perceive another person in terms of his or her height and weight, and these attributes would be encoded in relationship to the individual's own body attributes (i.e., the person is heavier than me). Additionally, when a person is self-focused, he or she should be more responsive to the aspects of the environment
that are relevant to the self, or he or she may become more self-involved. This notion is supported by the well-known cocktail party effect in which a person perceives his or her name from a multitude of conversation. This alone, according to Hull and Levy, may account for the change in behavioral response during the self-focused state. Since the individual is attending to, and as a result, processing different information when self-aware, the process of information organization may have a major impact on behavior.

**Empirical support for the Hull and Levy position**

Although the majority of research on self-awareness has been concerned with discrepancy reduction, Hull and his associates (Hull, 1981; Hull, Levenson, Young, & Sher, 1983; Hull & Levy, 1979; Hull & Young, 1983) have concentrated on the self-memory process and how it is effected by self-focus. In the first of a series of experiments, Hull and Levy (1979) had subjects participate in an incidental recall test similar to that used by Rogers et al. (1977). Prior to the test, these subjects had filled out the Fenigstein et al. (1975) self-consciousness scale. The authors found that subjects who were high in private self-consciousness tended to recall more of the trait adjectives than did the other participants. More importantly, however, these subjects (high self-conscious) recalled significantly more words
encoded as self-relevant than did subjects who used
different encoding referents. Thus, it appears that being
self-focused enhanced the subject's sensitivity to the
self-relevant aspects of the trait words and/or allowed the
subject to use a more elaborately developed schema. Hull
and Levy suggested that because the privately self-conscious
subjects did as well (and sometimes better) as the subjects
who were low in private self-consciousness on tasks which
were non-self relevant, the findings can be attributed to an
organizational process involving the self rather than to a
"bidirectional attentional phenomenon." Similar results are
reported by Turner (1980) using an incidental recall task.

Likewise, Hull and Levy (1979) attacked the Duval and
Wicklund (1972) position on self-evaluation. Hull and Levy
suggested that a discrepancy exists only under certain
circumstances and is not a necessary condition for the
performance enhancing effects of self-awareness. To
experience the negative affect associated with a state of
self-focus, subjects in their studies had to encode
information in terms of its self-relevance to evaluation
(Hull & Levy, 1979). In other words, self-focus causes the
individual to become more sensitive to self-relevant cues in
his or her environment. These cues may or may not produce
negative affect.

In further establishing a relationship between
self-focus and memory processes, Hull (1981) began a series of studies on the relationship between states of self-awareness and alcohol consumption. He suggested that alcohol consumption results in a decrease of self-focus. Hull et al. (1983) reported that subjects who drank alcohol used significantly fewer self-relevant statements than did subjects who received tonic. The authors suggested that this difference was due to the alcohol's interference with the self-relevant encoding processes. In a third study, subjects participated in an incidental recall task either under the influence of alcohol or a placebo. The results indicated that alcohol eliminated the effects of private self-consciousness on the ability to recall self-referent trait adjectives. The placebo had no effect.

Hull and Young (1983) allowed subjects to regulate their own alcohol consumption in a wine tasting task, while one-half of these subjects received positive feedback on an intellectual task, and the others received negative feedback. The authors found that those subjects who were high in self-consciousness drank more than other subjects when they received negative feedback and less when they had received positive feedback. These results suggest that those individuals who are high in private self-consciousness are more aware of self-relevant situational factors than were other subjects. When these factors were negative,
subjects sought to reduce self-focus by consuming greater amounts of alcohol. On the other hand, when the factors were positive, self-focus did not appear to be associated with negative affect since subjects did not attempt to reduce it.

Conclusions

While the major thrust of self-awareness research has been on the control aspects of the self, Hull and Levy's view provided an interesting alternative from which to view the phenomenon of self-awareness. Despite the apparent difference in perspectives, common themes can still be maintained. In conclusion, a generic self-awareness theory might state that when people focus inwardly on the self, their behavior becomes more consistent with salient standards. This may be the result of a motivational drive which attempts to reduce all negative discrepancies between standards and currents states (Duval & Wicklund, 1972); a discrepancy reducing feedback loop which also serves to bring behaviors in line with standards (Carver & Scheier, 1981); a state which intensifies the salient behavioral state (Buss, 1980); or the processing of information that is relevant to the self, making a set of self-contingencies most salient (Hull & Levy, 1979).
CHAPTER II
DECISION THEORY: A REVIEW OF THE LITERATURE

The topic of decision making has generated a plethora of multidisciplinary research, resulting in the use of a variety of models, methodologies, and paradigms to describe and explain the judgment process. It is beyond the scope of this review to delve into all areas of the decision-making literature (for a review of this literature see Hammond, McClelland, & Mumpower, 1980). The focus of this chapter will be to highlight several approaches to decision making characterized by cognitive analysis and information integration. The organization of the chapter is to: (a) present a short historical review of the antecedents of decision theory; (b) discuss several mathematical approaches commonly used to uncover and make inferences about decision strategies; (c) review the work on decision quality and its relationship to individual differences in decision processes; and (d) make several suggestions for improving decision accuracy.

Mathematical Models

Using mathematical models to study decision making enables the researcher to study the processes used to arrive at the decision, as well as the decision outcomes. Although the outcome of the decision is certainly important, restricting study to only observable criteria limits the
researcher's knowledge of the decision processes. By investigating the process of decision making, insight into how and why the individual made the decision is possible. To understand decision making, this insight is crucial. Two individuals may make very similar decisions in terms of outcome, but they may make these judgments for very different reasons. If these two individuals were asked to make a second decision, it is unlikely an accurate prediction could be made simply based on previous outcomes. Thus, in attempting to understand how and why the decision was made, or to predict future decisions, insights into how the decision maker weighs and integrates various cues and pieces of information seems to be essential. Mathematical models provide the means for such insight. Before discussing the nature of this insight, however, a short discussion of the historical development of mathematical models in psychology will be presented.

A historical perspective

Slovic and Lichtenstein (1971) traced the use of the information processing model of judgment in psychology to several major sources of influence. The first of these influences comes from early economic and philosophical schools of thought, centering on the notions of utility maximization (Edwards, 1954). Early philosophers suggested that choice was the result of people seeking to maximize
positive outcomes, while minimizing negative outcomes. Following this line of reasoning, economists developed sophisticated mathematical models to predict decision processes (such as those involved in consumer choice) based upon the principles of maximizing utility (assuming a constant environment) and subjective expected utility (assuming a probabilistic environment). While the use of such models was prevalent in economics, there was little attempt to integrate their uses into the field of psychology until the 1950s. In 1954, Edwards integrated the economic decision literature with the sparse psychological literature of the time that had applied models to decision making. From this integration he claimed that, "all of these topics represent a new and rich field for psychologists, in which a theoretical structure has already been elaborately worked out and in which many experiments need to be performed" (Edwards, 1954, p. 411). Edwards' work greatly influenced the development and formulation of normative decision theory.

The second major influence on modern decision theory is, again, borne out of psychologists' developing interest in the probabilistic nature of the environment. In the 1940s and 1950s many psychologists were beginning to turn toward probabilistic models to explain psychological phenomenon (Brunswik, 1940, 1955, 1956; Bush & Mosteller,
1951; Estes, 1959; Miller & Frick, 1949; Mueller, 1950; Smedslund, 1955). According to Estes (1959), "the state of the field in the late 1940s was ripe for a probabilistic or statistical type of learning theory" (p. 386). Estes began his theoretical work by fitting mathematical or probability functions to learning acquisition curves representing maze running, treating exceptions as probabilities rather than searching for mediating variables.

Probably the most influential of these theories, however, has been Brunswik's classic work on representative design and probabilistic theory (Brunswik, 1940, 1955, 1956). Brunswik believed that the systematic methodology used by psychologists limited their understanding of behavior. Because variables were being artificially manipulated and controlled in the laboratory, he concluded that the subjects' behaviors were limited in generalizability to unrealistically high relationships between variables and outcomes. He proposed that psychology adopt a methodology (this he named "representative design") that would allow the study of behavior as it is related to natural relationships among variables. In doing so, the uncertainty or probabilistic nature of the environment must also be taken into account when the subject responds to various situations. He states, "the environment to which the organism must adjust presents itself as semierratic and
that therefore all functional psychology is inherently probabilistic" (1955, p. 193).

Brunswik's notions, although controversial (Postman, 1954), are quite applicable to many decision tasks in which learning about the probabilistic environment is essential for adequate performance. For instance, decision makers are usually confronted with many interrelated environmental cues. In order to consistently make good decisions, the individual must understand the probabilistic nature of the environment. While Brunswik did not propose the use of specific mathematical models (with the exception that he used an index of correlation in his own research), others have more formally adopted the multiple regression model to study decision making in probabilistic environments (Dudycha & Naylor, 1966; Hammond, 1955; Hursch, Hammond, & Hursch, 1964). The propositions of Brunswik's lens model and Estes' statistical learning theory have facilitated the use of mathematical models of decision theory and have greatly influenced the decision theory literature, especially in the areas of learning and cue utilization.

Additionally, Slovic and Lichtenstein (1971) pointed to the impact of research by Miller (1956) on limited capacity for cue utilization; by Bruner, Goodnow, and Austin (1956) on concept formation; and to the facilitating effects of mathematical and computer advances for the arithmetic
requirements of statistical decision theory, as important sources of influence on actuarial decision making models.

Finally, Dawes and Corrigan (1974) attributed the growing interest in statistical models of judgment to their usefulness in evaluating human judgment. They suggested, with the rise of clinical psychology after World War II, a major area of investigation was to determine the degree to which clinicians could predict such variables as treatment success, recidivism, or even academic success. For instance, linear models provided both a means for comparison and a means for improvement. In fact, Meehl (1954) reviewed several studies which compared human judgment to that produced by the linear model. In all cases, when provided the same input variables as the judges, the linear models proved to be superior in prediction. Several years later, this same conclusion was echoed by Goldberg (1968b).

**Uses and assumptions of mathematical models**

Mathematical models have been used to study decision making in a wide variety of contexts from diagnosing psychiatric illnesses (Dawes & Corrigan, 1974; Goldberg, 1970) and physical illnesses (Christensen-Szalanski & Bushyhead, 1981; Einhorn, 1972; Hoffman, Slovic, & Rorer, 1968; Weinstein et al., 1980) to evaluating theories of motivation (Harrell & Stahl, 1981; Stahl & Harrell, 1981), performance in graduate school (Dawes & Corrigan, 1974), and
faculty teaching effectiveness (Hoepfl & Huber, 1970) to judging the quality of swine (Phelps & Shanteau, 1978), and related agricultural issues (Anderson, Dillon, & Hardacker, 1977), the value of stocks (Slovic, 1969; Slovic et al., 1972), the safety of nuclear power plants (Keeney, & Nair, 1977), discrimination claims (Maniscalco, Doherty, & Ullman, 1980), and even the point spreads of football games (Pankoff, 1967). The application of these models to the decision process can be characterized by two major purposes: (a) mathematical models may be used in a descriptive sense to represent the decision maker's judgments; and (b) the models may provide a normative or optimal model of the combination of cues in the environment with which to compare the decision maker's decision, or it may be used as a basis with which to improve the quality of judgment.

Representation. The notion of representing a judge's decisions via mathematical models is not a new one. For instance, Dawes and Corrigan (1974) reported that in 1923, Henry A. Wallace (later to become president Franklin Roosevelt's second vice president) proposed applying mathematical models to corn judges' decisions to determine what factors they considered important in judging corn. It was not until 1960, however, that this method received much attention (Dawes & Corrigan, 1974). The impetus for the interest came from a paper by Hoffman (1960) proposing that
mathematical models (in particular linear models) be used to represent cognitive processes. According to Hoffman (1960), a mental process refers to "a functional relationship which accounts for consistencies in response to divergent stimulus patterns" (p. 117). Mathematical models applied to a series of judgments are assumed to capture these relationships, thus, representing the judges' cognitive processes.

This assumption, that mathematical models are representative of decision processes, is limited, however, to what Hoffman (1960) termed "paramorphic representation." That is, while a particular model may account for much of the variance in the judges' decisions, its robustness may mask important information that also goes into the decision. In other words, while a judge may be using a complex strategy in which he or she integrates available cues in a nonlinear fashion, it may still be best represented by a simpler additive model (i.e., the linear model). For instance, random weights often do as well as optimal weights in predicting a criterion, yet rarely do people report randomly weighing variables in making their decisions. Although this assumption limits the use of mathematical models in the realm of understanding, Hoffman (1960) has proposed methods by which this limitation can be minimized.

One method of counteracting this problem involves determining the fit or appropriateness of the model by
examining the source of error from the regression analysis. Hoffman (1960) suggested that when the discrepancy between the judge and the model can be explained as unreliability (that is, representative of random error as opposed to systematic error) it is an indication that the model fits the judge. In other words, systematic error suggests the inappropriateness of the model, while random error suggests inconsistencies in the decision maker's judgment (due to factors such as fatigue or boredom). In a similar fashion, Goldberg (1968b) stated that the accuracy or representativeness of the model may be ascertained by: (a) cross-validating the regression equation on another subset of judgments (this yields the multiple correlation coefficient); (b) having the judge evaluate the same stimuli on two different occasions, computing a reliability coefficient; and (c) comparing the values of the multiple correlation with the reliability coefficient. The model is deemed to be a good representation of the judge's decision if the multiple correlation coefficient approaches the reliability coefficient.

A second means of increasing understanding has been to use more complicated, configural models of the decision process. Hoffman and his colleagues (Hoffman et al., 1968; Rorer, Hoffman, Dickman, & Slovic, 1967; Slovic, 1969), and Anderson and his colleagues (Anderson & Jacobson, 1968;
Lampe & Anderson, 1968; Sidowski & Anderson, 1967) have suggested that these more complex, configural models, which use techniques such as the analysis of variance, should be encouraged when the research goal is one of understanding the decision process. When the goal is one of prediction, the linear model has been recommended (Dawes & Corrigan, 1974; Goldberg, 1968b; Hoffman, 1960). The appropriate use of nonlinear versus linear models has not, however, been a clear-cut issue (Slovic, 1969). Slovic and Lichtenstein (1971), offered a temporary solution to the controversy by stating, "it seems appropriate to conclude that notions about nonlinear processes are likely to play an increasing role in our understanding of judgment despite their limited ability to outpredict linear models" (p. 683).

In conclusion, by using mathematical models to represent the judgment processes, the researcher obtains three important pieces of information. These are: (a) the importance or weight given to each of several environmental cues in the decision process; (b) the means by which the judge combines and integrates these cues (i.e., additively versus configurally); and (c) the consistency with which the judge uses and integrates these cues within the decision strategy represented by the model (this may be used as an indication of the model's fit or the consistency of the judge). Thus, mathematical models allow the researcher to
describe and, in a more limited sense, understand the decision process. Much of the practicality of this knowledge lies in its application to decision improvement. For example, Dawes and Corrigan (1974) suggested that replacing the decision maker with a model of his or her decision processes, a method termed "bootstrapping," will result in better judgments. The rationale behind this is that the model is more consistent and less susceptible to irrelevant cues and fatigue than is its human counterpart. Likewise, capturing strategies of experts may provide meaningful cues for the training of new decision makers.

Optimization. In addition to describing the judge's mental processes, mathematical or probability models may also be used to obtain information concerning the relationship between cues and outcomes in the environment. For example, an optimal decision strategy may be determined by obtaining the mathematical model that best predicts the use, weighting, and combination of cues in the environment, or it may be established by following an optimizing rule, such as Bayes' theorem. (A more detailed example of optimizing models will be discussed later.)

Like representative models of the judge, the use of optimizing models is not a new idea. For instance, Dawes and Corrigan (1974) stated that as far back as 1772, Benjamin Franklin used linear optimizing models to aid his
own decision making. More recent influences include applications of theories of rational, economical man and utility maximizing to psychological decision making (Edwards, 1954), the Brunswik lens model (Brunswik, 1956), describing the individual's interaction with the probabilistic environment, and the application of Bayes' theorem to judgment (von Neumann & Morgenstern, 1944). The common underlying assumptions of these theories are that: (a) judgment is a rational process; (b) optimal models of judgment do exist; and (c) these optimum models can be learned and followed. Thus, if a judge can model or take into account the optimum strategy (whether it be economic man, the environmental side of the Brunswik lens model, or Bayes' theorem) the decision quality and accuracy will likely be enhanced.

To address this notion further, an example following Brunswik's work will be considered in detail. Brunswik's (1955, 1956) theory rests on the basic assumption that the environment is probabilistic and should be studied in a probabilistic manner. This implies that knowledge of the probabilistic environment is of adaptive significance to the organism. In extending the lens model to decision making, Brunswik made the assumption that there is an optimal model (a model that optimizes prediction, and hence optimizes success) for combining and weighting cues in the
environment, and that the individual judge is more likely to be successful in judgments to the extent that he or she learns the natural relationship between cues in the environment, thus following the optimal model. For instance, the best strategy for predicting the winning horse at a race track may be obtained following Brunswik's model. When betting on a horse race, there are a multitude of cues the racing enthusiast may take into consideration when placing his or her bet. He or she may use information regarding the length of the track, or its condition, the jockey, the post position, the horse's past performance, or even the horse's name. Although horse racing is, without a doubt, a highly probabilistic event, and perfect prediction cannot be expected to occur, an optimal combination of these factors still exists. That is, a specific weighting and integrating of these cues will result in the highest likelihood of success. The model that best predicts the outcome is an optimal model.

With knowledge of the optimum model, the bettor may improve his or her chances of success in several different ways. First, the optimal model may be used as a source of comparison. Because the individual's own decision strategy could be obtained from a mathematical model, it could be compared to the optimum model. Second, the individual could attempt to model such a strategy (i.e., the model may
prescribe that he or she should consider past performance and the condition of the track most heavily, while ignoring name), and even receive feedback on how well he or she is accomplishing the task (either in terms of outcome or cue utilization). Third, the gambler could use the optimal model as a replacement for his or her own judgments. According to Dawes and Corrigan's (1974) work, this final use would very likely result in the best "luck" at the racetrack.

Much like the gambler, the researcher also obtains valuable information from these models, which can often be used to enhance decision making. In order to do so, however, several assumptions must be made. These are; (a) the individual's decision processes (i.e., his or her weighting and integration of cues) may be represented by a mathematical model; (b) the optimal weightings and combinations of cues in the environment can also be obtained and represented by a mathematical model; and (c) the interaction, representing the judge's relationship to the environment (i.e., knowledge of probabilities and the nature of the environment) can be determined statistically.
Situational constraints. A final concern is the appropriateness of the setting for studying decision making from the perspective of mathematical models. Much like classic arguments over the values of controlled laboratory experiments versus more naturalistic field studies, the appropriateness of the situation has been a disputed issue. For instance, following from his beliefs in representative design and the importance of studying judgment as it naturally occurs, Brunswik (1956) stated that the lens model is an appropriate model for studying phenomena in naturalistic settings because it incorporates the interaction between the individual and the environment. Thus, according to Brunswik, the naturalism of the research stimuli is essential for true understanding of the decision process.

Hoffman (1960), on the other hand, stressed the importance of controlled situations, in which multiple quantifiable cues are available and identifiable in the study of decision making. The control allows the researcher to better isolate the effects of the various factors on the decision. This restriction, contrary to Brunswik's, tends to limit the use of mathematical models in naturalistic settings, since most naturally occurring cues do not often meet these restrictions. Hoffman and his colleagues did suggest ways to minimize this problem by using relative
weights (Hoffman, 1960), or by using the analysis of variance technique (Hoffman, 1968; Hoffman et al. 1968).

**Approaches and paradigms**

The area of decision theory can be categorized into two major orientations. First, there is a vast body of literature incorporated under the general category of "Decision Analysis," incorporating much of the research conducted in the areas of mathematical and economic decision making. [See Raiffa, 1968 for a description of the area.] This includes work in the areas of utility and multiattribute utility analysis (Fishburn, 1970; Huber, 1974; von Neumann & Morgenstern, 1944), Bayes' theorem (Edwards, Lindman, & Savage, 1963; Lindley, 1971; Slovic & Lichtenstein, 1971), linear programming (Glicksman, 1963; Hadley, 1962; Hughes, & Gravoig, 1973; Swanson, 1980), network analysis (Whitehouse, 1970), dynamic programming (Hadley, 1974), game theory (Glicksman, 1963; Luce & Raiffa, 1957; von Neumann & Morgenstern, 1944), stochastic decision models (Fishman, 1978; Lee, 1966; Parzen, 1962; Takacs, 1966), and signal detection theory (Swets, 1964; Tanner, & Swets, 1954).

Characteristic of these paradigms is the division of the decision problem into smaller manageable units, followed by synthesis. Thus, the goal is for the decision maker to optimize his or her decision by following a mathematical
rule or model. If the decision maker follows the rule, the decision will likely be enhanced. For instance, an individual may be asked to make a financial decision involving the choice of two actions. Each of the actions is associated with a probability of risk and expected outcomes. The decision analyst would suggest that the decision be broken down into a number of sub-decisions and the decision maker base these choices on a mathematical formula, taking into account the utility of each outcome and the expected probability of attaining it. Typically, the emphasis of decision analysis has been strictly normative, with researchers paying little attention to explaining actual human choice (Lee, 1971).

The second orientation includes literature in the general categories of "Behavioral Decision Theory" (Edwards, 1961; 1967; Slovic & Lichtenstein, 1971), "Psychological Decision Theory" (Kahneman & Tversky, 1979), and "Social Judgment Theory" (Brunswik, 1956; Hammond, 1966). This includes work within several paradigms, including the linear model (Dawes & Corrigan, 1974; Hoffman, 1960; Slovic & Lichtenstein, 1971), the ANOVA model (Hoffman et al., 1968; Slovic, 1969; Slovic & Lichtenstein, 1971), integration theory (Anderson 1969, 1970), conjoint measurement (Luce & Tukey, 1964; Tversky, 1967), the Brunswik lens model (Brunswik, 1956; Dudycha & Naylor, 1966; Slovic &
Lichtenstein, 1971), the process-tracing approach (Clarkson, 1962; Hayes, 1968; Kleinmuntz, 1968), and multidimensional scaling (Subkoviak, 1975). Additionally, psychological decision theory encompasses studies on human irrationality (Kahneman & Tversky, 1979; Tversky, 1969; Tversky & Kahneman, 1981, 1983) and regret (Loomes & Sugden, 1982). While the basis of these areas in decision theory are also mathematical, the goal of the research is typified by the understanding and description of the decision process.

The diversity of decision-making issues, research problems, and situational constraints have resulted in this variety of mathematical approaches and paradigms to study human judgment. These approaches differ widely in the assumptions, methodologies, and statistical techniques they employ, as well as the problems they seek to answer. Again, because of the vast variety of research conducted on mathematical models of decision making, the focus of this paper will be narrowed to address two paradigms commonly used in the behavioral decision theory literature. These particular models have been chosen because of their emphasis on description and understanding, as well as on their normative capabilities. Discussion of the models will center on: (a) their assumptions; (b) a description of each model; (c) the model's uses; and (d) conclusions that have been drawn about the models. The paradigms to be included
in this discussion are the linear model and the nonlinear model.

The linear model and policy capturing

In studying the decision-making process, many researchers have applied a general linear function to a series of judgments. This procedure enables the researcher to capture an individual's decision policy or strategy, and to describe the ways in which the individual uses and integrates information. The application of this model to decision making has been attributed to Hoffman's (1960) work on the description of cognitive processes. Although many of the assumptions and rationale outlined by Hoffman have been discussed or alluded to in previous pages, a more detailed summary will be presented at this time.

Definitions and assumptions. Hoffman (1960) defined the linear model as "one in which judgments are described as a simple weighted sum of the values of the information available" (p. 119). In other words, it is assumed that if a judge's cognitive processes are such that he or she combines information in an additive fashion, the linear model would capture this as explainable variance. Additionally, any unexplainable variance would be in the form of error or random variance representing inconsistency rather than misfit of the model. When these conditions are met, the linear model is considered an appropriate
representation of the individual's decision processes. Again, this notion of description is limited, however, by Hoffman's concerns regarding paramorphic representation.

According to Hoffman (1960), the linear model, or mathematical models in general, are only appropriately used to describe decision making in controlled situations. That is, the situation must be one in which knowledge of all possible information is available, and both informational cues and the decision outcome are quantifiable. Generally these restrictions imply that the kinds of information available to the judge be constant across judgments, that it be expressed numerically, and that each variable attains at least ordinal level scaling. Again, this procedure allows the researcher better interpretation of the judge's use of cues. Contrary to this assumption is Brunswik's position of studying relationships as they occur in the natural environment. Although this limits the interpretability of causal relationships, it enhances the generalizability to real life situations.

The model. The linear model can be appropriately applied to a judgment situation in which the decision maker is asked to make a series of judgments based upon a number of stimulus cues. The judgments are treated as the dependent or criterion measures, while the stimulus cues are treated as independent or predictor variables. This
establishes judgment as a function of the use of various stimulus cues. The application of the model to the decision process is typically accomplished through the use of multiple regression procedures. According to Slovic and Lichtenstein's (1971) classification of decision theory approaches, the linear model falls within the category of correlational paradigms under the more general category labeled regression approaches. This simply implies the characteristic use of the multiple regression statistical procedure in modeling the judgment process.

By regressing the individual's judgments against the stimulus cues, the researcher obtains an equation representing the judge's cognitive processes. This equation is descriptive of the relationship between predictors and criterion that minimizes deviations from the regression line. In other words, the analysis yields a weighted sum of the predictor variables that best predicts the criterion value given by the individual judge. From this equation, the researcher further examines two important sources of information: a set of regression coefficients and the multiple regression coefficient.

**Regression coefficients.** A regression coefficient represents the average change in the criterion variable per unit of change in the predictor variable. The analysis results in a coefficient being assigned to each of the
predictor variables. The value or size of this coefficient (sometimes referred to as a beta weight) provides an objective index of the importance the judge attached to its corresponding stimulus cue. Thus, large regression coefficients suggest that the cue accounted for substantial variance in the judge's decision, while a small value would suggest the cue was only of minimal or trivial importance.

Hoffman (1960), however, cautioned the researcher in his or her interpretation of these values. He suggested that beta weights suffer from three limitations. The first is that coefficients cannot be compared across regression equations because of the differences in overall consistency of the models. Thus, if the researcher wants to compare how two decision makers value various cues, the comparison of beta weights would not be meaningful. Second, beta weights do not account for all of the predictable variance in the regression equation. This limits the researcher's ability to account for the variance in the judge's decision. Third, when the stimulus cues are not orthogonal, beta weights do not give an accurate description of their independent contributions to the judgment. Fortunately, these limitations can be minimized by transforming the beta weights to relative weights. [See Hoffman, 1960 for details regarding this procedure.] According to Hoffman (1960), relative weights offer several advantages. They are
comparable between judges, capable of theoretically accounting for all the variance in the judge's decision, and carry exact interpretation.

The multiple regression coefficient. In addition to regression coefficients, the regression analysis yields a measure of overall-goodness-of-fit. This measure, generally represented by the squared multiple regression coefficient \( R^2 \), refers to the percent of variance accounted for by the model (error variance may also be examined for this same purpose). The value of \( R^2 \) suggests the degree to which the model can predict future judgments. Thus, the higher the value of \( R^2 \) the better the model fits. Although values for \( R^2 \) range from 0 to 1.0, there are no established criteria for deciding whether or not a model is appropriate. They may be used, however, as sources of comparison between one or more models. For instance, the researcher may compare the appropriateness of a linear versus a configural model for a particular judge. The model producing the highest value of \( R^2 \) would be the model that best represented the decision making process.

If the model has correctly represented the judge's integration of information, the multiple regression coefficient may also be used as an indicator of the judge's consistency or his or her predictability in making decisions. For instance, some individuals may be highly
consistent in their judgment processes, and as a result their judgments will be highly predictable from the model. In these cases the $R^2$ index will be a high value (that is, the $R^2$ coefficient will approach 1.00). On the other hand, when an individual uses inconsistent or random strategies, predictability will be low, and multiple $R^2$ will be minimal (with the $R^2$ coefficient approaching 0.00).

**Uses of the linear model.** The initial applications of the linear model to behavioral decision making compared the predictive abilities of the clinician with those of actuarial analysis of data. These studies overwhelmingly found support for the superiority of the linear model in predicting both clinical outcomes (Goldberg, 1968a, 1968b; Grebstein, 1963; Meehl, 1954, 1959), and academic success (Dawes, 1971; Wiggins & Kohen, 1971). The conclusion was that in nearly all circumstances, simple linear combinations of criteria outperform human judges in predicting decision outcomes.

The second major purpose of applying the linear model to judgment is description or representation. According to Hoffman (1960), the goal of description is to provide a model representing (paramorphically) how the individual judge uses information in arriving at a decision. It is important to note that this model need not accurately prescribe how the individual weighted or combined
information, but only to suggest the combination of cues that can best predict the judge's future response. Many authors have attested to the model's ability to capture judges' policies. [For reviews of this literature, see Dawes, 1971; Dawes & Corrigan, 1974; Einhorn, 1970; Slovic & Lichtenstein, 1971.] The way in which these policies are captured and represented is through the application of a regression equation. This provides numerical indices of the importance assigned to various cues (from the regression coefficients) and the consistency with which the judge uses his or her decision strategy (from the value of the multiple correlation coefficient).

Thus, the information obtained from the regression model may be used as an aid in understanding the decision process. Additionally, it may serve to enhance decision making in several ways. In a representative sense, the linear model may be used in place of the judge as a time-saving device. For example, Dawes (1971), based on a cost-benefit analysis, suggested that a paramorphic model of a graduate school admissions committee be used to screen student applicants, at a savings of $18,000,000 per year (this figure takes into account professional time spent screening out applicants, the salaries of these faculty members, and the approximate percentage of applicants that would be eliminated by the mathematical model).
Additionally, studies have demonstrated that models of judges can out-perform clinicians in judging MMPI profiles (Goldberg, 1970), graduate admissions committees in identifying successful students (Dawes, 1971), students in evaluating ellipses (Yntema & Torgerson, cited in Slovic & Lichtenstein, 1971), and managers in making production scheduling decisions (Kunreuther, cited in Slovic & Lichtenstein, 1971). This phenomenon, termed "bootstrapping", has been successfully used to improve judgments under almost all realistic task conditions. Paramorphic models have also been used to enhance social policy decision making by making participants aware of how they combine and weight information. The rationale behind this procedure is that human judges cannot always accurately explain their judgments. With the aid of the linear model, however, these agreements and disagreements between judges can be identified, made public, and solved (Hammond, Rohrbaugh, Mumpower, & Adelman, 1977).

While the linear model has typically been used to represent the decision policy of the individual judge, research following the Brunswik lens model has focused heavily on the interrelationships between the decision maker and the environment. Thus, a central purpose of lens model research has been concerned with the study of the subject's ability to learn to correctly utilize environmental cues in
his or her judgments. This is accomplished by capturing the optimal combination of cues in the environment that best predict the criterion, as well as the subject's own policy equation. The subject is then given some form of feedback as to the correctness of his or her response, and the investigator measures any changes in performance on subsequent trials attributable to the feedback. [For a review of multiple cue probability learning and feedback, see Schmitt, Coyle, & King, 1976.]

**Conclusions.** The linear model of decision making has met with considerable success. The superiority of actuarial prediction over clinical judgment has been consistently supported (Goldberg, 1968a, 1968b; Meehl, 1954). This is not surprising, however, because models of judges do not suffer from the sources of unreliability that their human counterparts experience (such as boredom and fatigue). What is surprising, according to Dawes (1971), is "the only actuarial method considered in most of the research is that of a linear combination of criterion variables—and this very simple actuarial method consistently does better than clinical judgment" (p. 181).

Another area of investigation has been to assess the degree to which the linear model adequately represents human judgment. In these cases, the researcher is not concerned with the optimal level of the decision outcome, but rather
the model's ability to predict the judge's decision. Slovic and Lichtenstein (1971), in reviewing this literature, concluded that the linear model does do a good job in predicting these judgments, with multiple correlations ranging from .70 to the .90s. [Following the discussion on configural models, the topic of linear versus nonlinear variance will be further addressed.]

Nonlinear models

Although evidence has supported the use of the linear model as representative of the judgment process, introspective reports given by judges often indicate the use of more complex decision strategies (Goldberg, 1968a, 1968b; Meehl, 1954). These contrary indices have led many researchers to continue the search for configural judgment strategies (Goldberg, 1968b).

Definitions and assumptions. Hoffman (1960) defines the nonlinear model as:

\[ J = f(X_1, X_2, X_3, \ldots, X_k) \]

"wherein the exact functional relationship involving the k independent variables may be described in any number of ways" (p.121). These ways include the utilization of information via complex, sequential, and interrelated rules (Slovic & Lichtenstein, 1971).

One commonly studied form of nonlinear judgment is the curvilinear use of cue information. For instance, a
personnel director may only consider applicants whose test scores fall within an intermediate range, believing those below the score would not have the abilities to do the job, and those above this range would have too much ability and become bored. Because intermediate scores are weighted more heavily in this decision, a simple additive model would not accurately describe the judgment. Rather, a curvilinear model of the judgment process would be appropriate. The curvilinear model is one in which the variance in the decision caused by this nonlinear use of cue information may be captured by exponential terms added as predictors to the model (i.e., $X^2$, $X^3$, etc.).

A second form of nonlinear variance in the judgment process can be captured and explained by the configurational or interactional model. This model is based on the assumption that the judge uses information in such a way that the value given to one cue is dependent on the information acquired about another cue. For example, a personnel director may highly value an applicant who possesses both a college degree and job experience. However, when either factor exists in isolation it is given very little weight in his or her decision. To capture the nonlinear variance in the decision, the configurational model adds to the linear equation interaction terms (i.e., $b_1X_1X_2$). When a large number of cues exist, however, this procedure becomes cumbersome, and
the reliability of the equation comes into question (Hoffman, 1968). To deal with this problem, the researcher must either provide a vast number of cases for the subject to judge, omit higher order interactions based on the assumption that they are negligible (that is, to use a fractional replication design), or use statistical methods that are more conducive to interactional terms than the regression equation.

The model. Like the linear model, the nonlinear model may be applied to a series of judgments based upon multiple cues. The judgments are treated as criterion variables, while the cues and relationships among them are treated as the predictor variables. According to Goldberg (1968b), specification of the type of nonlinear model has typically been accomplished in one of two ways. First, the investigator may begin with a complex model (i.e., a model with configural terms) and work toward simplification. The terms of this model may include, for instance, all interaction terms, or it may be obtained through the judges' subjective reports of how they used the stimulus information. For instance, Kleinmuntz (1968) asked subjects to "think out loud" while making clinical judgments. These introspective reports were then used by Kleinmuntz to construct a computer program simulating the subject's thought processes.
Second, the researcher may start with a very simple model, such as the linear model, and proceed by adding more complex terms until the model adequately represents the judge. [For examples of studies advocating this procedure see, Hammond, Hursch, & Todd, 1964; Hoffman, 1960.] The application of this procedure is typically accomplished through the use of multiple regression or analysis of variance procedures (Goldberg, 1968b).

The multiple regression approach. When building a nonlinear model from the regression equation, the investigator begins with a simple linear model of the judge. Again, this model is based on the assumption that the judge is combining stimulus information in an additive fashion. After completing the analysis and obtaining the regression and the multiple regression coefficients, the researcher must test the appropriateness of the model. Using the procedure suggested by Goldberg (1968b), the multiple correlation coefficient (R) is then compared with a measure of the judge's reliability (obtained by correlating responses across trials). If the multiple correlation coefficient does not approach the value of the reliability coefficient, the model is inappropriate. In this case, the investigator introduces additional expressions to the model (such as, interaction terms or exponents) until the multiple correlation coefficient approaches the correlation.
coefficient. Goldberg (1968b) cautions, however, that the extra terms may explain chance characteristics of the judgments, and thus attenuate accuracy.

Although the Brunswik lens model has generally treated relationships among variables as a linear combination of cues, Hursch et al. (1964) proposed the introduction of the C coefficient into the regression equation to capture any sources of nonlinear variance. According to Hursch et al. (1964), "the C is the partial correlation between $Y_e$ (criterion outcomes) and $Y_s$ (subject's response) when the effects of $X_1, ..., X_n$ (environmental cues) are eliminated, and may be described as the correlation between the variance unaccounted for by the multiple correlation in the ecology and the variance unaccounted for by the multiple correlation in the subject's response system" (p. 46). If these residual variances are random, the C coefficient will be zero, and only the linear combination of cues will remain in the regression equation. In situations where the linear relationship does not account for sufficient variance, achievement depends on perceiving patterns of cues, as well as the effects of individual cues. The C coefficient allows the researcher to separate achievement into that representing linear and nonlinear use of cues. Slovic and Lichtenstein (1971) suggested, however, that the C coefficient is unsatisfactory in a descriptive sense due to
its lack of specificity. For example, a low C value could be the result of either the absence of linearity in the environment or differences in the use of nonlinear cues between the environment and the individual.

The analysis of variance approach. Like the multiple regression model, the analysis of variance model (ANOVA) is a form of the general linear model and can be used in both linear and nonlinear analyses (Goldberg, 1968b). The ANOVA model was first introduced to the decision theory literature by Hoffman et al. (1968). The authors suggested that the model's sensitivity to the nonlinear use of cues warranted its future use. For this reason, the ANOVA model has been preferred by many researchers investigating nonlinear decision making (Rorer et al. 1967; Slovic, 1969).

The ANOVA model is also applied to judgment tasks in which the individual makes a series of decisions based upon multiple cues. It, however, places two restrictions on the nature of these cues that the regression analysis did not. First, the cues used in the ANOVA model are assumed to be categorical in nature. If, however, the cues are continuous, they may be partitioned into a few discrete levels without violating this assumption. Second, the assumptions of the model suggest that the cues be orthogonal. The stimulus cues are then treated as independent variables, while the judgments are treated as
dependent measures. From the analysis, the investigator obtains several useful indices that can be interpreted in terms of the judgment process. These include: main effect indices, interaction terms, and an importance weight for each category of information.

Main effects and interactions. Obtaining significant main effects from the analysis suggests that the individual's decisions vary systematically with a specific cue. For example, a significant main effect for education would imply that a personnel director's decisions were dependent on the level of this variable, while other cues are held constant. Additionally, the main effects may be further divided into effects caused by linear, quadratic, or cubic trends (allowing the researcher to take into account curvilinear relationships). When the analysis yields a significant interaction, it implies that the judge responds to a specific pattern or configuration of cues. That is, the judge's use of one cue is dependent on the level of another cue.

Omega square. The omega square ($\omega^2$) is an index of the proportion of total variation in an individual's judgments which can be accounted for by the level of the particular cue or patterns of cues (Hays, 1963). This index is roughly equivalent to Hoffman's index of relative weight. Thus, the greater the value of omega square, the more
importance that can be attributed to the individual's use of the stimulus cue.

Other nonlinear approaches. One extension of the regression and ANOVA paradigms is Anderson's integration theory (1969, 1970). Like these approaches, integration theory is concerned with the weighting, and, in addition the scaling of stimulus cues and the compositional rules with which the cues are integrated. Integration theory tests composition rules (i.e., adding, subtracting, multiplying, or dividing models) using ANOVA techniques. A second extension is the theory of conjoint measurement (Krantz & Tversky, 1971; Luce & Tukey, 1964; Tversky, 1967). Like integration theory, the theory of conjoint measurement is concerned with testing composition rules. These rules are, however, of a qualitative rather than a quantitative nature. Finally, Einhorn (1971) found nonlinear use of cues following disjunctive (the judgment depends on only one attribute) and conjunctive rules (the judgment depends upon all criteria meeting a minimal level).

Uses of nonlinear models. Although empirical results repeatedly demonstrated the superior predictive ability of the linear additive model over the clinical judge, Meehl (1954) suggested that the clinician may be superior to the linear model in his or her ability to use nonlinear cue information. Not surprisingly, this notion seemed to be
supported by clinicians' self-reports of their judgment processes.

To test Meehl's hypothesis, many investigators compared the predictive ability of the linear model with that of more complex configural models. The results of these studies overwhelmingly demonstrated that the addition of nonlinear terms added little or nothing to the predictability of the model (Goldberg, 1965; Hammond et al., 1964; Hammond & Summers, 1965; Hoffman, 1960; Hursch et al., 1964).

Goldberg (1968b) stated:

You will recall that while our research strategy forces us to begin with a simple linear additive model, this model should give way to more complex ones, as configural and curvilinear terms are added to fit the judgmental processes of each particular judge. However, in study after study our initial hopes went unrealized; the accuracy of the linear model was almost always at approximately the same level as the reliability of the judgments themselves, and no-doubt because of this - the introduction of more complex terms into the basic equation rarely served to significantly increase the cross-validity of the new model (p. 488).

Despite these findings, many researchers have not abandoned their interests in nonlinear information
processing and have attempted to test several hypotheses explaining the preceding results. Goldberg (1968b) offered three such hypotheses: (a) it may be that human judges actually behave in a linear fashion and only think they are more complex than they really are; (b) human judges may actually behave in a nonlinear fashion, but the robustness of the linear model masks the true cognitive processes; and (c) human judges behave in a linear fashion for some tasks and in nonlinear ways for others.

Testing the plausibility of the second hypothesis, Yntema and Torgerson (reported in Slovic & Lichtenstein, 1971), demonstrated that a linear model could account for almost all of the variance (94%) in individual judge's decisions even when cue interactions were known to exist. Thus, while doing a good job of predicting the outcome, the linear model was not accurately describing the decision process. For this reason, several researchers looked to find tasks that were truly configural (Hoffman et al., 1968; Huber, Sahney, & Ford, 1969; Meehl, 1959; Rorer et al., 1967; Slovic & Lichtenstein, 1968; Summers & Stewart, 1968; Wiggins & Hoffman, 1968), or turned to statistical procedures, such as the ANOVA (Hoffman et al., 1968; Kort, 1968; Rorer et al., 1967; Slovic, 1969), and a priori approaches (Einhorn, 1971; Slovic, 1966; Tversky, 1969) to better capture nonlinear variance. Ogilvie and Schmitt
(1979) studied the effects of various situational factors on nonlinear judgment. They concluded that greater use of nonlinear models occurs both when the amount of information is increased and the decision maker is consistent.

Conclusions. From the results of these studies, it can be concluded that nonlinear models have met with mixed success. It appears that judges' verbal reports of their nonlinear use of cues may bear some truth. When researchers used tasks believed to be configural in nature, some evidence for the configural use of cues was established. For instance, Wiggins and Hoffman (1968) found that sign (a configural model characterized by the rational inclusion of cues), and quadratic (a general model including all first- and second-order interaction terms) models best described 16 of their subjects, while the linear model best described 12 judges. Edgell (1980) reported subjects were able to utilize configural information; however, as complexity increased this ability decreased. Likewise, researchers basing their models on ANOVA techniques (Hoffman et al., 1968; Rorer et al., 1967), and a priori strategies (Einhorn, 1971; Slovic, 1966, 1969) have found support for nonlinear information processing.

The nonlinear model has not, however, improved upon the predictability of the linear model. For instance, Hoffman (1960), Hoffman et al. (1968), and Rorer et al. (1967)
reported increases of 5%, 3%, and 6%, respectively, in the proportion of variance accounted for in the most configural judges' decisions. Goldberg (1968b) concluded that his second hypothesis was most compelling. That is, judges process information in nonlinear fashions, but the linear model is robust enough to reproduce the judgments. Thus, nonlinear models are useful when the goal is one of representation or understanding of the decision process. When the goal is prediction, however, the value of this added complexity of the model is questionable. Although many investigators have supported the linear model for prediction, Johnson and Mai (1979) cautioned making this conclusion on the basis of correlative indices. They suggested that the linear model's superiority in prediction was represented by rank ordering the importance of alternatives. The linear model may not, however, have the ability to out-predict nonlinear models in terms of distances between alternatives.

Subjective Indices of Judgment

The mathematical model is a means for gaining insight into an individual's cognitive processes. Objective indices, representing the individual judge's weighting strategy, are in the form of regression coefficients and relative weights from the regression analysis and omega squares from the analysis of variance. All of these indices
reflect the importance or value associated with each cue or combination of cues in the judge's decision. A second method for gaining insight into the judge's thoughts has been to rely on the judge's own self-reports. Like objective weights, these subjective indices also provide measures of the ways in which the individual judge uses and combines information. In the following paragraphs, several procedures for obtaining subjective weights will be reviewed, followed by a discussion concerning comparisons between the two types of indices.

Subjective procedures

Because individuals often have difficulty articulating the weights assigned to various cues, several investigators have relied on ranking, rating, and comparison methods to elicit these self-reports. Probably the simplest procedure is to have participants rank order the cues in terms of their believed importance in the decision. For example, the judge indicates the most valuable cue by assigning it a value of one, the second most valuable cue by assigning it a value of two, and so on. The most common procedure, however, is a method proposed by Hoffman (1960). Participants are asked to rate the cue values by distributing 100 points among them. Thus, cues that are believed to be more influential receive higher values than those cues that are of lesser importance. Variations of this procedure include
having subjects rate each cue on, for example, a 100 point scale. Again, the most valuable cues would receive the highest ratings; however, the sum of all ratings need not equal 100.

A third set of procedures involve paired comparison methods, such as pairing each cue with every other cue and asking the judge to rate the importance of one cue over the other. The result is a cumulative score for each cue indicating its relative value. A variation of this procedure asks the judge to choose a cue that he or she believes has a moderate importance value. This cue is then assigned the value of 100, and other cues are rated to reflect their relative importance. Other researchers have used more sophisticated procedures, such as the method of successive comparisons (Churchman, Ackoff, & Arnoff, 1957), or techniques aimed at uncovering nonlinear variance (Cook & Stewart, 1975).

In evaluating and comparing these procedures, investigators have found very little difference between the methods both in terms of predicting the actual criterion and corresponding to a statistical weighting procedure. According to Eckenrode (1965), "the results of these experiments showed that there were no significant differences in the sets of criterion weights derived from collecting the judgment data by any of the methods, but that ranking was by
far the most efficient method" (p. 180). Cook and Stewart (1975) concluded that Hoffman's method was as good as any other method (including more complex nonlinear procedures) for obtaining subjective indices. They did hypothesize, however, that if the task was clearly nonlinear, differences between procedures would have existed.

Finally, other researchers have relied on more complex process-tracing approaches to capture decision policies. These include: verbal reports during or after the decision task (de Groot, 1965; Kleinmuntz, 1968; Newell & Simon, 1972), and the participant's use of stimulus material on an information board (Billings & Marcus, 1983; Payne, 1976). The results of these analyses are generally described in terms of a flowchart or a computer simulation representing the judge's decision processes. [For a review of process-tracing see Svenson, 1979.]

Subjective versus objective weights

Many studies have made comparisons between the objective weights obtained from statistical procedures and the subjective indices obtained from self-reports. If both types of indices provide an accurate description of the decision process, a high correspondence between the two methods would be expected. The results of the studies have, however, been mixed. Some researchers have reported finding good correspondence between the two measures. For instance,
Smedslund (1955) asked subjects to learn numbers corresponding to multiattribute figures on a deck of cards. He reported that subjects' verbal reports were in high agreement with the objective weights obtained from correlational analyses. Likewise, when comparing the amount of variance accounted for by the objective and subjective policy equations, Cook and Stewart (1975) found only a small discrepancy. Subjects were quite accurate in rating their policies for granting students financial aid and graduate admission (that is, the subjective policies accounted for 93%, and 80% of the maximum linear variance). Hoepfl and Huber (1970) and Ashton (1974) reported similar results.

Other researchers, however, have reported that some subjects demonstrate a low correspondence between the two types of weights (Hoffman, 1960; McFatter, 1982; Muchinsky & Williams, 1984; Slovic, 1969; Slovic et al., 1972; Valenzi & Andrews, 1973). When researchers have compared the actual predictive power the two methods possess, statistical models have consistently out-predicted the subject's own self-reports (Hoepfl & Huber, 1970; Slovic, 1969; Slovic et al., 1972). An exception to these findings is reported by Grebstein (1963). In a study comparing actuarial prediction to self-reports, the linear multiple regression equation was approximately equal to clinicians' estimates of their own decision processes.
Evaluation of Decision Making

Quality of decisions

It goes without saying that decision making is a vital part of life. Unfortunately, people are not always very good at making quality decisions. Einhorn and Hogarth (1978) suggested that this lack of ability exists both across individuals and situations and is pervasive even among the educated and experienced. Yet, good decisions are made, and researchers have attempted to identify factors that differentiate between good and bad decisions.

Individual differences. If the cognitive processes that lead to good decisions can be discovered, the occurrence of these decisions may be facilitated. One approach to studying decision making has been to examine and describe the expert's decision-making processes. According to Slovic (1969), "the key to the expert's success resides in his ability to interpret and integrate information appropriately" (p.255). If the expert's strategy can be uncovered, it may be used to train others how to better the quality of their judgments, as well as make the expert's own judgments more consistent.

Much of the research on expert judgment has, however, found discrepancies in judgments across these individuals (Ashton, 1974; Hoffman et al., 1968; McFatter, 1982; Rorer et al., 1967; Slovic, 1969; Slovic, Rorer, & Hoffman, 1971;
Valenzi & Andrews, 1973; Zedeck & Kafry, 1977). For instance, Slovic et al. (1972) reported substantial individual differences in stockbrokers' uses of ecological cues. In fact, the expert stockbrokers disagreed more with each other over investment decisions than did less experienced MBA students, suggesting a higher degree of unreliability. McFatter (1982), on the other hand, reported both a higher degree of interjudge reliability and a higher correspondence between objective and subjective measures for expert judges than for college students. Finally, Slovic (1969) found disagreement between expert stockbrokers in investment decisions. Additionally, he reported that one expert was "intuitive", and was quite inaccurate in explaining his judgment policies, while the other expert stockbroker was more "rational" (able to explain his policies). He did not, however, compare the accuracy of the brokers' decisions. Because one goal of studying expert decision making is to improve upon judgment, it is necessary to explore reasons for these differences in accuracy of judgment.

One obvious difference between judges is the degree to which they are able to describe their decision-making processes. Verbal reports from experts often suggest that judgment is an intuitive process beyond accurate description. They may consistently make good decisions, yet
report being unaware of the processes and strategies used to arrive at those decisions. For example, Woodward and Armstrong (1979), in their book *The Brethren*, related an incident in which Supreme Court Justice Potter Stewart was asked to describe his standards in judging the obscene nature of films. According to Woodward and Armstrong, Justice Potter Stewart "...could not define obscenity, he had written, but 'I know it when I see it'" (pp. 15-16).

Likewise, Lusted (cited in Slovic, 1969) described the verbal reports of a radiologist explaining how he judged a metastatic lesion on an X-ray. The radiologist's reply was, "Because it looks like it!" Results from several empirical studies also provide examples of the "intuitive" judge. When objective weights from statistical analysis of the expert's decisions are compared with subjective weights reported by the expert, many researchers find little correspondence between the two weights (Slovic, 1969; Slovic et al., 1972; Valenzi & Andrews, 1973).

Other experts, however, seem to be more rational and accurately report on their decision processes with little trouble. Slovic (1969) described this individual as one who "instructs others in the art of emulating his judgments by reeling off the dozens of factors that he takes in consideration, each accompanied by an elaborate rationale" (p. 255). In other words, individuals at this extreme may
make good decisions and are highly knowledgeable (or so it appears) in reporting the processes upon which their judgments are based. Empirical evidence for the "rational" decision maker also exists. In these studies, experts have been quite accurate in reporting the value they place on ecological cues and the ways in which these cues are integrated (Ashton, 1974; McFatter, 1982; Smedslund, 1955).

Few studies, however, have investigated the relationship between decision accuracy and knowledge of decision processes. Muchinsky and Williams (1984) reported that some decision makers in their study made accurate decisions while others did not. Additionally, some decision makers were quite accurate in describing their cognitive processes while others were not. A relationship between accuracy and knowledge was not, however, supported. That is, those who were able to describe their decision processes (rational decision makers) were no more accurate in their judgments than those who did not display such knowledge. These results alone are not conclusive. It still may be that those individuals who are aware of what they do are also better at doing what they do.

Finally, in attempts to discover sources of individual differences in decision making, other researchers have looked at ability, personality, experience levels, and demographic factors in relation to decision accuracy. In
general, they have found no clear relationships between these factors and the quality of decision making (Muchinsky and Williams, 1984; Slovic et al., 1972; Zedeck & Kafry, 1977).

**Situational influences on decision making.** Although the quality of decision making is often attributed to the characteristics of the decision maker, quality of judgment may also be influenced by factors external to the individual. These situational factors include both characteristics of the judgment task and influential stimuli in the decision maker's environment.

**Cue characteristics.** Several researchers have studied cue characteristics and their differential effects on the judgment process. In a review of the literature, Slovic and Lichtenstein (1971) identified five cue characteristics and their relationships to decision outcomes. These included: (a) the interrelationships among the cues; (b) cue variability; (c) cue format; (d) the number of cues; and (e) cue-response compatibility. For each of these relationships, researchers have found substantial support for differential cue effects on decision making. First, several researchers have examined how the intercorrelational structure among cues effects cue utilization. The results of these studies have generally supported the notion that as intercue conflict increases
(that is, important cues disagree in their implications) subjects' cue utilization decreases (Hoffman, 1968; Slovic, 1966). Dudycha and Naylor (1966), however, found that when a second cue was paired with a cue of low validity, consistency of decision making was increased.

Second, studies on cue variability have found that highly variable cues are used to a greater extent than those cues that are less disperse (Morrison & Slovic, 1962, cited in Slovic & Lichtenstein, 1971; Uhl & Hoffman, 1958, cited in Slovic & Lichtenstein, 1971). Uhl and Hoffman attributed their findings to the subjects' motivation to make differential prediction, making highly variable cues more valuable. In a similar vein, the format in which the cues are presented also plays a role in cue utilization. For example, formats characterized by a wide dispersion of cues are utilized to a greater extent than formats whose distributions are more compact (Knox & Hoffman, 1962).

Researchers studying the effects of the number of cues on decision consistency have reported mixed results. Hayes (1964) and Einhorn (1971) both found that increasing the number of cues resulted in a decrease in decision consistency. Anderson (1977), however, reported no differences in the consistency index as the amount of information increased from six to eight cues. Similarly, Oskamp (1965) found no differences in accuracy due to the
number of cues but did find that subjects reported being more confident about their decisions when they had more information. Finally, Ogilvie and Schmitt (1979) found that as the number of cues increased, those subjects who used nonlinear models outperformed subjects who used linear models.

In terms of cue-response compatibility, researchers have concluded that high compatibility between cues and responses leads to quicker learning and greater accuracy (Fitts & Deininger, 1954; Slovic & Lichtenstein, 1968). For instance, if the cues are expressed in terms of dollars, it is easier for the subject to respond in terms of dollars, rather than in terms of a factor such as risk.

Since the Slovic and Lichtenstein (1971) review, researchers have examined additional cue characteristics, such as order of cue presentation and saliency of cues. Several studies have found that the order in which the subject is presented the cues plays a role in his or her cue utilization. For example, Ashton (1974) found that the order of cue presentation affected his subjects' audits and concluded the importance of a cue is partially determined by its context. Likewise, Tversky and Kahneman (1981) have demonstrated that previous information (initial values) determined subjects' subsequent responses because all further judgments were adjusted to this previous
information. Finally, Nisbett and Wilson (1977) reported that the order of presentation was the most important factor in determining subjects' evaluations of merchandise (this was not, however, reported by their subjects).

Contending the importance of cue saliency, Nisbett and Wilson (1977) suggested that accurate reports will occur when influential stimuli are salient and are plausible causes of the response they produce. People may err in their judgments, however, when they pay too much attention to highly salient, noninfluential cues. Tversky and Kahneman (1981) reported a similar phenomenon. They asked subjects questions, such as, is it more likely that a word begins with the letter r or has r as its third letter? Although the correct answer is the third letter, most subjects reported that more letters began with the letter r. Tversky and Kahneman suggested that this occurred because subjects searched their memories for words containing r. Because the first letter of a word is more salient than the other letters, it occurs more often during memory search.

Christensen-Szalanski and Bushyhead (1981) and Christensen-Szalanski and Beach (1982) reported similar results. In these studies subjects were better able to diagnose diseases if the base rates of these diseases were made salient (more familiar). Finally, Lichtenstein, Slovic, Fischhoff, Layman, and Combs (1978) suggested that
when subjects were asked to judge the frequency of lethal events, events such as murder were overestimated because they were more likely to capture the individual's attention and stick in his or her mind.

**Task characteristics.** Although cue characteristics are a component of the task, a set of factors pertaining to the task in general have also been identified to play an influential role in decision making. For instance, the familiarity or novelty of a task appears to determine the style of decision making an individual employs. For instance, Slovic et al. (1972) found that MBA students used more consistent strategies in evaluating stocks and were more aware of these strategies than were more experienced stockbrokers. They suggested that these findings were the result of recent classroom experience. Because students were in the process of learning how to make decisions, they were quite aware of their decision strategies and rules. Stockbrokers further removed from the learning process may have internalized their decision rules, thus being less consciously aware of them.

Muchinsky and Dudycha (1975) looked at the meaningfulness of the task and its effects on decision consistency and accuracy. They found that abstract tasks (tasks devoid of meaningful behavioral contexts) produced generally less consistent, less accurate decisions than tasks put into
meaningful contexts. More specifically, subjects who are asked to predict numbers from another set of numbers have more difficulty than subjects asked to diagnose illness, evaluate financial investments, and make judgments about other realistic stimuli.

Additionally, the actual predictability of the task in the environment is very influential in decision accuracy. If the task is not highly predictable, poor performance may be attributed either to the individual or to the parameters of the task. It could not be concluded that performance was the result of the individual's decision processes. Lastly, if the task is trivial or uninteresting, the subject may lose interest and motivation. In this case, the cause of poor performance could be attributed to either a lack of effort or to faulty decision processes.

Characteristics of the situation. The effects of various situational factors on the decision-making process also have been topics of much research. Investigators in the area of jury decision making have repeatedly shown that various extra-legal factors influence what are supposed to be rational decisions. To mention a few, Wolf and Montgomery (1977) found that the forcefulness of the judge's instructions affected decision making; Sigall and Ostrove (1975) showed how the attractiveness of the defendant interacted with the decision process; Gergen and Williams
(1984) showed how the severity of the consequences to the victim influenced the likelihood of guilty verdicts; and Kerr (1978) demonstrated that knowledge of the probable sentence affected the judgments regarding probability of guilt. These, and many more studies (see Kerr & Bray, 1982 for a review), have suggested that even in situations where standards of rationality and conscientiousness are emphasized and valued, irrelevant situational factors can alter the decision-making process.

Researchers in the area of group processes have also focused on the effects of situational variables on decision making. For instance, in comparing group to individual decision making, Ogilvie and Schmitt (1979) demonstrated the superiority of group decision making on a task in which subjects evaluated purchasing agents on the basis of several test scores. They suggested that the group's increased accuracy could be a result of groups being less likely than individuals to use reduction strategies.

In a literature review of group performance, Shaw (1976) suggested that group decisions are often superior to individual decisions because groups are likely to succeed at tasks which involve random error. He suggested this allows groups to make better judgments and to learn more quickly than individuals. Hagafors and Brehmer (1983) offered yet another explanation for group superiority. They found that
requiring a subject to justify his or her decisions resulted in greater consistency. Because group situations are more likely than individual situations to force the individual to present justification, the former tend to produce more consistent judgment.

Not all group situations, however, result in enhanced judgment. Studies in the area of social loafing have demonstrated that collective actions often result in decreased effort (Latané, Williams, & Harkins, 1979), especially if individual efforts are not identifiable in the group situation (Williams, Harkins, & Latané, 1981). This finding has been generalized to decision-making situations. For instance, Petty et al. (1977) and Petty, Harkins, and Williams (1980) found that subjects who believed that they alone were responsible for evaluating essays produced more comments than individuals who believed their responsibilities were shared with others. Although these studies involve judgment, they only considered its outcome.

Few researchers have evaluated the effects of collective action on the actual decision-making process. Studies that have done so have met with mixed results. For example, Weldon and Gargano (1984) found that subjects who shared responsibility in judging job descriptions exerted less cognitive effort than those subjects who participated in the task alone. That is, subjects who believed they were
working collectively produced fewer evaluations and used less complex judgment strategies than did individual evaluators. Williams and Williams (1983), however, reported no differences in the number of cues used by subjects in collective versus individual judgments in a weight-guessing task. Likewise, Williams, Williams, & Dush (1984) found no differences between collective versus individual subjects' use of decision strategies on an inkblot evaluation task.

Conclusions

The quality of a decision may be influenced by numerous dispositional and situational factors. Several of these factors have been identified and reviewed in the previous pages. Little research, however, has been conducted to investigate the role of focus of attention on the decision-making process and the decision outcome. In this dissertation, the influence of self-awareness on decision making will be examined both in terms of self-knowledge of decision processes and quality of decision-making. By considering the relationship between knowledge of decision strategy and decision quality, it may be possible to improve decision making in various situations.
CHAPTER III

A THEORETICAL INTEGRATION OF SELF-AWARENESS THEORY AND DECISION THEORY

The impact of self-knowledge has been a theme in both the theory of self-awareness and the theory of decision making. It is on this common ground that the two theories may be integrated.

Although, the existence of true self-knowledge, or cognitive insight, has been questioned by cognitive psychologists, there are occasions in which self-reports are more accurate than observer reports. The focus of self-awareness theory has been to further the understanding of such self-insight by identifying the antecedents of self-knowledge and the extent to which self-knowledge may affect behavior.

Like self-awareness researchers, decision theorists also have concentrated on gaining insight into cognitive processes. While much decision research has gained this insight through actuarial means, an interest in self-knowledge and self-report accuracy remains. It is through the comparison of objective indices with subjective reports that the validity of each measure may be assessed. Thus, while the central focus of self-awareness theory is to improve understanding of self-knowledge, studying self-knowledge in decision theory has been only secondary.
Self-knowledge, however, may play a role of greater importance in decision theory’s future.

By incorporating theoretical postulates and empirical findings from self-awareness and decision theories, this dissertation will provide the rationale needed to answer the following questions. First, does the lack of correspondence between objective and subjective indices of judgment, typical in the decision theory research, necessarily point to the invalidity of the self-report? Second, are there differences in the extent to which individuals accurately report on their cognitive states, and why might these differences exist? Third, what is the probable relationship between self-knowledge of decision processes and performance on the decision task?

Decision Making and Self-Awareness

Following a fixed capacity model of attentional focus, self-awareness theorists propose that an individual may focus either internally on the self or externally on the environment. The time which is spent focusing on the self is a measure of the individual’s state of self-awareness. Researchers in the area of self-awareness have both manipulated self-focus and measured individual variability in the trait to study its effects on behavior. In particular these researchers have been interested in how self-awareness affects the extent to which an individual can
accurately report on his or her attitudes, cognitions, and emotions. Additionally, some researchers have been interested in the effects of self-awareness on task performance.

Researchers in the area of decision theory also have been interested in the extent to which individuals report on their cognitions, and how this self-knowledge may affect performance on the decision-making task. They have not, however, systematically examined the effects of self-focus on decision making. In the following pages the rationale for doing so will be developed.

**Self-focus on a decision task**

The task of decision making requires the individual to pay attention to stimuli (cues) in the external environment and then to access cognitive rules to integrate the cues in some reasonable fashion. When attentional focus is inwardly directed, attention is drawn to salient aspects of the self. When it is outwardly directed, attention shifts to salient aspects of the environment. Increasing self-focus on a decision task is likely to result in increased awareness of the contents of the self. If the decision rule can be equated to a schema or standard, self-focus should result in greater adherence to the rule.

According to self-awareness theory, the individual will engage in a process whereby the standard is compared to the existing behavioral state. Thus, in the decision-making
task, self-focus should result in a comparison between the actual integration strategy (the existing behavioral state) and the salient decision rule (the standard). If a discrepancy exists between the two, the decision maker may either attempt to avoid the decision situation, or will bring behavior back in line with the salient decision rule.

**Objective versus subjective weights.** The first question posed in this chapter asked if the lack of correspondence between objective and subjective indices of judgment necessarily pointed to the invalidity of self-reports. Many studies in the area of decision making have made comparisons between the objective weights obtained from statistical procedures and subjective weights obtained from self-reports.

In general, the results from these studies have been mixed. For some individuals the correspondence was quite high, while for others it was quite low. Similarly, some studies have reported a high overall correspondence, while others suggested that participants were generally unaware of their decision policies. This lack of correspondence could be attributed to either a lack of self-insight on the part of the decision maker or to the statistical model's inability to correctly uncover the decision maker's strategy (i.e., uncovering a linear strategy when the decision maker is actually using a nonlinear combination of cues). Because
statistical models have been shown to consistently out-predict the individual's self-report, many researchers have used this as an indication of the model's validity.

Additional means of estimating the validity of the mathematical model may be to compare the objective weights with another objective index or with subjective self-reports under conditions of high self-focus. Finding a higher correspondence between the indices when self-focus is enhanced would provide additional support for the accuracy in representation of the mathematical model.

The rationale behind this proposition comes from research in the area of self-awareness. First, several studies have demonstrated that environmental cues reminding the individual of the self (i.e., mirrors, cameras, and tape recorders) induce states of self-focus. Likewise, individuals who are dispositionally high on the trait of self-awareness are more likely to take the self as the center of attention. Second, individuals in these states of heightened self-awareness tend to produce more accurate self-reports than do individuals who are less self-focused.

In the typical decision theory study, subjects are asked to either rate or rank order a number of cues to reflect the extent these cues influenced their decisions. Examining these cues may be a task in which the subject's attention is drawn outwardly to the stimuli in the
environment. If so, the subject would be expected to have little insight into his or her cognitive processes and to be not very successful in accurately reporting the decision rule. On the other hand, if the individual's attention was instead focused on the self, attention would likely be drawn to the decision rule (the salient standard) and a comparison between it and the existing behavioral state. This comparison process should result in an increase in accuracy of the individual's self-report.

Three theoretical propositions

Individual differences in self-reports. A parallel exists between research findings on individual differences in decision making and those in the self-awareness literature. The second question proposed in this chapter addresses this similarity. In the decision theory literature, some subjects are very good at matching their self-reports with objective indices of judgment. Other individuals do not exhibit this same ability. In fact, even experts within the same occupational discipline exhibit great variability in this skill.

Self-awareness researchers also have uncovered a difference between individuals in the degree to which they take the self as the center of their attention. Individuals high in the private self-consciousness trait are more likely to be in tune with salient aspects of the self, and thus are
better able to report on their attitudes, cognitions, and emotions than subjects who are low in the trait. It may be that those subjects who are dispositionally high in self-consciousness would be the same subjects who demonstrate a high correspondence between objective and subjective indices on a decision task.

Research in the area of self-consciousness suggested, however, that this relationship may be more complicated than it originally appeared. Buss (1980) proposed that when an individual is self-focused, attention may be drawn to either public or private aspects of the self, and that highly self-conscious individuals may be either characteristically high in private or public self-consciousness. An individual high in public self-consciousness becomes aware of role expectations. Conversely, an individual who is high in private self-consciousness tends to pay more attention to his or her personal attitudes and beliefs.

These differences in self-consciousness may also be evident in decision making. Individuals who are high in private self-consciousness would likely report on their decision rule, and thus exhibit a high correspondence between subjective and objective indices of decision making. In cases where an external decision rule exists (i.e., in studies of lens model feedback or in group decision situations), subjects who are high in public self-
consciousness may be more in tune to the external standard (i.e., to what other group members will want to hear) and report that they used the external strategy (even if they did not). In this case, a high correspondence between subjective and objective indices would not necessarily be expected to exist.

**Self-knowledge and performance on the decision task.** Although several researchers have expressed great interest in improving decision making, few studies have been able to uncover factors that consistently differentiate good from bad decision making. The major intent of this dissertation has been to address the question regarding the relationship between self-knowledge and decision accuracy. In particular, can heightened self-awareness be used to enhance the quality of decision making? If it can, implications exist for: (a) selecting decision makers via the self-consciousness attribute; and (b) constructing decision-making situations to better promote states of high self-focus.

Unfortunately self-awareness is not a panacea for all problems, including enhancing decision making. It cannot be expected that merely directing an individual’s attention to the self can magically result in a good decision. Instead, the relationship between self-awareness and decision accuracy is likely to be quite complex. In fact, self-awareness under some situations may even result in a
decrement in decision quality. By integrating these two bodies of research, this relationship can be better understood and suggestions on how to improve decision quality can be given.

The timing of self-focus

The previous questions have considered the effects of enhanced self-focus during the self-report stage of a task. That is, an individual is asked to engage in a task in which he or she reports on a previous attitude, cognition, emotion, or attribute of the self. Differences in accuracy of the report are then studied as a function of self-awareness. Again, empirical findings have suggested that increased self-focus results in a more accurate self-report. In the special case of decision making, increasing self-focus would be expected to enhance the correspondence between objective and subjective indices of decision strategies, as long as the salient standard was to accurately report the decision rule.

It is also possible to enhance self-focus during the decision-making as opposed to the self-report stage. For instance, measures of participants' previously stated attitudes can be compared with existing behaviors under conditions of low and high self-focus. When self-focus is high, individuals would likely bring their current behaviors in line with salient behavioral standards. These standards
can be thought of as schematas, indicating the appropriate behavior for the particular situation. Thus, not only can self-awareness increase an individual's self-knowledge (in the self-report stage), but it may also influence his or her performance when enhanced during the behavioral state. By considering the effects of self-focus during the behavioral stage, it is possible to further theorize about the relationship between self-focus and decision accuracy.

Motivational factors. Gibbons (1983) has suggested that behavioral regulation may be a result of both motivational and attentional factors. Again, self-awareness theory states that when an individual experiences a discrepancy between a standard and current behavior, he or she is motivated to bring the two in line. When self-focus takes place during the behavioral stage, the individual compares the current behavior with a previously existing standard; and if a discrepancy exists, the current behavior is likely to be changed to more closely follow the standard.

The effects of standards. Whether or not this results in improved performance is dependent on the desirability of the salient standard. For example, if the salient standard is to work efficiently, the effects of self-focus should increase the individual's effort to be efficient. Likewise, if the salient standard is to make a thorough decision, self-focused attention may cause the
individual to seek out more information, to pay more attention to detail, and to follow a salient decision rule strictly. In the case of external standards (i.e., the experimenter presents the subject with lens model feedback), self-awareness should result in greater adherence to that standard or instruction.

Not all standards, however, would be predicted to result in an improved decision. For instance, Carver and Scheier (1981) suggested that paying attention to a subordinate standard resulted in performance impairment. Thus, paying attention to one's racquet grip is likely to inhibit good performance, while a salient standard of being a good player would more likely have a facilitating effect. By focusing only on the grip, the player may fail to pay attention to other relevant factors in the environment (i.e., where their opponent is standing, how fast to run, etc.). Operating at higher levels of the behavioral hierarchy results in the lower levels of the behavior being automatically matched.

Similarly, if the decision maker focuses on subordinate factors of the decision task (i.e., carefully considering each factor and integrating it into the decision), decision making may be less than optimal. The superordinate standard of making a well-thought-out decision may cause the individual to automatically consider these factors, as well
as other factors such as making an efficient decision. This notion may help to explain some of the findings on expert versus novice decision making.

Students who are new at a decision-making task often closely follow a specific integration strategy, while experts report being more intuitive. It may be that the experts are operating at a higher level on the decision hierarchy, and following a decision rule becomes a more automatic task in their decision. If this is correct, self-focus may have a differential effect on expert versus novice performance. In fact, research in the area of social facilitation has suggested that self-focus results in performance facilitation for well-learned tasks, and inhibition for novel tasks (Carver & Scheier, 1981).

Conflicts among standards may also result in performance impairment. For instance, since decision making is in essence a cognitive task, judgments may be hindered when cognitive standards conflict with emotional standards. Researchers in the area of self-awareness have found that in situations where emotions have recently been aroused, the individual behaves more in line with the emotion than with any other salient standard. Thus, if the decision is of an emotional nature, self-awareness may adversely affect the decision outcome. For instance, a juror may experience very negative affect toward a defendant due
to the nature of the crime, despite the fact that the accused has not been proven guilty. If self-focus was enhanced in the juror (i.e., by a camera in the courtroom), the negative affect could influence the decision more heavily than the salient standard to consider all relevant trial information.

Finally, when a discrepancy exists between a standard and a current behavior, the individual may attempt to avoid the unpleasant situation rather than regulating his or her behavior. Thus, if an individual's judgments fail to meet the standards of good decision making, the individual may choose to avoid or leave the decision-making situation. Carver and Scheier (1981) suggested, however, that this shortcoming may be diminished by insuring that the individual has a high expectation that changing the behavior would result in a better decision.

Attentional factors. The positive effects of increasing self-focus may also be the result of several attentional factors. First, when an individual focuses on the self, he or she does not pay attention to irrelevant information in the environment. Thus, self-focused individuals are less susceptible to factors such as distractors, suggestibility, and demand cues. When the effects of these irrelevant factors can be reduced, the individual should be more likely to make a consistent
decision based on relevant task information. Second, based on attribution theory, self-focused individuals are also more likely to make dispositional attributions and take responsibility for their actions than are individuals who are not self-focused. This increased responsibility has been demonstrated to result in an increase in effort and improved task performance.

Some researchers, however, have suggested that self-focused attention impairs performance on an external task. More specifically, self-focus reduces the amount of attention the individual can pay to the task, which in turn can cause aversive effects on task performance. In reviewing the empirical evidence supporting this position, however, it appears that this decrement may only occur when the salient standard competes with good performance on the task. For instance, Carver and Scheier (1981) found when the salient standard involved self-doubt, self-focus resulted in performance impairment. When subjects were given high expectations of success, self-focus was associated with performance facilitation.

Finally, Hull and Levy (1979) have proposed that self-focus not only plays a role in behavioral regulation but also serves to organize and process information. For instance, a substantial body of research has been conducted to investigate the self's role in the processing of
information. In general, these studies have found that memory for task information improves when the subject encodes the information by using a self-referent. Empirical evidence suggests that self-focus promotes self-referent processing and encoding of information, and thus results in performance improvement. In fact, self-referencing encourages the individual to perceive external stimuli in terms of his or her own self-relevant attributes. In the case of decision making this means the self-focused individual is likely to encode terms from an external task (cues) with reference to the self. This should result in better memory for these factors, and possibly an improved overall task performance.

Conclusions

By combining the research from self-awareness theory and decision theory, it is possible to make several suggestions for the betterment of decision making. First, by making individuals self-aware during the self-report stage of the decision task, the correspondence between objective and subjective weights may be enhanced. Increasing this correspondence would provide additional support for using the mathematical model, not only to predict, but also to understand the decision process. Second, the dispositional measure of self-focus (self-consciousness) may be helpful in diagnosing the degree
to which individuals are knowledgeable about their decision processes. This finding would be very useful if a correspondence between decision accuracy and self-knowledge exists. Third, this integration provides a rationale and a methodology for testing the relationship between decision accuracy and self-awareness. The following chapter will use this rational to empirically test the effects of self-focus both during the self-report stage and the behavioral stage of the task.

While the focus of this dissertation has been on using self-awareness for decision improvement, integrating these two theories may also extend the self-awareness literature. The majority of self-awareness studies that have looked at the effects of self-focus have used dependent variables that are related to the self (i.e., accuracy of self-reports). Few studies, however, have examined the effects of self-focus on tasks not related to self-knowledge (i.e., performance on tasks external to the self). Those studies which have, reported mixed results. In an attempt to further extend self-awareness theory to decision making, the empirical study outlined in the following chapter will also serve to test the effects of self-focus on an external task (i.e., a task in which the measure of "correctness" is not a measure of accuracy of self-report).
CHAPTER IV

AN EMPIRICAL TEST OF THE INTEGRATION

The theoretical groundwork for integrating self-awareness theory and decision theory has been developed in the previous chapters. The purpose of this chapter is to test these propositions and to demonstrate the potential applicability of this integration.

Many occupations require decision makers to make judgments about individuals based on multiple attributes. For instance, personnel directors must examine a variety of factors such as educational level, experience, and test scores in order to make selection decisions. Similarly, admissions personnel, scholarship committees, and school counselors often make similar predictions about the success of students (or potential students) on the basis of attributes such as test scores, high school rank, and career goals.

This study will examine the effects of self-focused attention on such a task. It is possible that simply directing individuals to focus on the self while providing appropriate standards will result in the betterment of these decisions. Although this problem has clear applicability, it is difficult to study the effects of self-focused attention in an actual applied setting. That is, because
decisions in applied settings are often void of immediate feedback, it is difficult to evaluate the effects of self-focus. Using a similar task in a contrived, yet engaging setting, makes it possible to provide more direct feedback regarding the decision outcome. This feedback, in turn, can be used to isolate and evaluate the effects of the self-focus manipulation. In the present experiment, attentional focus and the specificity of the behavioral standard will be manipulated while decision makers engage in a grade point estimating task.

**The Hypotheses**

The effects of self-awareness may be separated into two categories: those that take place when self-focus occurs during the task, and those that occur when self-focus takes place during a post-task self-report.

**Self-focus and performance on the decision task**

It is first hypothesized that directing attention to the self during the estimation task will be accompanied by an increase in the decision maker’s effort to make a good decision. Previous research has suggested that self-focused attention may promote motivational changes in the individual. These changes should result in greater adherence to decision rules, searching for more relevant information, and perhaps spending more time working on the
task. When the time is fixed, however, self-focused individuals may use the available time more efficiently.

A second hypothesis is that self-directed attention will only result in a higher quality decision when a general overall standard of good decision making is made salient. The assumption behind this hypothesis is that when a general overall standard for performance is made salient, the individual automatically matches to standard all lower level standards. On the other hand, when a standard is of a subordinate nature, the subject may focus only on this aspect of the task at the expense of engaging in smoothly integrated behavior. Thus, when an appropriate standard is presented, self-focused individuals should be more likely to make accurate decisions than those individuals who are not self-focused or are not provided with a superordinate standard.

Self-focus and self-knowledge of decision processes

A second question addressed in this dissertation has focused on the effects of self-awareness on self-knowledge of decision processes. A robust finding in the self-awareness literature has been that directing attention to the self during a self-report results in a more accurate self-report. Extending this finding to the realm of decision making, it is hypothesized that directing
attentional focus to the self during the self-report stage of the task will result in an increased correspondence between objective measures of the decision process (i.e., beta weights from the participant's regression equation or time spent looking at each factor) and subjective measures (from the self-report). It is further hypothesized that when the individual is self-focused during both stages of the task, the self-knowledge will be further advanced. In these cases, not only would the self-aware participant be motivated to be truthful but may be more cognizant of the strategy used in the behavioral phases of the task.

Method

The task

Information on the grade point averages, high school percentile ranks, Drake test scores (SAT and ACT), gender, college of enrollment, and the undergraduate major of 2678 Drake University undergraduates was obtained from the office of Liberal Arts and Sciences at Drake University. The high school percentile ranks, Drake test scores, gender, and grade point averages were intercorrelated. The grade point average (GPA) served as a criterion variable, and a least squares multiple regression analysis was conducted to determine the predictability of GPA from the remaining three factors. The analysis revealed that GPA was moderately
predictable ($R = .60$) from the remaining three variables. The college and major variables were not included in the analysis because of the difficulty in interpreting qualitative factors. Differences between grade point averages across the colleges and majors, however, appeared to be negligible.

Additionally, intercorrelations between the predictor variables revealed low or moderate relationships between the three predictor variables, with correlation coefficients ranging from .07 to .54 (see Table 1).

From the 2678 subjects, a sample of 100 were randomly selected and subjected to the same analyses. In the sample, the regression analysis revealed that again, GPA was quite predictable ($R = .71$) from the remaining three factors, and the intercorrelations between these factors were low, with correlations ranging from .03 to .35 (see Table 2). This subset of data served as the task in the following study.

Participants

One hundred and twenty Drake University undergraduates served as participants for extra credit in their introductory psychology classes. Seventy-four of these participants were female, and 46 were male. Each participant was randomly assigned to one of eight experimental conditions.
Table 1
Ecological Cue Matrix
(Population = 2,672)

<table>
<thead>
<tr>
<th></th>
<th>GPA</th>
<th>DSc</th>
<th>HS%</th>
<th>Gen</th>
<th>Col</th>
<th>Maj</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drake Score</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS Percentile</td>
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<td>.54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>.10</td>
<td>-.07</td>
<td>.19</td>
<td></td>
<td></td>
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</tbody>
</table>
Table 2

Ecological Cue Matrix

(Sample = 100)

<table>
<thead>
<tr>
<th></th>
<th>GPA</th>
<th>DSc</th>
<th>HS%</th>
<th>Gen</th>
<th>Col</th>
<th>Maj</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drake Score</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS Percentile</td>
<td>.49</td>
<td>.35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>.10</td>
<td>.03</td>
<td>.27</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Procedure

Each participant reported to an office where he or she was greeted by an experimenter. The experimenter asked the student to be seated in front of a MIME 2 computer terminal (which is connected to the VAX 11/780 mainframe computer at Drake). In all conditions, the experimenter instructed the participant to type in his or her name on the computer and then read and respond to the following instructions:

Thank you for volunteering to participate in this study. We are interested to see how well you can predict Drake undergraduates' grade point averages from 5 sources of information. These include their: 1) High school percentile, 2) Drake Test Scores, 3) Gender, 4) College, and 5) Major.

Your task will be to select information about each student, and based upon that information, make a judgment regarding the student's GPA. To obtain this information, you must interact with the computer. For each student the computer will allow you to see up to 5 pieces of information. The amount of information used is determined by you. To obtain information on Gender, press the number ‘1’. This information will then be
presented on the screen. Likewise, information on High School Percentile, college, Drake Test Scores, and major may also be obtained by pressing the 2, 3, 4, and 5 keys, respectively. Again, you may obtain as much or as little information as you would like. You may also look at the same information more than once.

After you have obtained the desired information on a particular student, please press the '6' key. The computer will then ask you to enter your estimate of the student's GPA. When you have completed this task, the computer will move on to the next student and the process will be repeated.

Each participant was presented with ten sample trials to familiarize himself or herself with the task. Feedback based on regressing the three cues against the actual GPA was provided for the participant after completing each trial. When the participant finished the practice trials, the experimenter asked the participant if he or she had any further questions. Additionally, the experimenter explained the nature of each of the five factors. If the participant had no questions, the experimenter gave him or her instructions to press the 'Return' key when he or she was
ready to begin the task. The experimenter then left the
room, and the participant began the task of judging the GPAs
of 100 stimulus students. [A copy of the computer program
is displayed in Appendix A.] Following the completion of
the GPA estimations, each participant was taken to another
room and given a questionnaire containing a list of the five
cues and was asked to rate the importance of each cue in his
or her judgments of GPA. The questionnaire also contained
items concerning strategy, strategy change, amount of effort
expended, and several demographic and factual questions (see
Appendix B).

**Independent variables**

Type-of-Standard manipulation. Half of the
participants were randomly assigned to the **Subordinate**
Standard condition, in which they were informed on the
computer screen at the beginning and occasionally throughout
the trials of the following: "Your task is to carefully and
consistently weigh in your mind each of the five factors in
your judgment of GPA." The other half were randomly
assigned to the **Superordinate Standard** condition, in which
they were informed: "Your task is to make a thorough, well
thought-out decision." After each set of 25 trials, the
decision makers were reminded of their particular standard.
Self-awareness manipulation. Crossed with the type-of-standard manipulation were four self-awareness conditions. Participants were either made self-aware during the GPA estimation phase, self-aware during the self-report phase, self-aware during both phases, or not self-aware during either phase. One-fourth of the participants were randomly assigned to the Self-Aware-During-Task-Only condition. To achieve this, one mirror (10cm X 30cm) was located between the keyboard and the computer screen, angled so that the reflective surface faced the participant, and two other mirrors (30.48cm X 60.96cm, each) straddled the sides of the computer, also facing the participant, throughout the entire estimation task. After the task, the experimenter directed the participant into another room where he or she was seated at a table in order to complete the questionnaire. Placed in front of the participant in this room was another mirror (30.48cm X 60.96cm), in this condition facing away from the participant, so that he or she could not see his or her reflection.

For the Self-Aware-During-Self-Report-Only condition, the mirrors in the above condition were reversed, so that the mirrors in the computer room did not reflect the participant, while the mirror in the self-report room did reflect the participant. In the Self-Aware-During-Both-
Phases, all mirrors in both rooms reflected the participants, and in the Never-Self-Aware condition, all mirrors faced away from the participants.

Dependent variables

There were three major categories of dependent variables: decision effort, decision accuracy, and self-report accuracy.

Decision effort. The computer was programmed to measure two of the four measures of decision effort. The first measure was the average number of factors the individual looked at in making decisions. The second measure was the total time spent on the task. The squared multiple correlation ($R^2$) obtained from regressing each subject's responses against the three quantitative cue values served as a third measure of effort. The $R^2$ represents the consistency with which the participant utilizes the stimulus cues and hence employs a consistent decision strategy. The fourth measure was a self-report of decision effort from the postexperimental questionnaire. These four measures were intended to represent the participants' effort in making good decisions.

Decision accuracy. Two measures of decision accuracy were obtained by comparing the estimates of GPA made by the participants with the predicted GPAs based on a multiple
regression analysis of the actual GPA data (because the actual GPA criterion was subject to error variance, the predicted criterion was used in its place). The first measure of accuracy was the squared correlation ($r^2$) between the predicted GPAs and the estimated-GPAs for each stimulus student. This measure represents the relationship between how much variance in the predicted GPAs is accountable by each participant's estimates of those GPAs. The second measure was the mean absolute difference score ($|d|$) between predicted and estimated GPA. This measure overcomes the problem of absolute error of the $r^2$ index, however, it ignores the pattern of covariation in the responses over the 100 trials.

**Self-report accuracy.** To measure self-report accuracy two measures were used. First, a within-subject multiple regression analysis was conducted for each of the participants. Each participant's estimates of GPA over the last 50 trials were regressed against the three quantitative predictor variables. This provided an index of objective weights used by the participant in weighing the cues to estimate GPA. These objective weights were then correlated with the rankings from the self-reported use of these cues to obtain a measure of accuracy of self-report. Second, a measure was obtained by correlating the average time spent
viewing each cue (an objective indicator of cue utilization) with the participant's self-reported use of cues. These two measures provided an index of the subjects' self-knowledge.

**Summary of method**

This was a 2 (Standard: Superordinate or Subordinate) X 4 (Self-Awareness: Task Only, Self-Report Only, Both, or Neither) between-subjects experimental design. Analyses of variance were performed using the dependent variables as the criteria.

**Results**

The research questions addressed in this study required preliminary analyses of the raw data. These analyses are presented first to facilitate an understanding of the subsequent analyses.

**Within-subject multiple regression analyses**

The first analyses conducted were least squares multiple regression analyses for each of the 120 participants. Each participant's estimated grade point averages over the last 50 trials were regressed against the three quantitative predictor cues. This produced a squared multiple correlation coefficient for each subject (see Appendix C). The average $R^2$ was .72 with values ranging from .34 to .92 (see Table 3). The analyses also yielded a set of five beta weights for each participant. Because the
Table 3

Mean Accuracy and Effort Indices for Each Condition

<table>
<thead>
<tr>
<th>Cond#</th>
<th>C2</th>
<th>Id1</th>
<th>C2</th>
<th>Time</th>
<th>Self-Report</th>
<th># Cues</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.64</td>
<td>.25</td>
<td>.77</td>
<td>40.17</td>
<td>56.80</td>
<td>5.41</td>
</tr>
<tr>
<td>2</td>
<td>.53</td>
<td>.27</td>
<td>.69</td>
<td>36.30</td>
<td>43.67</td>
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</tr>
<tr>
<td>3</td>
<td>.57</td>
<td>.26</td>
<td>.68</td>
<td>39.47</td>
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<td>4</td>
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<tr>
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<td>.26</td>
<td>.69</td>
<td>37.30</td>
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<tr>
<td>7</td>
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<td>.26</td>
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<td>42.34</td>
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<td>4.84</td>
</tr>
<tr>
<td>8</td>
<td>.59</td>
<td>.26</td>
<td>.74</td>
<td>38.75</td>
<td>58.73</td>
<td>4.14</td>
</tr>
<tr>
<td>All</td>
<td>.60</td>
<td>.25</td>
<td>.72</td>
<td>37.63</td>
<td>51.35</td>
<td>4.72</td>
</tr>
</tbody>
</table>

1 = Superordinate; Never Self-Aware
2 = Superordinate; Self-Aware During Task Only
3 = Superordinate; Self-Aware During Self-Report Only
4 = Superordinate; Always Self-Aware
5 = Subordinate; Never Self-Aware
6 = Subordinate; Self-Aware During Task Only
7 = Subordinate; Self-Aware During Self-Report Only
8 = Subordinate; Always Self-Aware
intercorrelations between the cues were relatively low, these weights were used to represent the degree to which the participant utilized each of the three quantitative stimulus cues (see Appendix D).

**Pearson correlational analyses**

**Self-knowledge measures.** The second set of analyses involved correlating each participant's objective weights (beta weights from the regression equations) with subjective weights obtained on the postexperimental questionnaire. This provided a measure of each participant's self-knowledge (see Appendix E). The average $r$ was .82 with values ranging from -.24 to 1.00.

A second measure of self-knowledge was obtained by correlating each participant's average time-per-factor score with the self-report indices. The average time-per-factor score was based on the participant's responses across all 100 trials because these values were not appreciably different from scores based only on the last 50 trials ($r = .92$). These analyses also produced a correlation coefficient for each participant (see Appendix E). The mean correlation was .74, with coefficients ranging from -.29 to 1.00.
Comparison of objective indices. The beta weights and average time per factor scores were also correlated for each participant (see Appendix E). The average correlation between these two measures was .67, with coefficients ranging from -.48 to 1.00.

Accuracy of decision. Finally, to obtain a measure of accuracy, the participants' estimates of GPAs were correlated with the predicted GPAs. This analysis was conducted using both the values across all 100 trials and across the last fifty trials. Since there were no appreciable differences between the two measures ($r = .87$), the subsequent analyses were based on the full 100 trials. Thus, for each subject a value of $r^2$ was obtained across all 100 trials and is reported in Appendix C. The average $r^2$ was .60, and values ranged from .27 to .79.

Absolute differences analysis

The second measure of decision accuracy was obtained by calculating the average absolute difference score between estimated and predicted GPA. These scores are reported for each subject in Appendix C. The average absolute difference score was .25, with scores ranging from .17 to .59.
Manipulation checks

The effectiveness of the self-awareness manipulation was checked by a question in the postexperimental questionnaire. Participants answered "yes" or "no" to recalling seeing a mirror while they worked on the computer. The mirror manipulation was successful with 80% of the participants correctly identifying the self-awareness condition, $F(1, 118) = 88.5, p < .0001$ (see Appendix F). All participants who incorrectly identified the condition were in one of the Not-Self-Aware-During-Task conditions. All of these participants said that they recalled seeing the mirror. The mirror was not, however, facing them.

The effectiveness of the type of standard manipulation was also checked via a question in the postexperimental questionnaire. Participants were simply asked to report which of two statements appeared on the computer screen. The standard manipulation was successful, with only 3% of the reports being inaccurate, $F(1, 118) = 1121.0, p < .0001$ (see Appendix F).

Effort on the decision task

The means for each of the dependent variables measuring effort are shown in Table 3. [A summary of these variables for each of the 120 participants is displayed in Appendix C.] The correlations between each of the four effort
measures are displayed in Table 4. Each of the effort measures was analyzed with a series of two-way analyses of variance (ANOVA).

**Squared multiple correlation.** Effort was first measured by the consistency with which participants made decisions. It was expected that larger values of $R^2$ would be associated with being self-focused in the presence of a superordinate standard during the decision task.

Table 4

<table>
<thead>
<tr>
<th>Effort Matrix</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R^2$</td>
</tr>
<tr>
<td>Average # Cues</td>
</tr>
<tr>
<td>Total Time</td>
</tr>
<tr>
<td>Self-Report</td>
</tr>
</tbody>
</table>

Scores for participants in the Self-Aware-During-Task-Only and Always-Self-Aware conditions were collapsed to form one condition, the Self-Aware-During-Task condition. Likewise, scores for participants in the Never-Self-Aware and Self-Aware-During-Self-Report-Only conditions were combined to form the Not-Self-Aware-During-Task condition.

Participants in the Self-Aware-During-Task condition had an average $R^2$ correlation of 0.72, while participants in the Not-Self-Aware-During-Task condition averaged 0.73. This
relationship was not significant, $F(1, 116) = .000$, ns. Participants exposed to a Superordinate standard averaged a $R^2$ value of .73 compared to .72 for those participants in the Subordinate condition, $F(1, 116) = .435$, ns. There was not a significant interaction, $F(1, 116) = .044$, ns. [The ANOVA source table is displayed in Appendix F.1]

**Total time.** The second measure of effort was the total time the participant spent working on the GPA estimation task. It was expected that greater total times would be the result of increased self-focus in the presence of a superordinate standard. Scores were again collapsed across the self-awareness conditions.

Participants took an average of 36.06 minutes to complete the task in the Self-Aware-During-Task condition and an average of 39.21 minutes in the Not-Self-Aware-During-Task condition. Again, this difference was not in the predicted direction, however, the relationship was not significant, $F(1, 116) = .12$, ns. For the type of standard factor, participants in the Superordinate condition averaged 33.21 minutes, and those participants in the Subordinate condition averaged 37.60. This difference was not significant, $F(1, 116) = .29$, ns. There was not a significant interaction, $F(1, 116) = .001$, ns. [The ANOVA source table is displayed in Appendix F.1]
Self-reported effort. A third measure of effort was obtained on the postexperimental questionnaire. It was predicted that participants in the self-aware and superordinate standard conditions would report expending the most effort. Participants in the Self-Aware-During-Task-Only condition on the average reported exerting 42.4 units of effort, while participants in the Never-Self-Aware, Self-Aware-During-Self-Report-Only, and the Always-Self-Aware conditions reported exerting 54.10, 56.80, and 52.10 units, respectively, $F(3, 112) = 2.71, p < .05$. For type of standard, participants in the Superordinate Standard condition reported an average of 52.05 units of effort, while the participants in the Subordinate Standard condition reported 50.65. This difference was not significant, $F(1, 112) = .14$, ns. There were no significant interactions, $F(3, 112) = 1.86$, ns. [The ANOVA source table is displayed in Appendix F.]

Number of cues. The final measure of effort was based on the average number of cues the subject used in making a decision. It was predicted that greater effort would result in the use of a greater number of cues. Again, collapsing scores across the self-awareness conditions, participants in the Self-Aware-During-Task condition used an average of 4.47 cues, while participants in the Not-Self-Aware-During-Task
condition used 4.97 on the average. This difference was not significant, $F (1, 116) = 2.81$, ns. In the Superordinate condition, participants averaged using 4.65 cues. Participants in the Subordinate condition used on the average 4.79 cues. This difference was not significant, $F (1, 116) = .239$, ns. There was not a significant interaction, $F (1, 116) = 1.91$, ns. [The ANOVA source table is displayed in Appendix F.]

Accuracy on the decision task

The means for the two dependent measures of accuracy are shown in Table 3. [A summary of these variables for each of the 120 participants is displayed in Appendix C.] The two accuracy measures were correlated yielding a correlation coefficient of $-.87$. Each of these measures were analyzed using a two-way ANOVA (see Table 5).

Correlation. The first measure of accuracy was the squared correlation between estimated and predicted GPA. To normalize the distribution, the correlations were transformed to z-scores and squared. The average squared z-score for participants in the Self-Aware-During-Task condition was 1.20. Participants in the Not-Self-Aware-During-Task condition achieved an average z-score of .79. The ANOVA revealed a marginally significant difference between the two self-awareness conditions, $F (1, 116) =$
3.24, \( p < .074 \). For participants in the superordinate condition the average z-score was 1.10, and .89 for participants in the subordinate condition. This difference was not significant, \( F(1, 116) = .843, \) ns. There were no significant interactions, \( F(1, 116) = .263, \) ns. [The ANOVA source table is displayed in Appendix F.]

**Absolute difference scores.** The second measure of accuracy was the average absolute difference score between participants' estimates of GPA and predicted GPA. It was predicted that participants in the self-aware and superordinate standard conditions would have lower difference scores than subjects in the remaining conditions. The average absolute difference score for participants in the Self-Aware-During-Task condition was .26. Participants in the Not-Self-Aware-During-Task condition averaged .25. This difference was not significant, \( F(1, 116) = .117, \) ns. Participants in both the Superordinate and Subordinate Standard conditions averaged .25, \( F(1, 116) = .027, \) ns. There were no significant interactions, \( F(1, 116) = .448, \) ns. [The ANOVA source table is displayed in Appendix F.]

**Knowledge of self**

The two measures of self-knowledge are displayed in Appendix E. It was predicted that participants who were made self-aware during the self-report stage would be more
accurate in their self-reports than participants who were not made self-aware during this stage.

**Beta weights and self-reports.** To normalize the distribution, the correlation coefficients obtained from correlating each participant's beta weights with his or her self-reports were transformed to z-scores. A two-way ANOVA was conducted using the z-scores as dependent measures. Although the results were in the predicted direction, the ANOVA revealed no significant differences between participants in the Never-Self-Aware \( (M = .01) \), the Self-Aware-During-Task-Only condition \( (M = -.20) \), the Self-Aware-During-Self-Report-Only \( (M = .15) \), and the Always-Self-Aware condition \( (M = .05) \), \( F (3, 112) = .645, \) ns. Participants in the Superordinate Standard condition had an average score of .04, while participants in the Subordinate Standard condition averaged -.04. This difference was not significant, \( F (1, 112) = .203, \) ns. There were no significant interactions, \( F (3, 112) = .645, \) ns. [The ANOVA source table is displayed in Appendix F.]

**Time scores and self-reports.** The second measure of self-knowledge was the correlation between time spent on each cue and the participant’s self-report of cue utilization. To normalize the distribution, these correlation coefficients were transformed to z-scores and
used as the dependent measure in a two-way ANOVA. The ANOVA revealed no significant differences between participants in the Never-Self-Aware (M = 1.17), the Self-Aware-During-Task-Only (M = 1.18), Self-Aware-During-Self-Report-Only (M = 1.10), and always self-aware (M = 1.10), F (3, 112) = 0.815, ns. Participants in the Superordinate Standard condition had an average self-knowledge z-score of 0.02, while those in the Subordinate Standard condition averaged 1.02. This difference was not significant, F (1, 112) = 0.049, ns. There was not significant interaction, F = (3, 112) = 0.827, ns. [The ANOVA source table is displayed in Appendix F.]

Self-knowledge and decision accuracy

To compare self-knowledge with decision accuracy, the z-scores from the comparison of beta weights and self-reports were correlated with the correlative accuracy measures (also transformed to z-scores). It was predicted that those participants who were most knowledgeable would also be those participants who were most accurate. The results supported this prediction (r = 0.19, p < 0.02).

Enjoyment of task

Finally, the relationship between the two independent variables and the self-report of enjoyment was analyzed by a two-way ANOVA. On the average, participants reported enjoying the task 55.24 on a scale from one to 100. There
were no significant differences between participants in the four self-awareness conditions, $F(3, 112) = .954$, ns. Additionally, there were no significant differences between standard conditions, $F(1, 112) = .761$, ns. There were no significant interactions, $F(3, 112) = 1.89$, ns.

Discussion

Three hypotheses were tested. First, it was proposed that increasing self-focused attention while an individual engaged in a decision-making task would result in increased effort on the task. Second, the increase in effort brought about by self-focus would result in improved decision making when an appropriate superordinate standard was salient. Third, directing attention to the self during the self-report phase of the task would result in a greater correspondence between subjective and objective indices of the participants' cue utilization.

The effects of self-awareness during the decision task

The first two hypotheses were tested by manipulating self-focus and type-of-standard during the decision-making task. The results did not support these hypotheses. First, participants who were made self-aware during the judgment task did not exert more effort than participants who were not self-aware. In fact, participants who were self-aware during the decision task only reported exerting less effort.
than did participants in any of the remaining conditions. If it is true that participants really did exert little effort on the task, self-awareness should result in a truthful estimate of this effort. This finding is difficult to interpret, since it would have been expected that the participants who were self-aware during the self-report task would have indicated the least amount of effort. Second, self-aware participants did not make more accurate decisions than those who were not self-aware. This result persisted even when a superordinate standard of high performance was made salient.

**Interpretations of the results.** Several possible interpretations for the null relationship between self-awareness and task performance can be made. One explanation is that a relationship does not exist. While there is much empirical support suggesting that a relationship between self-knowledge and performance on a self-related task exists, it may be that the decision task presents a unique situation which is not subject to these psychological processes. Few studies have examined the relationship between self-awareness and performance on a task that is external to the self. It may be that self-focus distracts people from attending to an externally-oriented task. Before making such a conclusion, however, several
alternative interpretations must be explored.

The first of these explanations is that the task was not an appropriate paradigm for the types of analyses conducted in this study. Hopefully, this explanation is the least defensible. In choosing the task, several criteria were established and met.

The first criterion was that the decision task must have an accurate answer which was fairly predictable from the environmental cues available to the participants. This allows for the participants to be easily evaluated on their task performance. For the sample of stimulus students, the five cues accounted for slightly more than 50% of the total variance in GPA. Because GPA was not highly predictable from the five cues, some of the variance in the participants' performances could be attributed to chance. To insure that faulty decision making was not a result of this lack of predictability in the criterion, the predicted GPA, based on the the most predictive combination of cues in the environment, was used. These scores were used both as feedback to the participants and as a measure upon which to base the accuracy of the participants' responses.

The second criterion was that several cues in the environment be made available to the participant to use in his or her judgments. Ideally, these cues should vary in
the degree to which they predict GPA. In this task, five such cues were available. Although all five cues contributed significant variance to the multiple regression equation, the usefulness of the college and undergraduate major in estimating GPA were negligible. Still, this criterion appears to have been satisfied.

The third criterion was that the intercorrelations between the five environmental cues should be low. By examining the ecological cue matrix, it was concluded that this criterion was adequately met, with the highest of these intercorrelations being .35.

The fourth criterion required that task difficulty needed to produce a sizable variance in the participants' performance to avoid restriction of range problems in subsequent analyses. The dispersion of scores on all the dependent measures suggests that this criterion was met.

Finally, the fifth criterion was that the task be interesting enough to maintain the participants' attention. Based on self-reports of the participants, the GPA estimation task appeared to fulfill this goal as well. In fact, several participants reported that the task was very much like a game.

The paradigm, however, may have resulted in several unanticipated effects. The second interpretation for the
null findings involves the difficulty level of the task. Most tasks used in previous self-awareness research have been of a relatively simple nature. For instance, copying prose, reporting one's SAT score, and identifying mug shots. Few studies have had participants engage in a complex task, such as one requiring the consideration and integration of several factors into a judgment. This variation in difficulty may produce sizable differences in performance on the task based on the theory of social facilitation (Zajonc, 1965).

Zajonc (1965) suggested that increased arousal promotes facilitation of a dominant response. This response may either impair or facilitate performance. When the response is simple, or well-practiced, social facilitation theory predicts that arousal will result in social facilitation (improved performance on the task). On the other hand, when the dominant response is difficult or novel, arousal will cause a decrement in performance on the task. It has been suggested that self-focused attention may result in arousal and, as a result, produce the effects mirroring those proposed by social facilitation theory (Carver & Scheier, 1981).

The task used in this study could probably best be characterized as one of moderate difficulty. That is, some
participants were quite accurate while others were not. For those participants who found the task relatively simple, self-awareness should have enhanced their responses. For those participants who performed poorly, self-focus would likely result in performance impairment. Because all self-aware participants' scores were combined within the self-aware conditions, these two effects may have canceled each other out. This would result in the conclusion that there were no differences between self-aware and not-self-aware conditions. Future research is needed to explore this explanation. Participants should be assigned to either a novel or a well-practiced decision task (i.e., defined by the number of practice trials they receive) and the effects of self-directed attention be measured. Findings consistent with the arousal interpretation would suggest how self-awareness could be used to enhance decision making.

Although it is likely that participants were, at some point, aware of the mirrors (as indicated by the manipulation check), the third explanation is that the task may have been too involving for self-focus to maintain its effects. Again, most of the previous literature has relied on tasks that are relevant to the self. Becoming involved on such a task should cause the individual to become even more involved with the self-related task. Because this task
was external to the self, task involvement may have drawn the participant's attention away from the self. In other words, once participants became involved estimating GPAs they may have forgotten about the mirror. In fact, several participants commented that the mirror had little effect on them once they began the actual task (although no published research has shown participants to admit to such an effect).

The manipulation check in the present study is limited in evaluating the effects of the self-awareness manipulation. It cannot be determined whether or not participants remembered seeing the mirror only because they were reminded of it on the postexperimental questionnaire or if the mirror was influential throughout the task. In future research, process checks are needed to determine if the mirror produced a state of self-awareness during the actual decision-making task. Additionally, this limitation may be avoided in future research by using the dispositional factor rather than the situational manipulation.

In a similar vein, most self-awareness researchers manipulate self-focus for fairly short periods of time. In this study, participants were exposed to the mirrors for approximately thirty minutes during the task. It may be that the individual quickly habituates to the self-focusing stimulus and its effect is mitigated. Future research is
necessary to explore the effects of prolonged exposure to self-awareness producing stimuli on task performance.

A fourth explanation is that the mirror may have been aversive to many participants. In fact, one participant reported she woke up about five minutes prior to leaving her dorm room for the experiment and worked as rapidly as she could to avoid looking at herself in the mirror! Duval and Wicklund (1972) suggested that self-awareness brings about an unpleasant state which, if possible, the individual may attempt to avoid. By quickly completing the task, avoidance was possible in this study. Additionally, Carver and Scheier (1981) suggested this avoidance may be the result of negative expectancies for improving one's situation. In this case, participants may have believed they had little chance for improvement (this may have been the result of negative feedback) and may have quickly completed the task in order to avoid the mirror. Participants who received more positive feedback, however, may have had high expectations for success, making them more likely to pursue the task and match their behavior to standards. This confound also may have resulted in the absence of true differences between self-aware and not-self-aware conditions. Future research is needed to explore the role of type of feedback and self-awareness on task performance.
The fifth alternative explanation deals with the standard manipulation. For self-awareness to be effective, it is necessary to have an appropriate standard salient in the participant's environment. Although participants were exposed to standards on the computer task, these may not have been the most salient standards operating for them at the time. For example, the average time subjects expended on the task was relatively short (most participants spent around 30 minutes making 100 decisions). In fact, several students expressed concern that they might be late for an upcoming class. Thus, the time factor may have become a much more salient standard than the standard displayed on the computer screen.

Additionally, despite being able to correctly identify their standard conditions, participants may not have perceived the two standards as being very different, especially since this study used a between-subject design. It may have been more effective to choose a clearly subordinate standard, such as "make sure to hit the keys on the keyboard crisply." Much future research needs to be conducted to determine further the interactions between self-awareness and type of standard.

Conclusions. Because of the limitations and alternative explanations pointed out in the preceding
paragraphs, it is not possible to draw any firm conclusions about the relationship between self-awareness and performance on a decision task. Rather, this study should serve as a starting point for further research examining the effects of self-focus on decision making. It is suggested that further researchers explore the moderating effects of task difficulty, task involvement, and type of feedback on the relationship between self-awareness and performance on a task.

The effects of self-awareness during the self-report

The third hypothesis was tested by manipulating self-focus while the participant filled out a postexperimental questionnaire. The results did not support the hypothesis that self-aware individuals are better able to report on their decision making processes than individuals who are not self-aware.

Interpretation of the results. Several possible interpretations for the null relationship between self-awareness and knowledge of decision strategy can be made.

The first explanation is that a relationship between the two factors does not exist. This explanation is consistent with the claim that people do not have access to their cognitive processes. Nisbett and Wilson (1977) have suggested that people are often knowledgeable about the
outcomes of their thought processes; however, they lack any special insight into the thought processes associated with them. Previous studies on the effects of self-awareness have tended to involve self-reports characterized more by outcome than by process knowledge. For instance, when participants were asked to recall their SAT scores, they were recalling an outcome, not the processes involved with getting that particular information into memory. If individuals truly lack insight to cognitive processes, it is unlikely that self-awareness can enhance the accuracy of self-reports. If the information is not accessible, self-focus cannot be expected to improve memory of it.

To test Nisbett and Wilson's (1977) propositions and the effects of self-awareness further, future researchers could have subjects recall both accessible information (i.e., replicating Pryor et al., 1977) and inaccessible information (i.e., decision processes). Support would be gained if participants could recall the first category of information, but not the second.

A second explanation is that participants did not understand how to assign ratings on the questionnaire. That is, they knew what their cognitive processes were, but were unable to articulate them on the questionnaire. This interpretation seems unlikely, however, since the form used
was very similar to that used in other research comparing subjective and objective indices of decision making. Additionally, several participants were quite accurate in their self-reports suggesting that the directions were understandable.

The third interpretation is that the lack of correspondence between some participants' objective and subjective weights could be due to statistical artifacts. First, it may be the linear model is unable to accurately match the individual's decision processes. In other words, some participants may have combined cues linearly and reported this on the questionnaire. They would be defined as highly knowledgeable. Other subjects may have combined cues using nonlinear strategies, and reported this on the questionnaire. Because the linear model would not be sensitive to the subject's true strategy this participant would be categorized as not knowledgeable.

The likelihood of this being the actual explanation, however, is questionable. This study considered two different measures of objective weights, the first being beta weights obtained through multiple regression equations, and the second being measures of time spent on each cue. Because these two measures were highly correlated it is unlikely that the regression model masked the effects of the
self-knowledge manipulation. Additionally, as pointed out in a similar study by Muchinsky and Williams (1984), research has demonstrated that participants are often unaware of the influence of a single cue on their thought processes, making it unlikely that they would be aware of complex configural patterns on this decision task.

Second, Hoffman (1960) has suggested that beta weights may not be accurate representatives of the participants' utilization of cues if intercorrelations among the variables are high. In this study the intercorrelations were fairly low (the highest being .35). Even if this moderate degree of intercorrelation limited interpretation, it would be expected that a correspondence would exist between the second objective measure (time scores) and self-reports. Again, no such relationship was found.

The fourth alternative explanation is if most participants had lacked self-knowledge the null findings could be attributed to a restriction in range. This does seem to be a plausible explanation, however, since there was a large dispersion in self-knowledge scores using both the beta weights and time-per-factor scores as objective measures.

Conclusions. The relationship between self-awareness and accuracy of self-report is also obscured by limitations
and alternative explanations. Although the self-awareness manipulation was very similar to that used in previous research, there were no checks demonstrating that self-focused participants were aware of the mirror while filling out the postexperimental questionnaire. The results, however, are consistent with previous research conducted by Nisbett and Wilson (1977) and suggest that self-focus may not improve access to actual cognitive processes. Future research comparing access to outcome and process variables is needed to provide a better understanding of the relationship between an individual’s state of self-awareness and his or her ability to accurately report on decision-making processes.
FINAL CONCLUSIONS:
SELF-KNOWLEDGE AND DECISION-MAKING ACCURACY

The major focus of this dissertation has been upon the relationship between decision accuracy and knowledge of cognitive processes. If such a relationship exists, it may be possible to train individuals to be aware of factors they use in making decisions, with the assumption that this knowledge could improve their performance, or the performance of others adopting these same strategies. Indeed, many of the training procedures used by consultants for business and industry are based on an assumed relationship between self-knowledge and decision quality. In other words, individuals are given feedback and trained to be aware of factors they use in making decisions regarding personnel selection and performance appraisal. Likewise, experts are often asked to articulate their decision processes so that others may incorporate these same strategies.

This relationship also would have implications for selection of individuals for decision-making positions. For instance, if those individuals who are good decision makers are the same individuals who know the factors upon which they base these decisions, knowledge of decision strategy could be used as a selection device.
Based on the propositions of self-awareness theory, Chapter IV tested the relationship between knowledge of self and performance on a decision-making task by manipulating the participants' self-awareness. A major tenet of self-awareness theory is that self-awareness results in an increase in self-knowledge and adherence to salient standards and long-standing morals and beliefs. A decision rule may be such a standard. Thus, by making individuals self-aware and providing an appropriate standard, it was proposed that decision quality could be enhanced. The results, however, did not support this prediction.

Because of the limitations previously discussed, it is not possible to conclude from this study whether or not a relationship between self-awareness (as manipulated by situational cues) and decision quality does exist. Instead, several suggestions for research in the area of self-awareness and decision theory have been proposed. These suggestions would allow researchers to both better define the boundaries of self-awareness theory and test its usefulness to the enhancement of decision making.

Although manipulating self-focused attention did not result in improved decision making, the correlation between participants' self-knowledge scores and their decision accuracy suggests that a small positive correspondence does
exist ($r^2 = .36$). Future research needs to further explore the magnitude of this relationship, and if substantial, develop means for improving self-knowledge. Self-focused attention may be one such means.
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APPENDIX A
program gpatest

implicit integer*4 (a-z)

real time,
&   delta_time

character input_text*20,
&   name*20

logical sample

call init1(answer)
do while (answer.ne.0)
call init2(name,answer)
open(unit=12,name='[kw9521r.gpastuff]gpa.save.dat',status='new')
write(12,10) name,answer
sample=.true.
call lib$erase_page(1,1)
call lib$put_SGreen('Begin sample trials',12,30)
call lib$set_cursor(23,1)
call lib$get_screen(input_text,'Press RETURN to continue: ')
open(unit=10,name='sgpadata.dat',status='old',readonly)
call do_exper(sample,answer)
close(unit=10)

sample=.false.
call lib$erase_page(1,1)
call lib$put_SGreen('Begin experiment',12,32)
call lib$set_cursor(23,1)
call lib$get_screen(input_text,'Press RETURN to continue: ')
open(unit=10,name='sgpadata.dat',status='old',readonly)
open(unit=11,name='gpaout.dat',status='unknown',access='append')
time=secnds(0.0)
call do_exper(sample,answer)
delta_time=seconds(time)
close(unit=10),
close(unit=11)
write(12,20) delta_time
close(unit=12, dispose='print/delete')
open(unit=13, name='gpainfo.dat', status='unknown',
    access='append')
write(13,30) name, answer, delta_time
close(unit=13)
call lib$erase_page(1,1)
call lib$put_screen('Experiment complete; contact monitor',
    12,22)
call lib$set_cursor(23,1)
call lib$get_screen(input_text)
do while (input_text(1:2).ne.'go'.and.input_text(1:2).ne.'GO')
call lib$put_screen(char(7), 23, 25)
call lib$erase_line(23,1)
call lib$get_screen(input_text)
endo
call init1(answer)
endo
call lib$erase_page(1,1)
call exit
10 format(1x,a,i2//)
20 format(/1x,'Total time =',f9.2)
30 format(1x,a,i2,f9.2)
end

subroutine get_option(option)
implicit integer*4 (a-z)

character input_text*10

call lib$set_cursor(18,4)
call lib$get_screen(input_text,'Option: ',in_len)
call ots$csv_t1_l(input_text(:in_len),option)
call lib$erase_page(18,12)
return
end

subroutine decode_data(gender,gendere, &
& college,collegec, &
& major,majore)

implicit integer*4 (a-z)

character cgender *6, &
& genderc *6, &
& college *12, &
& collegec *12, &
& cmajor *28, &
& majorec *28

dimension cgender (0:1), &
& college(0:5), &
& cmajor (0:33)

data cgender /'Male','Female'/, &
& college/'Liberal Arts', &
& 'Business Adm', &
& 'Education', &
& 'Journalism', &
& 'Fine Arts',
& cmajor
'Pharmacy/',
'undeclared',
'Public Administration',
'Computer Science',
'Accounting',
'Marketing',
'News',
'Finance',
'Radio and TV',
'Advertising',
'Elementary Education',
'Music',
'Management',
'Pharmacy',
'Biology',
'Theatre',
'Art',
'Political Science',
'Retail Management',
'Internl Relations',
'Psychology',
'Computer Info Systems',
'Public Relations',
'Special Education',
'Accounting',
'H uman Services',
'Pre-Law',
'Actuarial Science',
& 'English',
& 'Health Science',
& 'Earth Science',
& 'Pre-Med',
& 'Sociology',
& 'Radio News',
& 'General Business'/

genderc(1:)=cgender(gender)(1:)
collegec(1:)=ccollege(college)(1:)
majorc(1:)=cmajor(major)(1:)
return
end

subroutine init1(answer)
implicit integer*4 (a-z)
character input_text*2

call lib$erase_page(1,1)
call lib$set_cursor(10,1)
write(6,10) -
call lib$set_cursor(16,9)
call lib$get_screen(input_text,'Selection: ',in_len)
call ots$cvt_ti_l(input_text(:in_len) ,sel)
do while (sel.lt.1.or.sel.gt.3)
   call lib$put_screen(char(7),16,9)
call lib$erase_page(16,9)
call lib$get_screen(input_text,'Selection: ',in_len)
call ots$cvt_ti_l(input_text(:in_len),sel)
enddo
if (sel.eq.3) then
  answer=0
  return
else if (sel.eq.1) then
  answer=0
else
  answer=4
endif

call lib$erase_page(1,1)
call lib$set_cursor(10,1)
write(6,20)
call lib$set_cursor(17,9)
call lib$get_screen(input_text,'Selection: ',in_len)
call ots$cvt_til(input_text(:in_len),sel)
do while (sel.lt.1.or.sel.gt.4)
  call lib$put_screen(char(7),17,9)
call lib$erase_page(17,9)
call lib$get_screen(input_text,'Selection: ',in_len)
call ots$cvt_til(input_text(:in_len),sel)
endo
do while (sel.lt.1.or.sel.gt.4)
  answer=answer+sel
endo
return

10 format(20x,'Set up for Participant'/
 & 20x,22('-')/ & 20x,'1 -- Superordinate participant'/
 & 20x,'2 -- Subordinate participant'/
 & 20x,'3 -- End Session'/)
20 format(20x,'Participant's Selfawareness'/
 & 20x,22('-')/ & 20x,'1 -- Never SA'/
& 20x,'2 -- SA during task'/
& 20x,'3 -- SA during report'/
& 20x,'4 -- Always SA'/
end

subroutine do_exper(sample,answer)

implicit integer*4 (a-z)

parameter max_options = 6

real
time,
& opt_time,
& gpa,
& egpa

character header1 *80,
& header2 *80,
& header3 *80,
& cgender *6,
& ccollege *12,
& cmajor *28,
& ccount *3,
& cdtst *2,
& cpercentile *2,
& input_text *10

logical sample

dimension opt_count(1:max_options-1),
& opt_time(1:max_options-1)
data header1/'Student High School
& Drake Undergraduate'/
& header2/'Number Gender Percentile College
& Test Scores Major'/
& header3/'-------- ------ -------- --------
& -------- -------- -------- --------'/

call lib$erase_page(1,1)
call lib$put_screen(header1,1,1)
call lib$put_screen(header2,2,1)
call lib$put_screen(header3,3,1)
call lib$set_cursor(9,1)
write(6,10)_
count=0
read(10,20,iostat=stat)
& gender,percentile,college,dts,major,gpa
do while (stat.eq.0)
do i=1,max_options-1
  opt_count(i)=0
  opt_time(i)=0.0
enddo
count=count+1
call decode_data(gender,gender,
& college,college,
& major,major)
call ots$cvt_l_ti(dts,dcts)
call ots$cvt_l_ti(percentile,percentile)
call ots$cvt_l_ti(count,count)
call lib$erase_line(4,10)
call lib$put_screen(count,4,2)
if (mod(count-1,25).eq.0) then
if (answer.lt.5) then
    call lib$put_screen('Your task is to make a thorough,
&well thought out decision.',21,1)
else
    call lib$put_screen('Your task is to carefully and
&consistently weigh in your mind each of the ',21,1)
call lib$put_screen('five factors in your judgement of
&the GPA.',22,1)
endif
endif
call get_option(option)
do while (option.le.0 .or. option.gt.max_options)
call lib$put_screen(char(7),18,12)
call lib$erase_page(18,12)
call get_option(option)
enddo
do while (option.ne.max_options)
call lib$erase_line(4,10)
opt_count(option)=opt_count(option)+1
if (option.eq.1) then
call lib$put_screen(cgender,4,10)
else if (option.eq.2) then
call lib$put_screen(cpercentile//',4,21)
else if (option.eq.3) then
call lib$put_screen(ccollege,4,31)
else if (option.eq.4) then
call lib$put_screen(cgpa,4,50)
else
call lib$put_screen(cmajor,4,59)
endif
time=secnds(0.0)
old_option=option

call get_option(option)
do while (option.le.0 .or. option.gt.max_options)
call lib$put_screen(char(7),18,12)
call lib$erase_page(18,12)
call get_option(option)
enddo

opt_time(old_option)=opt_time(old_option)+seconds(time)
enddo

call lib$erase_line(4,10)
call lib$erase_page(18,12)
call lib$set_cursor(20,1)
call lib$get_screen(input_text,'Enter your estimate of the

&GPA: ')
call ots$cvt_t_f(input_text,egpa,,%val(1))
do while (egpa.le.0.or.egpa.gt.4)
call lib$put_screen(char(7),20,32)
call lib$erase_line(20,1)
call lib$get_screen(input_text,'Enter your estimate of the

&GPA: ')
call ots$cvt_t_f(input_text,egpa,,%val(1))
enddo

call for$cvt_d_tf(gpa,input_text,%val(2))
call lib$put_screen('The actual GPA is: //input_text(7:10),

&21,1)
call lib$set_cursor(23,1)
call lib$get_screen(input_text,'Press RETURN to continue: ')
call lib$erase_page(19,12)
if (.not.sample) then
    write(11,60) count,(opt_count(i),opt__time(i),
    &i=1,max_options-1),egpa
    write(12,60) count,(opt_count(i),opt__time(i),
& i=1,max_options-1),egpa
endif
read(10,20,iostat=stat)
& gender,percentile,college,dts,major,gpa
enddo
return

10 format(12x,'Display Option List'/
& 12x,19('-')/
& 12x,'1 -- Gender' /
& 12x,'2 -- High School Percentile' /
& 12x,'3 -- College' /
& 12x,'4 -- Drake Test Scores' /
& 12x,'5 -- Undergraduate Major' /
& 12x,'6 -- Estimate GPA')
20 format(i1,i2,i1,2(i2),f4.2)
60 format(1x,i3,5(i2,f7.2),f4.2)
end

subroutine init2(name,answer)
implicit integer*4 (a-z)
character name*20,
& input_text*10

call lib$erase_page(1,1)
call lib$set_cursor(12,26)
call lib$get_screen(name,'Please enter your last name: ')
call lib$erase_page(1,1)
write(6,10)
call lib$set_cursor(23,1)
call lib$get_screen(input_text,'Press RETURN to continue: ')
call lib$erase_page(1,1)
write(6,20)
if (answer.lt.5) then
    call lib$put_screen('Your task is to make a thorough, &well thought out decision.',15,1)
else
    call lib$put_screen('Your task is to carefully and &consistently weigh in your mind each of the ',15,1)
    call lib$put_screen('five factors in your judgement of &the GPA.',16,1)
endif
call lib$set_cursor(23,1)
call lib$get_screen(input_text,'Press RETURN to continue: ')
return
format(6x,'Thank you for volunteering to participate in this'/ 
&1x,'study. We are interested to see how well you can ', 
&'predict'/ 
&1x,'Drake undergraduates'' grade point averages from 5 ', 
&sources of'/ 
&1x,'information. These include their: 1) High School ', 
&'Percentile', '/ 
&1x,'2) Drake Test Scores (ACT and SAT), 3) Gender, 4) College,'/ 
&1x,'and 5) their Major.'// 
&6x,'Your task will be to select information about each student,'/ 
&1x,'and based upon that information, make a judgement regarding'/ 
&1x,'the student''s GPA. To obtain this information, you must'/ 
&1x,'interact with the computer. For each student the computer'/ 
&1x,'will allow you to see up to 5 pieces of information. The'/ 
&1x,'amount of information used is determined by you. To'/ 
&1x,'obtain information on Gender press the number 1. This'/ 
&1x,'information will then be presented on the screen. Likewise'/
information on High School Percentile, College, Drake /
Test Scores, and Major may also be obtained by pressing /
the 2, 3, 4, and 5 keys respectively. Again, you may /
obtain as much or as little information as you would like. /
You may also look at the same information more than once, /
and you may look at the information for as long as you like.

After you have obtained the desired information on a particular student, press the 6 key. The computer will then ask you to enter your estimate of the student's GPA. When you have completed this task, the computer will move on to the next student and the process will be repeated.
Participant number and initials ______________________

1) PLEASE RATE EACH OF THE FIVE FACTORS SO THAT A HIGH RATING REPRESENTS A RELATIVELY IMPORTANT FACTOR IN ESTIMATING GRADE POINT AVERAGE, AND A LOW RATING A RELATIVELY UNIMPORTANT FACTOR. IF YOU DID NOT USE A FACTOR RATE IT ZERO. THE SUM OF YOUR RATING MUST EQUAL 100.

   GENDER

   HIGH SCHOOL PERCENTILE

   COLLEGE

   DRAKE TEST SCORES

   UNDERGRADUATE MAJOR

   TOTAL = 100%

2) DID YOU HAVE A SPECIFIC STRATEGY?

   YES _____   NO _____

   IF YES, DESCRIBE YOUR STRATEGY:

3) DID YOU SHIFT YOUR STRATEGY?

   YES _____   NO _____

   IF YES, PLEASE DESCRIBE HOW YOUR STRATEGY CHANGED, AND HOW OFTEN:
DECISION MAKING QUESTIONNAIRE

1. What is your gender?  [ ] Male  [ ] Female

2. To the best of your knowledge, what was your high school percentile rank?
   [ ] I think this is accurate  [ ] This is just a guess

3. What college are you enrolled in?
   [ ] Business Administration  [ ] Liberal Arts & Sciences
   [ ] Education  [ ] Pharmacy
   [ ] Fine Arts  [ ] Other
   [ ] Journalism  [ ] Do not know

4. To the best of you knowledge, what were your scores on the following?
   ACT _______  SAT _______

5. What is your undergraduate major?

6. What is your cumulative Grade Point Average?

7. Which of the following statements appeared on the computer screen?
   [ ] Your task is to make a thorough well thought-out judgment of GPA.
   [ ] Your task is to carefully and consistently weigh in your mind each of the five factors in your judgment of GPA.

8. Do you recall seeing a mirror while you were working on the computer?
   [ ] Yes  [ ] No
9. How much did you enjoy this task? (place a slash anywhere on the continuum that best reflects your answer.)

/..../..../..../..../..../..../..../..../..../..../
not at all very much

10. Compared to your utmost effort (the amount of effort you would exert if your life literally depended on it) how much effort did you exert on your first 50 estimates?

/..../..../..../..../..../..../..../..../..../..../
0% 50% 100%

11. Compared to your utmost effort (the amount of effort you would exert if your life literally depended on it) how much effort did you exert on your last 50 estimates?

/..../..../..../..../..../..../..../..../..../..../
0% 50% 100%

THANK YOU VERY MUCH FOR PARTICIPATING IN THIS EXPERIMENT. PLEASE CONTACT THE EXPERIMENTER BEFORE YOU LEAVE.
APPENDIX C
Accuracy and Effort Indices for Each of the 120 Participants

Condition 1:
Superordinate Standard; Never Self-Aware

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Condition 2:
Superordinate Standard; Self-Aware During Task Only

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Condition 3:

Superordinate Standard; Self-Aware During Self-Report Only

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Condition 4:

Superordinate Standard; Always Self-Aware

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Subordinate Standard; Never Self-Aware

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Subordinate Standard; Self-Aware During Task Only

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Subordinate Standard; Self-Aware During Self-Report Only

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Subordinate Standard; Always Self-Aware

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Beta Weights for Each of the 120 Participants

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Superordinate Standard; Never Self-Aware

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Condition 2:

Superordinate Standard; Self-Aware During Task Only

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Superordinate Standard; Self-Aware During Self-Report Only

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Superordinate Standard; Always Self-Aware

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Subordinate Standard; Never Self-Aware

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Subordinate Standard; Self-Aware During Task Only

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APPENDIX E
Correspondence Between Objective and Subjective Weights for Each of the 120 Participants

Condition 1:
Superordinate Standard; Never Self-Aware

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Condition 4:

Superordinate Standard; Always Self-Aware

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**Condition 5:** Subordinate Standard; Never Self-Aware

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Condition 6:

Subordinate Standard; Self-Aware During Task Only

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Condition 7:
Subordinate Standard; Self-Aware During Self-Report Only

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Condition 8: Subordinate Standard; Always Self-Aware

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Table F1
Source Table for ANOVA on the Mirror Manipulation Check

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<th>DF</th>
<th>Mean Squares</th>
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<th>p&lt;</th>
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Table F2
Source Table for ANOVA on Standard Manipulation Check

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Table F3
Source Table for ANOVA on Multiple $R^2_s$

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<th>Mean Squares</th>
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Table F4
Source Table for ANOVA on Actual Total Time (in seconds)

| Source      | Sums of Squares | DF | Mean Squares | F    | p <  
|-------------|-----------------|----|--------------|------|------
| Standard    | 142,368.76      | 1  | 142,368.76   | 2.9  | ns   
| Self-Aware  | 1,065,388.88    | 1  | 1,065,388.88 | 2.16 | .144 |
| Stand X SA  | 535.56          | 1  | 535.56       | 0.00 | ns   
| Residual    | 57,114,938.78   | 116| 492,370.16   |      |      

Table F5
Source Table for ANOVA on Self-Reported Effort

| Source      | Sums of Squares | DF | Mean Squares | F    | p <  
|-------------|-----------------|----|--------------|------|------
| Standard    | 58.80           | 1  | 58.80        | 0.14 | ns   
| Self-Aware  | 3537.90         | 3  | 1179.30      | 2.71 | .048 |
| Stand X SA  | 2424.60         | 3  | 808.20       | 1.86 | .141 |
| Residual    | 48720.00        | 112| 435.00       |      |      |
### Table F6

Source Table for ANOVA on Average Number of Cues Used

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### Table F7

Source Table for ANOVA on Accuracy (Correlative Index) (z - transformed data)

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Table F8
Source Table for ANOVA on Accuracy
(Absolute Difference Scores)

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Table F9
Source Table for ANOVA on Self-Knowledge
(Self-reports and beta-weights are $z$-transformed)

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Table F10
Source Table for ANOVA on Self-Knowledge
(Self-reports and time scores are z-transformed)

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Table F11
Source Table for ANOVA on Self-Reported Enjoyment of Task

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