Situational Context and Personality Influences on Motor Performance: A Test of Self-Determination Theory

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SITUATIONAL CONTEXT AND PERSONALITY INFLUENCES ON MOTOR PERFORMANCE: A TEST OF SELF-DETERMINATION THEORY

By

Trena N. Thompson

A Thesis Submitted to the
Department of Human Factors and Systems
in Partial Fulfillment of the Requirements for the Degree of
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SITUATIONAL CONTEXT AND PERSONALITY INFLUENCES ON MOTOR PERFORMANCE: A TEST OF SELF-DETERMINATION THEORY

By
Trena N. Thompson

This thesis was prepared under the direction of the candidate’s thesis committee chair, Christina Frederick, Ph.D., Department of Human Factors & Systems, and has been approved by the members of the thesis committee. It was submitted to the Department of Human Factors & Systems and has been accepted in partial fulfillment of the requirements for the degree of Master of Science in Human Factors & Systems.

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A special thanks is also owed to parents, Wayne and Lynn Collins, and to Mark Hebensperger for their relentless support and encouragements that helped me attain my educational goals.
This research attempted to predict motor performance through consideration of an individual’s personality orientation and the manipulation of motivation through priming a specified situational context. The effect of the personality orientation and situational prime on self-handicapping was also analyzed. Hypotheses were derived from key concepts of self-determination theory, specifically causality orientation theory, and previous work by Hodgins and colleagues (in press). The results of the study indicated that motor performance was not predicted by personality, situational prime, or the interaction of the two variables.
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Introduction

This research attempted to predict motor performance and self-handicapping using personality orientation and motivation. The research was based on self-determination theory (SDT), specifically causality orientations theory, a mini-theory of SDT, which focuses on human functioning as an interaction between personality and various situational contexts. According to SDT, when the context satisfies one’s needs and desires, then self-determination can be expected to increase, potentially yielding enhanced behavioral and performance outcomes, making SDT and causality orientation theory a valuable asset when analyzing the influence of personality and situational contexts in predicting behavioral and performance outcomes. (Deci & Flaste, 1995; Deci & Ryan, 1985a).

Self-determination is defined as the human capability to choose behaviors and actions that are consistent with and fulfill one’s basic needs and inner desires (Deci, 1980; Deci & Flaste, 1995). Self-determination is structured and measured at an individual personality level, with the individual’s causality orientation representing an aspect of personality. Situations, in turn, are interpreted based on the individual’s personality (Deci & Ryan, 1985a). Thus, behavior is contingent on both personality and situation, with greater emphasis on personality since the context will be interpreted in accordance with the individual’s personality.

Previous studies yielded similar results in that the individual’s autonomy orientation as well as autonomy supportive contexts lead to desired behavioral outcome (Williams, 2002). However, most studies on the influence of personality and context on performance involve only autonomy and controlled motivational states. Impersonal is often excluded in studies/experiments, making it difficult to hypothesize the affect of the impersonal orientation on
behavior and performance outcomes. Furthermore, most existing literature only involves self-satisfaction, perceived competence, self-perceptions, and attitudes. Behaviors are only tested within a specified context, such as academia, sports, health care, etc. (see section on related research and practical applications). Hence, the contexts are not truly manipulated, actual performance is not tested, and the samples are homogeneous, generalized to the specified context only. The study is unique in four aspects: (1) it tests all three causality orientations, (2) the orientations are tested using varying temporary situational contexts, (3) it tests actual performance in addition to self views (indicative of self-handicapping), and (4) a heterogeneous sample is used. The study tests the findings and conclusions of other related research while adding further support for self-determination theory, by testing these variables in order to make the findings more generalizable.

**Self-Determination Theory (SDT)**

SDT is an “organismic-dialectical metatheory” of motivation focusing on human functioning and personality within various situational contexts (Deci & Ryan, 2001; Deci & Ryan, 1985a). SDT is considered a metatheory in that it consists of four mini-theories: (1) Cognitive evaluation theory, which evaluates effects of social context on intrinsic motivation, (2) organismic integration theory, which is specific to self-integration and regulation of values as well as the developmental extrinsic motivation, (3) causality orientations theory, which details individual differences in social contexts, and (4) basic needs theory, which discusses the concept of basic needs, goals, and motivation in respect to optimal health and well-being (Deci & Ryan, 2001; Ryan & Deci, 2002).

SDT contends that humans are active organisms with natural, innate, and constructive tendencies toward psychological growth and self-integration. Humans strive to satisfy their basic
psychological needs. These needs consist of: competency, autonomy, relatedness, the need to seek and engage in new experiences, and the need to integrate these experiences into a unified sense of self (Hodgins, Yacko, Gottlieb, Goodwin, & Rath, in press; Ryan & Deci, 2002). These innate human tendencies rely on “nutriments” from situational contexts (social, external, or environmental factors or forces), in order for the human to function effectively and satisfy his/her organismic needs (Hodgins et al.; in press; Ryan & Deci, 2002). Contextually, behavior is affected by the presence or absence of adequate “nutriments” or resources (Deci, 1980; Deci & Ryan, 1985a). Stated simply, each individual must utilize both internal (personality) and external (situational) contexts to support the fundamental process of human nature and satisfy his/her own operative needs.

**Self-Determined Motivation.** Individuals functioning in accord with their own integrated needs and tendencies are referred to as self-determined, or functioning autonomously (Hodgins et al., in press). SDT focuses on the extent to which humans are self-determined, which means they are engaging in behaviors and experiences with a full sense of choice (Deci & Flaste, 1995; Deci & Ryan, 2001; Deci & Ryan, 1985a).

“The psychological hallmark of self-determination is flexibly managing the interaction of oneself and the environment. When self-determined, one acts out of choice rather than obligation or coercion, and those choices are based on an awareness of one’s own organismic needs and a flexible interpretation of external events” (Deci & Ryan, 1985a, p.38). Every individual to some extent possesses the capacity to be self-determined, however, not all choose to engage in self-determined behaviors (Deci, 1980). To lose self-determination signifies the loss of control over oneself. One may lose self-determination without being aware or conscious of it, but to restore self-determination, one must be aware and deliberate (Deci, 1980).
Self-determined motivation involves an internal perceived locus of causality, void of external pressures or forces such as rewards or contingencies that control behavior (Deci & Ryan, 1985, Deci, 1980). True self-determination is intrinsically motivated. However, self-determination may be extrinsically motivated if regulated by self-integrated needs and goals (Deci & Ryan, 1985a, Ryan & Deci, 2002).

**Nonself-determined Motivation.** Nonself-determination is exemplified through controlled or impersonal functioning. With nonself-determined functioning, behavior is fully extrinsically motivated and based on physical or physiological factors (Deci, 1980).

When one or more operative needs (which stem from basic psychological needs required to function or operate effectively) are not met, humans may attempt to compensate for the thwarted needs by engaging in defensive behaviors. Over time, this may cause the individual to become alienated from his/her own true needs and tendencies. Individuals then experience a lack of genuine self-esteem and autonomy, resulting in the establishment of a “compensatory” self-esteem (Hodgins et al., in press). Maintenance of “compensatory” self-esteem is based on ego-invested self-structures which place self-worth contingent on specific outcomes from the environment, most of which are uncontrolled by the individual. Hence, behavior and motivation is said to be controlled (Hodgins et al., in press).

When individuals lose autonomy but are unable to compensate for the thwarted needs their self-structures become chaotic leaving little basis for a sense of self-esteem, whether genuine or contingent (“compensatory”). These individuals are said to experience impersonal motivation or amotivation (Hodgins et al., in press). For an impersonal-oriented individual, there are no directing contextual forces, resulting in the inability to regulate his/her behavior(s) (Deci & Ryan, 1985a). Thus, the impersonal-oriented individual cannot satisfy his/her basic needs
and desired outcomes are viewed as unattainable (Deci & Ryan, 1985a; Hodgins, Yacko, Gottlieb, Goodwin, & Rath, in press). Due to the characteristics of impersonal functioning, SDT contends that individuals experience the worst behavior outcomes and performance in impersonal motivational states (Hodgins et al., in press).

**Causality Orientation Theory**

Causality orientation theory focuses on each of these motivational orientations in detail. “The causality orientations approach is intended to index aspects of personality that are broadly integral to the regulation of behavior and experience” (Ryan & Deci, 2002, p.21). Causality orientation theory focuses personality, that is the differences in individuals, and contexts that will support self-determination (Ryan & Deci, 2002). These individual differences comprise the personality aspect of an individual. Motivation, behavior, experience, and performance are dependent on the interaction of immediate situational contexts and the individual’s personality (Ryan & Deci, 2002).

Causality orientation theory expands on individual differences in people’s motivational orientations toward specific situations or contexts (Ryan & Deci, 2002). It is these relatively stable differences in individuals that equate to individual personalities. Causality orientation theory refers to personality as one’s (motivational or causality) orientation. Personality originates from experiences, which vary in degree of exposure to controlling, motivating, and demotivating situations during development (Deci & Flaste, 1995; Ryan & Deci, 2002). These prior experiences, as well as the individuals’ interpretation(s) of them are unique. This creates differences in individuals, which becomes the personality. In short, individuals interact in situations or contexts based on their own unique personality derived from interpretations and
interactions of past experiences, which, in turn, become continuous predictors for future interpretations and behavior (Deci & Flaste, 1995).

The causality orientation theory involves three motivational states or classes of behaviors referred to as causality orientations. These orientations, autonomy, controlled, and impersonal, differ in degree of self-determination and represent a facet of personality (Deci & Ryan, 2001; Deci & Ryan, 1985a; Ryan & Deci, 2002). According to SDT, the causality orientations provide the foundation that allow for the predictions of motivation, behavior, and performance (Ryan & Deci, 2002).

**Autonomy-Oriented.** According to SDT, when an individual possesses self-determined motivation, he/she is said to be autonomy-oriented (Hodgins et al., in press). The concept of autonomy focuses on choice, engaging in behaviors and/or actions with feelings of independence, self-sufficiency, freedom, etc. and to flexibly and actively evaluate all options, alternatives, choices, etc.

An autonomy-oriented individual perceives him/herself to be the origin or source of behavior (Ryan & Deci, 2002). Autonomy involves initiating and regulating behaviors or actions in accordance with one’s own interests, motives, goals, and integrated values (Hodgins et al., in press; Deci & Ryan, 1985a; Ryan & Deci, 2002). Behaviors may be conscious, deliberate, and analytical or they can be spontaneous and intuitive. In either respect, the individual is dynamically and flexibly involved in making choices (Deci & Ryan, 1985a). Thus, behaviors are NOT automatic or conditioned (Deci & Ryan, 1985a). According to SDT, in making choices, an autonomy-oriented individual utilizes all available information and resources, considers all options and/or alternatives, and may adjust to fixed situations (Deci & Ryan, 1985a; Deci, 1980). In other words, if only one behavior option exists in a specific fixed situation, the
autonomy-oriented individual is flexible in that he/she can adjust to the situation without
becoming defensive or immobile. “When autonomous, individuals experience their behavior as
an expression of the self, such that, even when actions are influenced by outside sources, the
actors concur with those influences, feeling both initiative and value with regard to them” (Ryan
& Deci, 2002, p.8). In short, self-determined behaviors are chosen based on integrated goals and
basic psychological needs (Deci & Ryan, 1985a).

Autonomy-oriented individuals display greater creativity and enhanced perceived
competence than nonself-determined individuals (Deci & Ryan, 1985a). Autonomy-oriented
individuals also take greater responsibility for their own actions and/or behaviors, making fewer
excuses for themselves, and are less likely to derogate others than nonself-determined
individuals (Hodgins, et al., in press Deci & Ryan, 2001). They regard information, even if
negative feedback, as non-defensive and constructive (Hodgins et al., in press). They are self-
motivated and tend to seek out opportunities, activities, settings, and/or jobs that are autonomy
conducive, optimally challenging and interesting, and provide informational feedback (Deci &
Ryan, 2001; Deci & Ryan, 1985a).

They are also flexible and, to some extent, invulnerable to losing intrinsic motivation and
self-determination in nonself-determined contexts. “If the person has integrated regulations that
were initially extrinsic, the person will be more able to remain self-determining in the presence
of extrinsic controls” (Deci & Ryan, 1985a, p. 157). Meaning that when introduced to a nonself-
determined context, autonomy-oriented individuals will be less vulnerable or less influenced by
the nonself-determined contexts.

Control-Oriented. Individuals who are control-oriented initiate and regulate behaviors
based on extrinsic contextual forces (Deci & Ryan, 1985a). Behaviors are nonintegrated, and are
extrinsically motivated, by *either* external *or* internal demands and pressures, such as reward contingencies, inner emotions, deadlines, ego-involvement, and/or the directives of others (Deci & Ryan, 2001). The individual lacks self-determination and a sense of freedom, resulting in restricted awareness and actions that are not integrated (Deci & Ryan, 1985a). An example of a control initiated behavior is a student’s decision to study for a class; they *have to* study they do not *choose to* (note that this example is not indicative to all students) (Ryan & Deci, 2002). Controlled forces, or controlled events/situations, pressure an individual towards a specific behavior outcome (Deci & Ryan, 1985a; Hodgins et al., in press).

Those individuals who are control-oriented tend to display greater pressures and tensions and are less creative and flexible than autonomous individuals (Deci & Ryan 1985a). Behaviors are often in forms of compliance or rebellion/defiance resulting from a conflict of power between the controller and the controlled (Deci & Ryan, 1985a; Deci & Flaste, 1995). Rebellion or defiance is indicative of a strive for autonomy, while compliance puts emphasis on demands of the environment rather than on needs and feelings and in turn, denying one’s true sense of self (Deci & Ryan, 1985a). Hence, with compliant behaviors, the integrated self is underdeveloped and the organismic needs are suppressed (Deci & Ryan, 1985a).

Behaviors display self-embellishment following success and guilt and/or shame following failure (Deci & Ryan, 1985a). Controlled behaviors seem to be directed based on emphasis placed on wealth, fame, and other extrinsic factors and include aggressively trying to win competitions, over-investing in appearance, accumulating wealth, etc. (Deci & Ryan, 2001). Basically, the individual is compensating for their unsatisfied needs through aligning their thoughts and actions with controls in order to reduce anxiety or discomfort and/or threat to their ego-invested self esteem (Deci & Ryan, 1985a).
Impersonal-Oriented. The impersonal orientation relates to amotivation and is the lowest level self-determined motivation according to SDT (Hodgins et al., in press; Ryan & Deci, 2002). It is "based in a sense of one’s being incompetent to deal with life’s challenges" (Deci & Ryan, 1985a, p. 159). The impersonal-oriented individual will act with no conscious awareness or intention, no identification with, and no endorsement of his/her behavior. Behaviors are viewed as neither intrinsically nor extrinsically motivated (Deci & Ryan, 1985a). Contextual forces stemming from the internal realm, specific to individual personality, seem overwhelming and unmanageable and are often experienced as emotion-laden. Often crimes stem from overwhelming inner contextual forces.

Impersonal-oriented behaviors are erratic, inconsistent, unpredictable, and non-intentional, resulting from an incomplete psychological structure created to deal with contextual (external or internal) forces (Hodgins, et al., in press; Deci & Ryan, 1985a). Because contextual forces are viewed as uncontrollable and unpredictable, impersonal-oriented individuals experience a sense of incompetence and helplessness and are unable to cope with reality or regulate experiences effectively (Hodgins, et al., in press; Deci & Ryan, 2001; Deci & Ryan, 1985a).

Impersonal-oriented individuals may dissociate from his/her behavior by distorting or forgetting it (Deci & Ryan, 1985a). They cannot manage their drives and emotions and may become immobile and passive (Deci & Ryan, 1985a). They feel easily overwhelmed and anxious with experience. In summary, an impersonal-oriented individual behaves without intentions and lacks a sense of purpose. Impersonal-oriented individuals are driven by unconscious forces, are likely to engage in addictive behaviors and feelings of helplessness, and possess a high level of anxiety (Deci & Ryan, 1985a).
Openness to Experience

Openness to experience is a characteristic of autonomous functioning. Openness facilitates the integration of self and experience over time, or more simply stated, the “ability to learn and grow from experience” (Hodgins et al., in press, p.9). According to Hodgins and colleagues, openness is associated with fewer escape and avoidant behaviors, overall lower defensiveness and enhanced performance (Hodgins et al., in press). Due to the nature of autonomous functioning, with respect to choice and openness to experience, individuals can be expected to openly experience a wide range of emotions void of repression. Self-determined (autonomous) individuals can choose effective action(s) in situations by not engaging in self-protective strategies/behaviors.

Nonself-determined functioning is associated with defending against experience or use of escape and avoidant behaviors, which are not conducive for optimal performance (Hodgins et al., in press). Control-oriented individuals tend to engage in defensive behavior against experience in performance activities in order to protect their ego. Defense behaviors include self-handicapping behaviors such as deliberately performing badly or presenting themselves poorly (Deci & Ryan, 1985a). Individuals display a high level of ego-invested (nonself-determined) competence in performance, which undermines intrinsic motivation. To the extent that the context does not coincide with ego-invested self-structures, performance will be hindered (as displayed through defensive and self-handicapping behaviors) (Deci & Ryan, 1985a; Hodgins et al., in press). The impersonal orientation is related to low-self esteem, depression, and a continuous state of negative effect, warranting a defensive stance against experience (Ryan & Deci, 2002). Although, impersonal-oriented individuals engage in defensive behaviors, they are unable to devise effective defense strategies (Hodgins, et al., in press; Deci & Ryan, 2001).
From this viewpoint, it can be expected that nonself-determined individuals have degraded motivation and performance (as opposed to self-determined individuals) in respect that they are not open to experience (Hodgins & Knee, 2002; Hodgins et al., in press).

In short, according to SDT self-determined individuals perform and behave at optimal levels because they are operating from integrated self-structures and experiencing a genuine self-esteem. Furthermore, individuals feel that they can flourish within the situational context because it supports the tendencies for their organismic needs to be satisfied (Deci & Flaste, 1995). Hence, SDT contends that the satisfaction of needs allows for openness to experience, which, in turn, facilitates performance.

**Personality and Performance.** However, a quantitative summary of 15 prior meta-analytic studies investigating personality and job performance demonstrated that openness to experience did not predict “overall work performance” but did predict “success in specific occupations or relate specific criteria” (Barrick, Mount, & Judge, 2001, p. 9). Openness to experience is defined as “intellectance, creativity, unconventionality, and broad-mindedness” (Barrick, Mount, & Judge, 2001, p. 11). Openness to experience only predicted training proficiency and did not predict performance. “It appears that employees who are intellectual, curious, imaginative, and have broad interest are more likely to benefit from the training. These employees are likely to be ‘training ready’ or more willing to engage in learning experiences” (Barrick, Mount, & Judge, 2001, p. 12).

**Behavior and Performance Outcomes**

To iterate the concept of self-determination, consider driving home from work daily. This behavior is nonself-determined, in that the behavior is automatic and inflexible, especially if other options exist, but are not being considered. If an accident occurs and you opt an alternative
route, the behavior is then said to be self-determined in that it involves the *choice* of a better route home. However, if you become upset and inflexible, and continue along the same route, even though it is inefficient, the behavior would be considered nonself-determined, in that it is controlled by emotional and/or inner forces (Deci, 1980).

It is the interaction between the individual and the situational contexts that allows for predictions of motivation, behavior, and performance (Deci & Flaste, 1995; Deci & Ryan, 2001; Ryan & Deci, 2002). Personality is based on individual differences in behavior and is the primary determinate in what one attends to and how events are interpreted. This interpretation affects behavior outcomes (Deci & Ryan, 1985a). In short, based on SDT, behavior and performance outcomes are a function of the individual's personality (causality orientation), contextual forces, and their interactive effects (Deci, 1980).

*Contextual Forces.* Situational contexts can “either facilitate and enable the growth and integration propensities with which the human psyche is endowed, or they can disrupt, forestall, and fragment these processes resulting in behaviors and inner experiences that represent the darker side of humanity” (Ryan & Deci, 2002, p.6).

Situational contexts, including inner (physiological and psychological) and external situational (environmental or social) forces, vary in the degree of influence on individual behavior, motivation, and experience. Individuals gravitate to situations or experiences that will support basic need fulfillment (Ryan & Deci, 2002). When the environment or situation is autonomy supportive and satisfies one’s needs and desires, then self-determination will increase (Deci & Flaste, 1995; Deci & Ryan, 1985a). When contexts promote self-determination, internalization occurs and behaviors are regulated in accordance with one’s sense of self (Deci, Eghrari, Patrick, & Leone, 1994). Controlling contextual forces demand, pressure, and prod
behaviors, thoughts, emotions, and actions (Deci & Flaste, 1995). In short, enhanced motivation and performance can be expected under contextual forces that support basic psychological needs, specifically autonomy conducive contexts (Ryan & Deci, 2002).

**Personality Influences.** As previously discussed, behavior is also dependent on the individual’s interpretation of the context (Deci, 1980; Deci & Ryan, 1985a). If contextual forces are not consciously attended to, then behavior will be dictated by external (environmental or social) and/or inner, unconscious elements (Deci, 1980).

It is possible for the individual’s personality (causality orientation) to override or not be influenced by the situational context (Deci & Flaste, 1995). Individuals interpret and respond to situational contexts in a manner that is consistent with their orientation, (Deci & Ryan, 1985a). For example, a control-oriented individual would take a suggestion, a situation in which choice does exist, and interpret it as a demand. Control would be perceived in the situation even when the contextual force (the suggestion) was not controlling (Deci & Ryan, 1985a). This explains different behavioral outcomes resulting from the same context (Deci & Flaste, 1995). The same phenomenon can be demonstrated in classroom settings where children who are instructed by the same teacher are affected differently, exhibiting varying academic performance levels. (Note that this example is based on previous research, as cited in section on academics. It does not take individual differences in ability into consideration). Therefore the deduction can be made that some individuals may perform better in specific contexts, while others may be unaffected or uninfluenced. In short, the relatively stable personality, or causality orientation, of the individual is a significant determinant of behavior (Deci & Ryan, 1985a).

As opposed to the situational contexts, personality is the major causal factor in understanding and predicting behavior. Individuals process information from external and/or
internal experiences differently. It is the individual differences in personality that elicit the
different levels of motivation, behavior, and performance (Deci & Ryan, 1985a).

*General Causality Orientations Scale (GCOS)*

The General Causality Orientations Scale (GCOS) was devised to measure the degree or
strength of motivational orientations within an individual, which then can be used to potentially
predict behavior (Deci & Ryan 2001; Deci & Ryan, 1985a). There are three subscales,
autonomy, impersonal, and controlled, which correspond to the three levels of self-
determination. Each individual possesses, to some degree, all three causality orientations.

The three subscales represent individual differences, or personality influences, unique to
each individual, which dictate the manner in which the individual attends to and interprets
contextual forces. The strength of the orientations vary in relation to context (i.e. social
relationships, work atmosphere, intimate relationship, etc.), therefore the scale includes a wide
range of reactions and responses in order to adequately encompass enough variance to permit the
predictability of behavior across various contexts (Deci & Ryan, 1985a).

The GCOS has two forms available, the original version, which consists of 12-vignettes
and 36 items and an expanded version, consisting of 17-vignettes and 51 items (Deci & Ryan,
2001; Hodgins, et al., in press). The original version is geared toward achievement situations.
The expanded version, includes situations of social interactions in addition to the original items
(Deci & Ryan, 2001). The current study utilizes the 17-vignette version to be consistent with the
original work of Hodgins and colleagues, which also used the 17-vignette version.

For the purpose of this experiment, individuals were classified as one of the three
orientations, autonomy-oriented, control-oriented, or impersonal-oriented, based on their GCOS
scores (scoring information is detailed in the procedure section).
Related Research and Practical Applications

“By evoking needs and applying appropriate criteria, SDT research has been able to pinpoint and examine factors in social environments that either hinder or facilitate self-motivation and performance, and those that thwart initiative and positive experience across diverse settings, domains, and cultures” (Ryan & Deci, 2002, p.9). These behavioral predictions have value; health care, parenting, education, religiosity, work organizations/management environments, environmentalism, psychotherapy, sports/physical activity/coaching, and various other human activities (Deci & Flaste, 1995; Deci & Ryan, 2001; Ryan & Deci, 2002).

Health Care. Most behaviorally related research within the medical field focuses on reducing or eliminating high risk behaviors, such as smoking, eating unhealthy diets, not exercising, and excessive drinking (Knee & Neighbors, 2002; Williams, 2002). Other health related research on self-determination involves long-term medication adherence, positive post-operative surgery attitudes and outcomes, maintaining adequate weight loss, and controlling or regulating glucose/blood sugar levels (King, 1984; Knee & Zuckerman, 1996; Williams, 2002; Williams, Freedman, & Deci, 1998; Williams, Grow, Freedman, Ryan, & Deci, 1996; Williams, Rodin, Ryan, Grolnick, & Deci, 1998). Autonomy-oriented individuals or individuals in autonomy supportive contexts exhibited the most positive behavioral outcomes.

Academia. In a study of college students, autonomy-oriented students have higher perceived competence, a greater interest/enjoyment in work, lower anxiety, greater satisfaction, positive academic performance, greater conceptual understanding, better memory, more positive emotions in classroom, lower drop out rate, and were more focused on grades than their control-oriented peers (Black & Deci, 2000; Deci, Vallerand, Pelletier, & Ryan, 1991; Muir; 2001). Several studies have demonstrated higher academic achievement among students who are
autonomy-oriented or who have autonomy supportive teachers (Boggiano, Flink, Shields, Seelbach, & Barrett, 1993; Flink, Boggiano, & Barrett, 1990; Flink, Boggiano, Main, Barrett, & Katz, 1992; Miserandino, 1996; Reeve, 2001; Wong, 2000). However, these studies do not include analysis of the impersonal realm.

Other. Self-determination theory has also been applied to the study of road rage (with driving angry and aggressive driving behaviors associated with the controlled orientation), any authoritative or supervisory context(s) including sports coaching and/or managers in business organizations, sales and marketing (specifically negotiation tactics), and romantic relationships (Knee, Neighbors, & Vietor, 2001; Knee, Patrick, Vietor, Nanayakkara, & Neighbors, 2002; Pullins, Haugtvedt, Dickson, Fine, & Lewicki, 2000).

Research of Hodgins and Colleagues

Hodgins and colleagues investigated of the effect of personality and situational prime on athletic performance (Hodgins, et al., in press). The Hodgins et al. study consisted of a total of thirty (one was eliminated) undergraduate collegiate rowers, all of whom were volunteers. The GCOS was administered, and participants were classified into one of the three causality orientations, based on their highest standardized score of the GCOS subscales. Participants were administered a self-handicapping measure (SHM) which measured claimed self-handicaps and constructed self-handicaps. Both are forms of defense behaviors. Estimated rowing performance and actual rowing performance were also recorded (Hodgins, et al., in press). Participants were then randomly assigned to a situational prime.

Results indicated that those autonomy-primed individuals demonstrated the least self-handicapping and best performance, while individuals who were primed impersonal demonstrated the most self-handicapping and worst performance. A series of between-subjects
analyses of variance were performed using the following independent variables: primed motivation (autonomy, control, and impersonal), GCOS motivational orientation, and gender. The dependent variables consisted of claimed self-handicap, constructed self-handicap, estimated rowing performance, and actual rowing performance.

The results were as follows: there were no main effects of primed motivation or GCOS motivational orientations on rowing. However, there were significant interaction effects of the two motivational variables: on estimated rowing time and actual rowing time. Performance of those individuals who were self-determined (autonomously oriented on the GCOS) was least influenced by the situational prime, while performance of those who were least self-determined (impersonal oriented on the GCOS) was most influenced by the situational prime (Hodgins, et al., in press).

These findings are “consistent with Self-Determination Theory and shows the importance of both individual differences [personality] and situational contexts for motivation and behavior. That is, those with greater self-determination (as measured by the GCOS) are less susceptible to the effects of temporary situational contexts (as represented here by Primed Motivation)” (Hodgins, et al., in press, p. 36). These findings also provide the groundwork and conception for the current study and its hypotheses.

Hypotheses Overview

The purpose of the present study was to predict motor performance through consideration of an individual’s personality orientation and the manipulation of motivation through temporary situational contexts. Hypotheses were derived from key concepts of self-determination theory, specifically causality orientation theory, and previous work by Hodgins et al. (in press). Self-determination is structured and measured at an individual personality level; however, it is also
contingent on contextual (situational) forces. When the situation is autonomy supportive and satisfies one’s needs and desires, then self-determination will increase and enhanced performance outcomes can be expected (Deci & Ryan, 1985a; Deci & Flaste, 1995. More emphasis is placed on personality (the GCOS score) than the situational context since individuals attend to and interpret contextual forces on the basis of his/her own causality orientation(s), or personality. Hence, it can be assumed that, if primed to a specified motivational condition, the individual will perceive or interpret the situation/event in respect to their orientation despite its actual content (Deci & Ryan, 1985a). Furthermore, the greater the self-determination of an individual (indicative of a high autonomy GCOS score) the less susceptible or influenced the individual is to the effects of primed motivation (situational contexts) (Hodgins, et al., in press).

Hypotheses regarding self-handicapping were based on the concept that defense behaviors are indicative of nonself-determined functioning. Hence, it was expected that individuals who are self-determined (autonomy-oriented on the GCOS) or are exposed to a self-determined supportive context (the autonomy-primed situational context) would not exhibit characteristics of nonself-determined functioning, including self-handicapping.

In the present study performance was measured using a simple motor task, the groove steadiness test. The dependent variables to measure performance were: number of hits (interpreted as errors) and time (in seconds). The dependent variables to measure self-handicapping were: estimated performance level (very poor, poor, fair, average, above average, or superior) and estimated number of hits per trial. The independent variables were (1) personality as represented by the individual’s causality orientation designated by the GCOS and (2) situational context created by priming motivation using a sentence scramble created by Hodgins et al. (in press).
Main Effects of Personality and Situational Context on Performance

Autonomy-oriented or autonomy-primed (indicative of self-determination) participants were expected to exhibit the best performance outcomes. Participants who were control-oriented or control-primed were expected to perform worse than autonomy-oriented or autonomy-primed but better than impersonal-oriented or impersonal-primed participants.

Overall, it was predicted that there would be main effects of personality orientation and situational context on performance. Specifically, the following hypotheses were tested:

Hypothesis 1: Autonomy-oriented participants were predicted to have better performance outcomes than control-oriented participants.

Hypothesis 2: Autonomy-oriented participants were predicted to have better performance outcomes than impersonal-oriented participants.

Hypothesis 3: Control-oriented participants were predicted to have better performance outcomes than impersonal-oriented participants.

Hypothesis 4: Autonomy-primed participants were predicted to have better performance outcomes than control-primed participants.

Hypothesis 5: Autonomy-primed participants were predicted to have better performance outcomes than impersonal-primed participants.

Hypothesis 6: Control-primed participants were predicted to have better performance outcomes than impersonal-primed participants.

Interaction Effects of Personality and Situational Context on Performance

Self-determination (autonomy-oriented) and Primed Motivation. Participants who are autonomy-oriented on the GCOS were NOT expected to be influenced by any of the three primed motivational states due to the fact that the information will be interpreted in an autonomy
supportive manner, regardless of primed condition. Overall, no interactive effects are expected for autonomy-oriented individuals in any of the primed motivational states.

*Hypothesis 7:* Performance of participants who are autonomy-oriented and autonomy-primed will be equal to the performance of participants who are autonomy-oriented and control-primed.

*Hypothesis 8:* Performance of participants who are autonomy-oriented and autonomy-primed will be equal to the performance of participants who are autonomy-oriented and impersonal-primed.

*Hypothesis 9:* Performance of participants who are autonomy-oriented and control-primed will be equal to the performance of participants who are autonomy-oriented and impersonal-primed.

**Nonself-determination (Control-oriented and impersonal-oriented) and Primed Motivation.** When autonomy-primed, control and impersonal-oriented participants can be expected to exhibit increased performance outcomes, with impersonal-oriented individuals being most influenced by the prime (demonstrating the greatest increases performance).

*Hypothesis 10:* Participants who are control-oriented and autonomy-primed are predicted to have better performance outcomes than participants who are impersonal-oriented and autonomy-primed.

However, when primed to the control or impersonal motivational conditions, performance can be expected to worsen, with the impersonal prime demonstrating the worst performance decrements. In other words, control-oriented or impersonal-oriented individuals primed to the impersonal motivational state are expected to be most influenced by the primed state, meaning that they would display the greatest declines in performance.
Hypothesis 11: Participants who are control-oriented and autonomy-primed are predicted to have better performance outcomes than participants who are control-oriented and control-primed.

Hypothesis 12: Participants who are control-oriented and autonomy-primed are predicted to have better performance outcomes than participants who are control-oriented and impersonal-primed.

Hypothesis 13: Participants who are control-oriented and control-primed are predicted to have better performance outcomes than participants who are control-oriented and impersonal-primed.

Hypothesis 14: Participants who are impersonal-oriented and autonomy-primed are predicted to have better performance outcomes than participants who are impersonal-oriented and control-primed.

Hypothesis 15: Participants who are impersonal-oriented and autonomy-primed are predicted to have better performance outcomes than participants who are impersonal-oriented and impersonal-primed.

Hypothesis 16: Participants who are impersonal-oriented and control-primed are predicted to have better performance outcomes than participants who are impersonal-oriented and impersonal-primed.

Main Effects of Personality and Situational Context on Self-Handicapping

Participants who were autonomy-oriented or autonomy-primed (indicative of a self-determination) were expected exhibit the least self-handicapping (higher performance estimates and fewer estimated number of hits) as opposed to those control or impersonal-oriented or – primed, with impersonal displaying the most.
Overall, it was predicted that there would be main effects of personality orientation and situational context on self-handicapping. Specifically, the following hypotheses were tested:

*Hypothesis 17:* Autonomy-oriented participants were predicted to demonstrate less self-handicapping than control-oriented participants.

*Hypothesis 18:* Autonomy-oriented participants were predicted to demonstrate less self-handicapping than impersonal-oriented participants.

*Hypothesis 19:* Control-oriented participants were predicted to demonstrate less self-handicapping than impersonal-oriented participants.

*Hypothesis 20:* Autonomy-primed participants were predicted to demonstrate less self-handicapping than control-primed participants.

*Hypothesis 21:* Autonomy-primed participants were predicted to demonstrate less self-handicapping than impersonal-primed participants.

*Hypothesis 22:* Control-primed participants were predicted to demonstrate less self-handicapping than impersonal-primed participants.

*Interaction Effects of Personality and Situational Context on Self-Handicapping*

*Self-determination (autonomy-oriented) and Primed Motivation.* Participants, who are autonomous on the GCOS, were NOT expected to be influenced by any of the three situational primes because (according to SDT) autonomy-oriented individuals do not engage in defensive behaviors. Overall, no interactive effects are expected for autonomy-oriented individuals and primed motivational states.

*Hypothesis 23:* Self-handicapping estimates will be equal for participants who are autonomy-oriented and autonomy-primed and participants who are autonomy-oriented and control-primed.
Hypothesis 24: Self-handicapping estimates will be equal for participants who are autonomy-oriented and autonomy-primed and participants who are autonomy-oriented and impersonal-primed.

Hypothesis 25: Self-handicapping estimates will be equal for participants who are autonomy-oriented and control-primed and participants who are autonomy-oriented and impersonal-primed.

Nonself-determination (Control-oriented and impersonal-oriented) and Primed Motivation. When autonomy-primed, control and impersonal-oriented individuals can be expected to exhibit little or no self-handicapping, with impersonal-oriented individuals being most influenced by the prime (demonstrating least self-handicapping).

Hypothesis 26: Participants who are control-oriented and autonomy-primed are predicted to demonstrate less self-handicapping than participants who are impersonal-oriented and autonomy-primed.

However, when primed to control or impersonal motivational conditions, self-handicapping can be expected to increase, with the impersonal-prime demonstrating the most self-handicapping. In other words, control-oriented or impersonal-oriented individuals autonomy-primed are expected to exhibit less self-handicapping as opposed to those primed control or impersonal, with those in the impersonal motivational state expecting to be most influenced by the primed state, meaning that they would display the most self-handicapping.

Hypothesis 27: Participants who are control-oriented and autonomy-primed are predicted to demonstrate less self-handicapping than participants who are control-oriented and control-primed.
Hypothesis 28: Participants who are control-oriented and autonomy-primed are predicted to demonstrate less self-handicapping than participants who are control-oriented and impersonal-primed.

Hypothesis 29: Participants who are control-oriented and control-primed are predicted to demonstrate less self-handicapping than participants who are control-oriented and impersonal-primed.

Hypothesis 30: Participants who are impersonal-oriented and autonomy-primed are predicted to demonstrate less self-handicapping than participants who are impersonal-oriented and control-primed.

Hypothesis 31: Participants who are impersonal-oriented and autonomy-primed are predicted to demonstrate less self-handicapping than participants who are impersonal-oriented and impersonal-primed.

Hypothesis 32: Participants who are impersonal-oriented and control-primed are predicted to demonstrate less self-handicapping than participants who are impersonal-oriented and impersonal-primed.
Methods

Participants

Sample size and power estimates (see appendix K) for the current study were calculated based on the results presented in Hodgins et al. (in press) via phi and the Pearson-Hartley power charts (Keppel, 1991). Results of the power analysis indicated that a samples size of 45 (n = 5) or 54 (n = 6) would yield sufficient power with estimates ranging from .55 to .75. The power estimates are conservative based on the conservative degrees of freedom used, meaning that actual power can be expected to be greater than the estimates. Hence, although a sample of 54 would be desirable, a sample size of 45 was expected to yield sufficient power and was used for the current study.

Participants were recruited from three undergraduate Human Factors psychology courses and were offered extra credit for their participation in the study. A total of 57 participants completed the GCOS and 53 of those participants completed the sentence scramble and the Groove Steadiness Test. Of these (53) participants, 45 were actually used in the overall data analysis. Data from two participants (on the sentence scramble and the groove steadiness test) were eliminated due to distractions and/or deviations from the experimental methodology that could have potentially interfered with the priming technique and/or accurate and consistent data collection. In addition, data from two participants who moved the stylus through the groove in less than .80 seconds on two or more trials were eliminated (see discussion section for detailed explanation). Once the desired criteria of 45 participants was reached (excluding the four who were eliminated), four additional individuals, who desired to complete the second part of the study for the extra credit, were allowed to do so but the data was not included in the analysis.
Of the 57 overall participants, there were 40 males and 17 females, ranging in age from 18 to 47, with a mean age of 22 years. Majors included Human Factors, Aviation Business, Aviation/Air Traffic Management, Aeronautical Science, Aerospace Studies, Elementary Education, Aerospace Electronics Engineering, Safety Science, Aeronautical Engineering, Computer Science, and Aeronautical Systems Management. There were 3 freshmen, 14 sophomores, 13 juniors, and 27 seniors. (All demographic information was not used the analyses. It was collected for population specification).

Of the 45 participants used in the data analysis, there were 33 males and 12 females, ranging in age from 18 to 47, with a mean age of 23 years. There were 3 freshmen, 9 sophomores, 10 juniors, and 23 seniors.

Materials

*The Groove Type Steadiness Tester (Model #32010).* The current study utilized the groove steadiness test to measure motor performance. The Groove Type Steadiness Tester is a perceptual motor coordination device designed to test dynamic steadiness and to measure hand eye-coordination in pushing a metal-tipped stylus through a gradually narrowing groove without touching the sides of the groove (see appendix H) (Lafayette Instruments, 1997). The sides are adjustable stainless steel plates, which are indexed in centimeters for accurate performance measures. Accessories include a stylus, a 1/100 second stop clock, and an impulse counter (See appendix G). Every time the stylus touches the stainless steel sides the tone will sound and the light will flash. Performance on the groove steadiness task was measured in terms of mean number of hits (error) per trial and mean time (in seconds) per trial. Self-handicapping, in terms of estimated performance level and estimated number of hits per trial, was also recorded before beginning the groove steadiness task.
The Groove Steadiness Test significantly correlates with the tremor disability questionnaire score \((r = 0.63, p = 0.001)\) and \((r = 0.49, p = 0.016)\), total tremor score (tremor examination, \(r = 0.68, p < 0.001\) and \(r = 0.41, p = 0.005\)), performance-based score \((r = 0.81, p = 0.01\) and \(r = 0.58, p = 0.019\)) (Louis, Yousefzadeh, Barnes, Yu, Pullman, & Wendt, 2000, p. 95). Test-retest reliability was high, \(r = 0.79-0.94, p < 0.001\) (Louis, Yousefzadeh, Barnes, Yu, Pullman, & Wendt, 2000). For ages 21 to 40 (the age range that corresponded most to the current study), mean number of hits (range and standard deviation) was 6.0 \((1-13, 4.2)\) \((N=7)\) (Louis, Yousefzadeh, Barnes, Yu, Pullman, & Wendt, 2000).

The General Causality Orientations Scale. The current study uses the GCOS consisting of 17 vignettes and 36 items (see appendix A). Each vignette describes a typical social or achievement situation such as applying for a job or interacting with a friend and has three behavioral responses, each corresponding to a causality orientation (autonomous, controlled, and impersonal) (Deci & Ryan, 2001).

For each of the behavioral responses, the participant specifies on the answer sheet (see appendix B) the response most indicative of their behavior, using a 7-point Likert scale \((1 = \text{very unlikely}, 7 = \text{very likely})\). Higher scores represent higher amounts of the specific orientation. It is possible for individuals to have high scores on more than one orientation, demonstrating the combinations of orientations. However, for the purpose of this study, each participant is classified as one of the three orientations based on the GCOS scoring. Using the GCOS answer key (see appendix C), the participant’s orientation was determined by summing the responses for each of the three orientation subscales items all of the 17 vignettes (Deci & Ryan, 2001). The raw scores are then transformed into z-scores. Each participant was then classified into one of the three orientations (autonomy, controlled, or impersonal) based on the subscale they scored.
highest on relative to their z-scores. This scoring is the recommended scoring for the measure (Koestner, Gingras, Abutaa, Losier, DiDio, & Gagne, 1999; Deci & Ryan, 1985b) and is consistent with the criterion study this project is based upon (Hodgins, et al., in press).

Details of the construction and information on reliability and validity are in Deci and Ryan (1985b). The scale demonstrates internal consistencies (Cronbach alphas) of about 0.75, with recent studies ranging from .75 to .92 (Deci & Ryan, 2001; Hodgins, et al., in press). The autonomy and impersonal subscales correlate negatively (r = -.25), control and impersonal correlate positively (r = .27), and autonomy and control were unrelated (r = .03) (Deci & Ryan, 1985b; Hodgins, Yacko, Gottlieb, Goodwin, & Rath, in press). Subscales demonstrate good internal reliability (alphas = .75 to .90) and test-retest reliability (.74 over two months) (Deci & Ryan, 2001; Hodgins, et al., in press).

Sentence Scramble. Hodgins and her colleagues devised the sentence scramble task as an experimental manipulation of motivation in order to investigate the effects of temporary situational context on performance (Hodgins, et al., in press), which was primarily based on the situational priming technique of Bargh and his colleagues (Bargh, Chen, & Burrows, 1996). The sentence scramble creates a temporary situational context. As previously discussed in the introduction, SDT contends that motivation and behavior are influenced by the situational context in which the individual interacts. Hence, it can be expected that motivation can be manipulated to a target state based on the type of support the context provides. In other words, if the context or sentence scramble is autonomy supportive, then the participant can be expected to be motivationally primed to an autonomous state.

The sentence scramble task consists of three versions, each priming one of the causality orientations: autonomy, controlled, and impersonal (See appendices D, E, and F). Each version
has 30 items, or scrambled sentences, which alternate between 15 filler or neutral items, and 15 target items. The filler or neutral items are the same for all three versions. The target items are intended to prime the target motivational state. For example, autonomy-primed words used are autonomous, choiceful, and self-determined. Words to prime for control include ought, should, and must, while impersonal words consist words such as unable, helpless, and passive. All items in each scramble consist of five words. The participants must arrange the words in a grammatically correct four-word sentence (Hodgins, et al., in press).

Previous research indicates that priming situational contexts activates personality traits, producing behaviors consistent with the primed group (Bargh, Chen, & Burrows, 1996; Kawakami, Dovidio, & Dijksterhuis, 2003; Kawakami, Young, & Dovidio, 2002).

Procedure

The research was divided into two parts administered on two separate occasions. The first part was the administration of the GCOS and the second part consisted of the sentence scramble and the groove steadiness test.

The GCOS was collectively administered to three undergraduate Human Factors summer classes at Embry-Riddle Aeronautical University. Participants were initially briefed on the general details of the study and then required to sign a consent form. The GCOS took approximately 15-20 minutes for completion, although no time limits were set. After each class completed the GCOS, all GCOS scores for each participant were summed for each orientation subscale and then transformed into z-scores to determine each participant’s primary causality orientation. The primary orientation score was based on which orientation subscale he/she scored highest on relative to their z-scores (Koestner, et al., 1999).
Participants were then asked to return at a later date for completion of the sentence scramble and the groove steadiness test. The sentence scramble task and groove steadiness test was individually administered and took approximately 15 minutes for completion of both per individual. There were no time limits for either task.

Power analysis (see appendix K) indicated that it was desired to have a total of 45 individuals complete the sentence scramble and groove steadiness test: 15 autonomy-oriented individuals, 15 control-oriented individuals, and 15 impersonal-oriented individuals. In each (orientation) group of 15, five were administered the autonomy primed sentence scramble (see appendix D; Sentence Scramble – A), five the control primed sentence scramble (see appendix E; Sentence Scramble – C), and five the impersonal primed sentence (see appendix F; Sentence Scramble – I) (See Table 1 for illustration). This was done to create the situational prime for the study.

Table 1.
Orientation and Priming Grid

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Autonomy</th>
<th>Control</th>
<th>Impersonal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomy</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Control</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Impersonal</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

15 15 15 45
Participants were randomly assigned to one of the three sentence scramble tasks. Three envelopes, labeled autonomy, control, and impersonal, each contained 15 slips of paper (five labeled autonomy, five labeled control, and five labeled impersonal). Each envelope corresponded to the GCOS orientation. With respect to a participant’s GCOS orientation, a slip of paper was drawn out of the corresponding envelope to determine which sentence scramble the participant would receive.

After completing the sentence scramble to create the situational prime, the participant was then read instructions for the groove steadiness test and given one demonstration. Participants were instructed to remain seated with no supports of any kind (i.e. arms or elbows on the table) while completing the test. They were also instructed to proceed horizontally from left to right for all trials starting with the large end of the groove and to keep the metal tip of the stylus touching the mirrored bottom of the apparatus from the start of each trial to the end of each trial (this was to ensure that participants were moving the stylus between the groove and not above it). Each participant was allowed 10 trials on the Groove Steadiness Task. To minimize a potential practice effect, no practice runs were allowed. After the demonstration and before actual performance, each individual was asked to estimate their performance (very poor, poor, fair, average, above average, or superior) and their estimated number of hits per trial. Participants were instructed not to begin until the experimenter said, “Go.” Between each trial, each participant was asked if he/she was ready for the next trial. It was specified that the number of hits, which would be registered as errors, and time per trial would be recorded. However, it was specified there were no time limits for each trial. When the experimenter said “Go” the time on the stopwatch began. It ended when the stylus came to the end of the groove. Upon completion, participants were debriefed.
No subjective statements pertaining to the participant's performance were made at any time during testing in order to ensure that there were no indications or introductions of explicit threat, such as failure feedback, into the context of the experiment at any time. Each participant was only allowed 10 trials on the Groove Steadiness task. Time (in seconds) and number of hits (errors) were recorded for each 10 trials. All instructions/directions and demonstrations of the task were the same for each participant. Performance levels were measured in terms of number of hits (errors) and time on the groove steadiness test.

All data results were analyzed using a 2 x 3 between subjects multivariate ANOVA with alpha equal to .05.

Results

Performance

Using a between-subjects multivariate ANOVA to test hypotheses 1-6, the results of the experiment indicated that the overall model tested using the independent variables of personality orientation and (situational) prime to predict performance was not significant, $F(8,36) = .98, p = .47$ (for mean hits per trial) and $F(8,36) = .97, p = .47$ (for mean time per trial)). At Results indicated that both the main effects and interaction effects of personality orientation and situational primed motivation, indicative of the influence of a temporary situational context, did not relate to performance. For the mean number of hits, the observed power was .38 and the effect size was .18. For the mean time, the observed power was .38 and the effect size was .18. See Tables 2 & 3 for source tables and Tables 4 & 5 for the means and standard deviations for mean number of hits per trial and mean time (in seconds) per trial. See Figures 1 & 2 for visual representations of the results.
Table 2:

Analysis of Variance for Mean Hits on the Groove Steadiness Test

<table>
<thead>
<tr>
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<th>df</th>
<th>F</th>
<th>η</th>
<th>p</th>
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</thead>
<tbody>
<tr>
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<td>.47</td>
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<td>Orientation</td>
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<td>.15</td>
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<tr>
<td>Interaction</td>
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<tr>
<td>Within-group error</td>
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Table 3:

Analysis of Variance for Mean Time on the Groove Steadiness Test

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<th>F</th>
<th>η</th>
<th>p</th>
</tr>
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<td>Interaction</td>
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<td>.58</td>
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<tr>
<td>Within-group error</td>
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</table>
Table 4:
Means and Standard Deviations for Mean Hits per Trial

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<th>Means</th>
<th>Standard Deviations</th>
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<tbody>
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<tr>
<td></td>
<td>Control-Primed</td>
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<tr>
<td></td>
<td>Impersonal-Primed</td>
<td>4.99</td>
<td>4.23</td>
</tr>
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<td>Control-Oriented</td>
<td>Autonomy-Primed</td>
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<td>Control-Primed</td>
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<td>Control-Primed</td>
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<td>Impersonal-Primed</td>
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<td>1.51</td>
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</table>

Table 5:
Means and Standard Deviations for Mean Time (seconds) per Trial

<table>
<thead>
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<th>Orientation</th>
<th>Prime</th>
<th>Means</th>
<th>Standard Deviations</th>
</tr>
</thead>
<tbody>
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Figure 1. Graph showing the interaction effects of personality and situational priming on mean number of hits per trial.
Figure 2. Graph showing the interaction effects of personality and situational priming on mean time (in seconds).

Self-Handicapping.

For analytic purposes, the estimated performance levels, very poor, poor, fair, average, above average, and superior, were equated to numbers ranging from very poor = 1 to superior = 6. Using a between-subjects multivariate ANOVA to test hypotheses 7-12, the results of the experiment indicated that the overall model tested using the independent variables of orientation and (situational) prime to predict self-handicapping was not significant, $F(8,36) = 1.69, p = .14$ (for estimated performance) and $F(8,36) = 1.29, p = .28$ (estimated number of hits per trial). Neither the main effects or interaction effects of personality orientation and situational primed motivation related to estimated performance level or estimated number of hits per trial. For the estimated performance level, the observed power was .64 and the effect size was .27. For the
estimated number of hits per trial, the observed power was .50 and the effect size was .22. See
Tables 6 & 7 for source tables and Tables 8 & 9 for the means and standard deviations for
estimated performance level and estimated number of hits per trial. See Figures 3 & 4 for visual
representations of this information.

*Table 6:*

Analysis of Variance for Estimated Performance Level

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*Table 7:*

Analysis of Variance for Estimated Number of Hits per Trial

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Table 8:

Means and Standard Deviations for Estimated Performance Level
(1 = Very Poor; 6 = Superior)

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<th>Standard Deviations</th>
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Table 9:

Means and Standard Deviations for Estimated Number of Hits per Trial

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Figure 3. Graph showing the interaction effects of personality and situational priming on estimated performance level.
Figure 4. Graph showing the interaction effects of personality and situational priming on estimated hits per trial.

Discussion

The present study examined the relative influences of personality orientation and situational prime, representative of the effect of temporary situational contexts, on motor performance and self-handicapping. Performance was measured in terms of mean number of hits per trial and mean time per trial. Self-handicapping was measured in terms of estimated performance level and estimated number of hits per trial.

It was hypothesized that individuals who were self-determined (autonomy-oriented or autonomy-primed) would yield better performance and the least self-handicapping than those individuals who were nonself-determined, or who were primed to control or impersonal contexts, with the impersonal orientation or prime yielding the
worst performance and the most self-handicapping (see hypotheses 1-2, 4-8, and 10-12). Results of the analysis did not support these stated hypotheses in that there were no significant main effects or interaction effects of personality orientation and/or situational prime on performance or self-handicapping. However, it was hypothesized that individuals who are autonomy-oriented would not be influenced by any of the situational primes (no effects were predicted) (see hypothesis 3 and 9). Overall, there were no interactive effects for autonomy-oriented individuals and primed motivational states, which were consistent with the hypotheses.

The fact there were no significant main effects was consistent with the previous research findings of Hodgins and colleagues. However, the findings of the current study are inconsistent with the previous research in that no significant interaction effects were found.

Discrepancies between the studies’ results can be accounted for by various reasons. First, participants for the Hodgins’ experiment were not offered any extrinsic motivators, such as the extra credit offered in the present study. Second, participants were all experienced rowers and were familiar with the machine used (Model C Ergometer) to measure rowing performance. Hence, participants in the Hodgins’ experiment were proficient with the task and the experiment, meaning performance could be better estimated because they had engaged in the task previously, yielding a more clear effect of priming on defense behaviors and estimated performance outcomes. Whereas the current study used a task with which all participants were unfamiliar. Also in Hodgins’ study, a teammate acted as the experimenter and the experiment was conducted during practice (all team members volunteered except one). There were no
error measurements in the original study, due to the nature of the Ergometer task. It could be that in the Hodgins study, the fact that all participants were of high ability and familiar with the task influenced the results in that error variability was kept to a minimum. This would help to explain why the present study did not yield the same findings.

These findings of the present study could be a function of many explanations. First and foremost, the groove steadiness test posed several confounding problems to the experiment. Although the tester was initially positioned horizontally parallel with the edge of the desk, participants were allowed to arrange or angle the groove steadiness tester in a position that was comfortable to them with the stipulation that the large end of the groove must be on the left side of the person (i.e. the tester could not be positioned vertically). This was allowed because portion of the experiment took place in a small cubicle and movement for both the experimenter and the participant was extremely constricted. Most individuals with more substantial size, particularly men, had to position themselves at a 45-degree angle in the cubicle in order to have sufficient and comfortable room for movement.

The groove steadiness tester also posed several problems for effective data collection and analysis. Four individuals moved the stylus through the groove in less than a second, with scores ranging from .71 to .96 seconds (data from two of these participants, who scored less than .80 on more than two trials, were replaced by other participant data in the overall analysis). This data was unusable for two reasons: (1) the speed is too quick for the experimenter to accurately measure the time with the stopwatch as opposed to those who took longer than a minute and (2) if the stylus touched the metal
side once and continued through the narrowing groove to the end with the stylus touching the side, it would register as only one hit. This, in itself, poses a great problem in data analysis in that outcomes of such situations would appear to possess quick times with minimal errors. However, this is NOT the case. The stylus was moving too quickly to register all the hits and it registered (in most cases) one hit, since the stylus remains touching the side from beginning to end of the test. For this reason, data from participants whose time was less than .80 on more than 3 of the trials was replaced. To avoid this problem in future replications of this experiment, it is recommended that a different test of motor skill be chosen.

Within the present study, the effect sizes were fairly low or moderate for all, meaning that the variability between groups is relatively low. This is an indication that performance and self-handicapping may be caused by other constructs or variables. It is possible that gender differences may have had an effect in data collection and results, in that the experimenter noticed differences in performance and self-handicapping between the genders. Although not analyzed due to uneven sample sizes, it seemed apparent to the experimenter that males were less likely to display high levels of self-handicapping (i.e. admit that he would perform poorly), as opposed to the females of which some exhibited high self-handicapping. It may be also be that motor performance is primarily a function of ability, rather than personality. In a summary of 15 meta-analytic studies of personality traits and job performance, openness, which related to autonomy and self-determination as discussed in the introduction, was not a valid predictor of performance and posed weak relationships with overall job performance (Barrick, Mount, & Judge, 2001). Furthermore ability, specifically motor ability, is different for each individual. In
the Hodgins research, ability was held somewhat constant by using individuals who were all experienced rowers. The current study used a more generalized population, with a larger range of motor abilities. In this case, performance variability could be accounted for by ability.

The observed power of the main effects and interaction effects were low meaning that there was a relatively high probability of a Type II error. The obvious method to increase power and reduce the probability of a Type II error would be to increase the sample size. However, a power analysis to determine the sample size that would yield a power of .80, could not be conducted based on the results of the current study in order. If the experiment were repeated using the same motor task, we suggest that adequate space be provided for the participants to complete the task and that the position the tester be consistent for each individual. Furthermore, to minimize practice effects and the possibility of participants moving the stylus too quickly for accurate hits to register, it is recommended that the experimenter vertically and horizontally rotate the tester consistently for each individual and test participants using both the dominant hand and the non-dominant hand. It is also recommended to keep gender consistent, and if at all possible, try to control for ability. It is also recommended to try to eliminate the potential influence of the extrinsic motivator of extra credit. Overall, it is recommended that a different task be used for motor testing. Research could also be expanded to incorporate other areas performance such as cognitive performance, attention and vigilance, training, etc. Training proficiency should especially be of interest since this is related to openness to experience (Barrick, Mount, & Judge, 2001).
Conclusion

The study attempted to test the findings and conclusions of other related research and add further support for self-determination theory. Although the current study yielded results that were not significant, it provided a test of self-determination theory unique in respect to the investigation of actual performance while assessing all three causality orientations within varying situational contexts while using a heterogeneous sample. The results and recommendations of the current study provide the foundation for future experimental replications in order to make more generalized conclusions pertaining to self-determination and performance.
References


human motivation and personality. Retrieved December 16, 2002, from the Department of psychology and social sciences, University of Rochester Website:

http://www.Psych.rochester.edu/SDT


Appendix A

Consent Form
This research is conducted to investigate self-determination and performance, specifically the influences of situational contexts and personality on a motor performance task.

The study is divided into two parts. During the first part of the study, you will be administered the General Causality Orientations Scale (GCOS), which will determine your personality orientation and level of self-determination. The expected duration of the GCOS is 15 minutes.

You will be contacted to schedule an appointment for the second part of the study, which consists of a motor performance task. Not all participants will be contacted to return for participation in the second part.

All results and data will be confidential. You may withdraw from participation at any time.

I (Print name), ____________________________, consent to participate in the research on self-determination and performance and acknowledge that I have read and fully understand the consent form. I sign it freely and voluntarily. A copy has been given to me.

Name (signature): ____________________________ Date: __________

Contact Information:
Email: ____________________________
Phone: ____________________________

If you have any questions or require additional information regarding the research, my contact information is as follows:

Trena Thompson
Email: tnt2776@hotmail.com

Thank you for your participation.
Appendix B

The General Causality Orientations Scale
The General Causality Orientations Scale (GCOS)
(17-vignette version)

On these pages you will find a series of vignettes. Each one describes an incident and lists three ways of responding to it. Please read each vignette and then consider the responses in turn. Think of each response option in terms of how likely it is that you would respond in that way. We all respond in a variety of ways to situations, and probably each response is at least slightly likely for you. If it is very unlikely that you would respond in the way described in a given response, you would select numbers 1 or 2. If it is moderately likely, you would respond in the midrange of numbers; and if it is very likely that you would respond as described, you would select the 6 or 7. Please select one number for each of the three responses on the answer sheet for each vignette. The actual items begin on the next page.
1. You have been offered a new position in a company where you have worked for some time. The first question that is likely to come to mind is:

a) What if I can't live up to the new responsibility?
   
   1  2  3  4  5  6  7
   very unlikely  moderately likely  very likely

b) Will I make more at this position?
   
   1  2  3  4  5  6  7
   very unlikely  moderately likely  very likely

c) I wonder if the new work will be interesting.
   
   1  2  3  4  5  6  7
   very unlikely  moderately likely  very likely

2. You had a job interview several weeks ago. In the mail you received a form letter which states that the position has been filled. It is likely that you might think:

a) It's not what you know, but who you know.
   
   1  2  3  4  5  6  7
   very unlikely  moderately likely  very likely

b) I'm probably not good enough for the job.
   
   1  2  3  4  5  6  7
   very unlikely  moderately likely  very likely

c) Somehow they didn't see my qualifications as matching their needs.
   
   1  2  3  4  5  6  7
   very unlikely  moderately likely  very likely

3. You are a plant supervisor and have been charged with the task of allotting coffee breaks to three workers who cannot all break at once. You would likely handle this by:

a) Telling the three workers the situation and having them work with you on the schedule.
   
   1  2  3  4  5  6  7
   very unlikely  moderately likely  very likely

b) Simply assigning times that each can break to avoid any problems.
   
   1  2  3  4  5  6  7
   very unlikely  moderately likely  very likely

c) Find out from someone in authority what to do or do what was done in the past.
   
   1  2  3  4  5  6  7
   very unlikely  moderately likely  very likely
4. **You have just received the results of a test you took, and you discovered that you did very poorly. Your initial reaction is likely to be:**

a) "I can't do anything right," and feel sad.
very unlikely 2 3 4 5 6 7

b) "I wonder how it is I did so poorly," and feel disappointed.
very unlikely 2 3 4 5 6 7

c) "That stupid test doesn't show anything," and feel angry.
very unlikely 2 3 4 5 6 7

5. **When you and your friend are making plans for Saturday evening, it is likely that you would:**

a) Leave it up to your friend; he (she) probably wouldn’t want to do what you’d suggest.
very unlikely 2 3 4 5 6 7

b) Each make suggestions and then decide together on something that you both feel like doing.
very unlikely 2 3 4 5 6 7

c) Talk your friend into doing what you want to do.
very unlikely 2 3 4 5 6 7

6. **You have been invited to a large party where you know very few people. As you look forward to the evening, you would likely expect that:**

a) You'll try to fit in with whatever is happening in order to have a good time and not look bad.
very unlikely 2 3 4 5 6 7

b) You'll find some people with whom you can relate.
very unlikely 2 3 4 5 6 7

c) You'll probably feel somewhat isolated and unnoticed.
very unlikely 2 3 4 5 6 7
7. You are asked to plan a picnic for yourself and your fellow employees. Your style for approaching this project could most likely be characterized as:

a) Take charge: that is, you would make most of the major decisions yourself.

very unlikely 2 3 4 5 6 7
very likely

b) Follow precedent: you're not really up to the task so you'd do it the way it's been done before.

very unlikely 2 3 4 5 6 7
very likely

c) Seek participation: get inputs from others who want to make them before you make the final plans.

very unlikely 2 3 4 5 6 7
very likely

8. Recently a position opened up at your place of work that could have meant a promotion for you. However, a person you work with was offered the job rather than you. In evaluating the situation, you're likely to think:

a) You didn't really expect the job; you frequently get passed over.

very unlikely 2 3 4 5 6 7
very likely

b) The other person probably "did the right things" politically to get the job.

very unlikely 2 3 4 5 6 7
very likely

c) You would probably take a look at factors in your own performance that led you to be passed over.

very unlikely 2 3 4 5 6 7
very likely

9. You are embarking on a new career. The most important consideration is likely to be:

a) Whether you can do the work without getting in over your head.

very unlikely 2 3 4 5 6 7
very likely

b) How interested you are in that kind of work.

very unlikely 2 3 4 5 6 7
very likely

c) Whether there are good possibilities for advancement.

very unlikely 2 3 4 5 6 7
very likely
10. A woman who works for you has generally done an adequate job. However, for the past two weeks her work has not been up to par and she appears to be less actively interested in her work. Your reaction is likely to be:

a) Tell her that her work is below what is expected and that she should start working harder.

1 very unlikely 2 moderately likely 3 very likely

b) Ask her about the problem and let her know you are available to help work it out.

1 very unlikely 2 moderately likely 3 very likely

c) It's hard to know what to do to get her straightened out.

1 very unlikely 2 moderately likely 3 very likely

11. Your company has promoted you to a position in a city far from your present location. As you think about the move you would probably:

a) Feel interested in the new challenge and a little nervous at the same time.

1 very unlikely 2 moderately likely 3 very likely

b) Feel excited about the higher status and salary that is involved.

1 very unlikely 2 moderately likely 3 very likely

c) Feel stressed and anxious about the upcoming changes.

1 very unlikely 2 moderately likely 3 very likely

12. Within your circle of friends, the one with whom you choose to spend the most time is:

a) The one with whom you spend the most time exchanging ideas and feelings.

1 very unlikely 2 moderately likely 3 very likely

b) The one who is the most popular of them.

1 very unlikely 2 moderately likely 3 very likely

c) The one who needs you the most as a friend.

1 very unlikely 2 moderately likely 3 very likely
13. You have a school-age daughter. On parents' night the teacher tells you that your daughter is doing poorly and doesn't seem involved in the work. You are likely to:

a) Talk it over with your daughter to understand further what the problem is.
   1 2 3 4 5 6 7
   very unlikely  moderately likely  very likely

b) Scold her and hope she does better.
   1 2 3 4 5 6 7
   very unlikely  moderately likely  very likely

c) Make sure she does the assignments, because she should be working harder.
   1 2 3 4 5 6 7
   very unlikely  moderately likely  very likely

14. Your friend has a habit that annoys you to the point of making you angry. It is likely that you would:

a) Point it out each time you notice it, that way maybe he(she) will stop doing it.
   1 2 3 4 5 6 7
   very unlikely  moderately likely  very likely

b) Try to ignore the habit because talking about it won't do any good anyway.
   1 2 3 4 5 6 7
   very unlikely  moderately likely  very likely

c) Try to understand why your partner does it and why it is so upsetting for you.
   1 2 3 4 5 6 7
   very unlikely  moderately likely  very likely

15. A close (same-sex) friend of yours has been moody lately, and a couple of times has become very angry with you over "nothing." You might:

a) Share your observations with him/her and try to find out what is going on for him/her.
   1 2 3 4 5 6 7
   very unlikely  moderately likely  very likely

b) Ignore it because there's not much you can do about it anyway.
   1 2 3 4 5 6 7
   very unlikely  moderately likely  very likely

c) Tell him/her that you're willing to spend time together if and only if he/she makes more effort to control him/herself.
   1 2 3 4 5 6 7
   very unlikely  moderately likely  very likely
16. Your friend’s younger sister is a freshman in college. Your friend tells you that she has been doing badly and asks you what he (she) should do about it. You advise him (her) to:

a) Talk it over with her and try to see what is going on for her.
   very unlikely 2 3 4 5 6 7
   moderately likely
very likely  

b) Not mention it; there’s nothing he (she) could do about it anyway.
   very unlikely 2 3 4 5 6 7
   moderately likely
very likely  

c) Tell her it’s important for her to do well, so she should be working harder.
   very unlikely 2 3 4 5 6 7
   moderately likely
very likely  

17. You feel that your friend is being inconsiderate. You would probably:

a) Find an opportunity to explain why it bothers you; he (she) may not even realize how much it is bothering you.
   very unlikely 2 3 4 5 6 7
   moderately likely
very likely  

b) Say nothing; if your friend really cares about you he (she) would understand how you fell.
   very unlikely 2 3 4 5 6 7
   moderately likely
very likely  

c) Demand that your friend start being more considerate; otherwise you’ll respond in kind.
   very unlikely 2 3 4 5 6 7
   moderately likely
very likely  
Appendix C

GCOS Response Form – 17 Vignettes
Name: ____________________________ Date: __________
Last 4 of social security number: ________________ Age: __________
Sex:  M  F  (circle one)
Year in School: ____________________________
Major: ________________________________

GCOS Response Form - 17 Vignettes

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</table>


Appendix D

GCOS Response Form Key – 17 Vignettes
GCOS Response Form - 17 Vignettes

1. a I b C c A
   7. a C b I c A
13. a A b C c I
2. a I b A c C
   8. a I b A c C
14. a C b A c I
3. a C b I c A
   9. a I b C c A
15. a I b A c C
4. a C b A c I
   10. a A b C c I
16. a A b C c I
5. a A b I c C
   11. a C b I c A
17. a A b I c C
6. a A b I c C
   12. a A b I c C
   KEY: A = Autonomy
         C = Control
         I = Impersonal
Appendix E

Sentence Scramble – A
Sentence Scramble – A

Below are items for a language proficiency test that many people find enjoyable and interesting to do. This test has not been used in college students, however. Therefore, we need to obtain norms for college students. Please use the five words on each line to construct a grammatically correct four-word sentence to the right.

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<td>book we the read top</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>options have I two and</td>
<td></td>
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<tr>
<td>3.</td>
<td>sale for by sweatshirts are</td>
<td></td>
<td></td>
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<tr>
<td>4.</td>
<td>feel are choiceful I usually</td>
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<tr>
<td>5.</td>
<td>dollars salad on costs two</td>
<td></td>
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<tr>
<td>6.</td>
<td>is to this opportunity my</td>
<td></td>
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<tr>
<td>7.</td>
<td>often soda but drink I</td>
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<td>8.</td>
<td>to we choose so leave</td>
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<td>9.</td>
<td>on bookmark used the she</td>
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<tr>
<td>10.</td>
<td>enjoy I freedom my he</td>
<td></td>
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<tr>
<td>11.</td>
<td>tablecloth and blue the is</td>
<td></td>
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<tr>
<td>12.</td>
<td>in we autonomous often are</td>
<td></td>
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<tr>
<td>13.</td>
<td>bright is the yes lamp</td>
<td></td>
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<tr>
<td>14.</td>
<td>have by preference a we</td>
<td></td>
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<tr>
<td>15.</td>
<td>is to here served lunch</td>
<td></td>
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<tr>
<td>16.</td>
<td>to go and I decided</td>
<td></td>
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<td>17.</td>
<td>is the now desk wooden</td>
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<td>18.</td>
<td>to our we classes selected</td>
<td></td>
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<td>19.</td>
<td>apple was to the delicious</td>
<td></td>
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<td>20.</td>
<td>on choice we a have</td>
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<td>21.</td>
<td>here the by telephone is</td>
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<td>22.</td>
<td>we today unconstrained were our</td>
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<td>23.</td>
<td>the her to fits shoe</td>
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<td>24.</td>
<td>can self-regulate to usually I</td>
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<td>25.</td>
<td>you coffee the is hot</td>
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<td>26.</td>
<td>actions and my are independent</td>
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<td>27.</td>
<td>at the new computer is</td>
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<td>28.</td>
<td>now to I unrestricted am</td>
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<tr>
<td>29.</td>
<td>he now are wears glasses</td>
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<tr>
<td>30.</td>
<td>am I still for self-determined</td>
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Appendix F

Sentence Scramble - C
Below are items for a language proficiency test that many people find enjoyable and interesting to do. This test has not been used in college students, however. Therefore, we need to obtain norms for college students. Please use the five words on each line to construct a grammatically correct four-word sentence to the right.

1. book we the read top
2. do we to this must
3. sale for by sweatshirts are
4. do I should to homework
5. dollars salad costs two for
6. to I smile ought and
7. often soda but drink I
8. for required to I’m study
9. in bookmark used the she
10. work to with obligated I’m
11. tablecloth and blue the is
12. meet we on deadlines must
13. bright is the yes lamp
14. for boss coerced my me
15. is to here served lunch
16. was obey we’re compelled to
17. is the now desk wooden
18. compulsory to attendance is our
19. apple was to the delicious
20. giving in to necessary is
21. here the by telephone is
22. manipulates my to me boss
23. the her to fits shoe
24. so behavior my they restrict
25. you coffee the is hot
26. forced by to study I’m
27. at the new computer is
28. the by limits constrained us
29. he now are wears glasses
30. very are we pressured that
Appendix G

Sentence Scramble – I
Sentence Scramble – 1

Below are items for a language proficiency test that many people find enjoyable and interesting to do. This test has not been used in college students, however. Therefore, we need to obtain norms for college students.

Please use the five words on each line to construct a grammatically correct four-word sentence to the right.

1. book we the read top
2. by people don’t passive try
3. sale for by sweatshirts are
4. victimized they be feel often
5. dollars salad costs two for
6. the shall uncontrollable was task
7. often soda but drink I
8. lost they but tried the
9. in bookmark used the she
10. was lacking by he skill
11. tablecloth and blue the is
12. inability his obvious was for
13. bright is the yes lamp
14. unable more stop to I’m
15. is to here served lunch
16. helpless she before feels often
17. is the now desk wooden
18. impossible is winning often top
19. apple was to the delicious
20. cannot this complete I only
21. here the by telephone is
22. incompetent is Julia quite but
23. the her to fits shoe
24. unsuccessful efforts to all were
25. you coffee the is hot
26. was I’m work unmotivated to
27. at the new computer is
28. against we’re with powerless it
29. he now are wears glasses
30. am failure a for I
Appendix H

Groove Steadiness Test Performance Sheet
GROOVE STEADINESS TEST PERFORMANCE SHEET

Name: ________________________________  Date: __________
Social (last 4 digits): ____________________  Time: __________
Phone #: ______________________________
GCOS Orientation: _______________________
Primed Orientation: _______________________

Performance Estimate:
Very Poor  Poor  Fair  Average  Above Average  Superior

Estimate of Hits: _________

Performance Measurement:

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Appendix I

The Impulse Counter
The Impulse Counter:
Appendix J

The Groove Steadiness Tester
The Groove Steadiness Tester:
Appendix K

Power Analysis Based on the Hodgins’ Research
Power Analysis Based on the Research of Hodgins and Colleagues

Hodgins and colleagues used 3 x 3 Factorial ANOVA, and the results of the study indicated an interaction effect of \( F(1,30) = 9.76 \) for actual rowing performance. Below are the derivations for the estimated power and sample size using \( \alpha = .01 \):

Using \( n = 5 \)

Compute phi:

\[
\Phi_{A \times B}^2 = \frac{n_{\text{new}}}{n_{\text{old}}} \left( \frac{(a - 1)(b - 1)}{((a - 1)(b - 1) + 1)} \right) \left[ F_{A \times B} - 1 \right]
\]

\[
\Phi_{A \times B}^2 = \left[ \frac{5}{3} \right] \left[ \frac{(3 - 1)(3 - 1)}{((3 - 1)(3 - 1) + 1)} \right] \left[ 9.76 - 1 \right]
\]

\[ \Phi = 3.42 \]

Compute power:

\( \text{df}_{\text{num}} = 8; \text{df}_{\text{den}} = 36 \)

Using the Pearson-Hartley charts (Keppel, 1991) and \( \text{df}_{\text{den}} = 30 \), in order to be more conservative, an estimated sample size of 45 (\( n = 5 \)) would yield a power of .55.

Using \( n = 6 \)

Compute phi:

\[
\Phi_{A \times B}^2 = \frac{n_{\text{new}}}{n_{\text{old}}} \left( \frac{(a - 1)(b - 1)}{((a - 1)(b - 1) + 1)} \right) \left[ F_{A \times B} - 1 \right]
\]

\[
\Phi_{A \times B}^2 = \left[ \frac{6}{3} \right] \left[ \frac{(3 - 1)(3 - 1)}{((3 - 1)(3 - 1) + 1)} \right] \left[ 9.76 - 1 \right]
\]

\[ \Phi = 3.74 \]

Compute power:

\( \text{df}_{\text{num}} = 8; \text{df}_{\text{den}} = 54 \)

Using the Pearson-Hartley charts (Keppel, 1991) and \( \text{df}_{\text{den}} = 30 \), in order to be more conservative, an estimated sample size of 54 (\( n = 6 \)) would yield a power of .75.

Based on the power estimates, results of the power analysis indicated that a samples size of 45 (\( n = 5 \)) or 54 (\( n = 6 \)) would yield sufficient power with estimates ranging from .55 to .75. The power estimates are conservative based on the conservative degrees of freedom used, meaning that actual power can be expected to be greater that the estimates. Hence, although a sample of 54 would be desirable, a sample size of 45 was expected to yield sufficient power and was used for the current study.