A Social Cognitive Model of Creatine Use Among Male, Recreational Weight-Lifters

David M. Williams

Submitted to the Faculty of
Virginia Polytechnic Institute and State University
In Partial Fulfillment of the Requirements for the Degree of

Master of Science
In
Psychology

Richard A. Winett, Chair
Eileen S. Anderson
Robert S. Stephens

December 15, 2000
Blacksburg, VA

Keywords: Creatine, Weight-Lifters, Social Cognitive

A Social Cognitive Model of Creatine Use
Among Male, Recreational Weight-Lifters

David M. Williams

(ABSTRACT)

This study investigated social cognitive determinants of creatine supplementation among 171 male, undergraduate, recreational weight-lifters. Participants responded to a packet of questionnaires that assessed their history and rate of creatine use, self-efficacy for improving their workout performance with and without creatine, and expected outcomes of improved workout performance and creatine use, as well as several other demographic variables.

Fifty percent of the sample reported past creatine use. The data was used to establish the internal consistency, test-retest reliability and predictive validity of factor-based scales for valued outcome expectancies and disincentives for creatine use scales. A social cognitive model was shown to predict past creatine use (R^2 = .372). The results lay the groundwork for further examination of the determinants of creatine supplementation and the use of other controversial and potentially harmful performance-enhancing dietary supplements.

Table of Contents

CHAPTER 1 BACKGROUND

The major focus of the present study was to investigate the psychological determinants of creatine use. The use of various types of dietary supplements in the United States has increased dramatically in the past few years (Nesheim, 1999). This includes daily vitamins, herbal supplements, and performance enhancing supplements. Many of these dietary supplements have not been thoroughly investigated due to the Dietary Supplement Health and Education Act (1994), which allows supplements to be marketed without the testing of their safety through clinical trials. One dietary supplement which has received recent attention from a number of researchers is creatine.

Creatine is an amino acid derivative that is present in most meats, milk, and some fish; creatine is also endogenously synthesized in the liver, pancreas, and kidney. Ninety-five percent of the body's creatine stores are present in the skeletal muscle of the human body. In a resting state, approximately 60% of creatine exists in the phosphorylated form (phosphocreatine), while the remaining 40% is free-form.

Creatine functions mainly as a facilitator in the resynthesis of adenosine triphosphate (ATP). The breakdown of ATP provides the energy needed for muscle contraction through the breakdown of a high-energy phosphate bond and subsequent loss of a phosphate group. The resulting adenosine diphosphate (ADP) must gain an additional phosphate group in order for the resynthesis of ATP to occur. When rapid and repeated muscle contraction is necessary, phosphocreatine (PCr) functions as an aid in the resynthesis of ATP through the donation of its phosphate group to ADP.

Once PCr has lost its phosphate group, it is transformed into free-form creatine (Cr). During exercise, PCr stores are quickly depleted. However, during recovery, Cr binds with free-floating phosphate to replenish PCr levels. Because the breakdown of ATP supplies the energy needed for muscle contraction, PCr's role in the resynthesis of ATP serves to facilitate energy production. PCr is especially useful to the body during high intensity, short-duration physical activity such as sprinting or weight training, when accelerated resynthesis of ATP is necessary to provide adequate energy to skeletal muscles.

Both Cr and PCr are eventually broken down into creatinine and subsequently excreted at the rate of about 2 grams per day (Demant & Rhodes, 1999). It is necessary for humans to replenish this lost creatine on a daily basis. However, creatine exists in our diets in very small amounts. For example, one-half pound of meat contains approximately one gram of creatine (Feldman, 1999). Therefore, in addition to exogenous intake, creatine is endogenously synthesized. The amount of endogenous creatine synthesis depends on one's exogenous intake. In a normal American diet, about half of the body's creatine is produced endogenously (Demant & Rhodes). However, those who ingest lower amounts of creatine are able to produce enough creatine endogenously to meet their daily needs.

There is anecdotal evidence that creatine may have been used by Olympians as a performance enhancing supplement as early as 1992 (Feldman, 1999). Since then, creatine has been used by many professional athletes. Feldman (1999) cites a 1998 *USA Today* poll indicating creatine use by approximately 20% of professional baseball players, and 25-75% of professional football players. The increased use of the supplement is evidenced by the fact that in 1997 creatine reached sales of $200 million in the U.S. alone (Clarkson & Rawson, 1999).

The use of creatine as a performance enhancing supplement stems from the idea that ingestion of large amounts of creatine could saturate the skeletal muscles with the nutrient, allowing them to produce more energy during high intensity movements such as those necessary during participation in many sports. Kraemer and Volek (1999) propose a model of creatine supplementation in which increased ingestion of exogenous creatine leads to an increase in muscle concentration of total creatine (TCr – The total amount of creatine, including PCr and Cr), which in turn leads to increased PCr availability and resynthesis. Subsequently, the increased availability and resynthesis of PCr results in delayed depletion of PCr during exercise, and thus increased performance during high intensity training.

Creatine is typically supplemented in dosages of 20 to 30 grams per day for a one week <u>loading</u> phase, followed by a maintenance dose of 5 grams per day taken indefinitely. Several recent studies show that creatine supplementation can significantly increase skeletal muscle concentrations of both TCr and PCr (Kreis et al., 1999; McKenna, Morton, Selig, & Snow, 1999; Schedel, Tanaka, Kiyonaga, Shindo, & Schutz, 1999; Vandenberghe, Van Hecke, Van Leemputte, Vanstapel, & Hespel, 1999; Volek et al., 1999). However, there is some controversy concerning the optimal dose. While some continue to advocate creatine loading for the most effective and rapid increase in creatine concentrations (Hultman, Soderlund, Timmons, Cederbald, & Greenhaff, 1996), others (Vandenberghe et al.) feel that such a loading phase is not necessary.

Greenhaff (1994) found that those with lower initial TCr increased their overall creatine level more after supplementation than those with higher initial creatine levels. This is consistent with the idea that there is a maximum level of creatine that the body will hold, with excess creatine being excreted (Poortmans & Francaux, 1999).

While many agree that creatine supplementation increases intramuscular concentrations (Kreis et al., 1999; McKenna et al., 1999; Schedel et al., 1999; Vandenberghe et al., 1999; Volek et al., 1999), there is less agreement with respect to the effects of creatine supplementation on performance. In a review of outcome studies, Demant and Rhodes (1999) identified 17 well-controlled studies indicating an increase in performance on various high-intensity movement tasks. Conversely, they found 11 studies indicating no effects on performance. In another review, Williams and Branch (1998) found 23 studies showing significant improvement in short-term high intensity performance and 20 showing no effect. There is some agreement among authors that differences in outcomes may be due to the existence of responders and non-responders to creatine supplementation based on initial creatine level (Demant & Rhodes, 1999; Feldman, 1999). As Demant and Rhodes contend, this phenomenon, combined with a relatively low sample size in most studies " . . . may explain many of the equivocal results reported in the literature" (p. 55).

Recently, there has been some evidence of possible kidney dysfunction due to prolonged creatine use (Greenhaff, 1996; Pritchard & Kaira, 1998). In a discussion of dietary protein intake, Brenner, Meyer, and Hostetter (1982) indicate that a nitrogen-rich diet may contribute to kidney dysfunction. Poortmans and Francaux (1999) admit, " . . . the high nitrogen content

(32%) of creatine could add some strain on the kidney if taken in large excess for a long period of time" (p. 1108). However, their recent study (1999) shows no significant difference in kidney function between controls and nine subjects taking an average dose of 10 g/day everyday over an average period of 2.67 years. The only difference between groups was a much higher urinary output of creatine in the supplementation group, approximately 35 times that measured in controls.

Another concern is that prolonged supplementation may lead to a decrease in the body's endogenous synthesis of creatine (Silber, 1999). While some research has shown preliminary evidence that endogenous synthesis does recover upon termination of supplementation (Balsom, Soderlund, & Ekblom, 1994; Hultman et al., 1996), no studies have investigated this occurrence after prolonged creatine supplementation. Silber (1999) indicates that any daily dose of creatine beyond 2 grams interferes with the body's natural regulation of creatine. He further states: "Ingestion of creatine supplements in loading (pharmacological) doses directly affects the most sensitive links in the complex mechanism of homeostatic self-regulation" (p. 180).

The most prominent side-effect of creatine supplementation is the increase of body mass, thought to be due to increased water retention in skeletal muscle (Balsom et al.,1994; Clarkson & Rawson, 1999; Hultman et al., 1996). Most authors agree that this increase in body mass, coupled with the lack of need for accelerated ATP synthesis during long-term more endurance oriented tasks, makes creatine ineffective, at best, in more endurance-oriented, sub-maximal sports or exercise (Clarkson & Rawson, 1999; Demant & Rhodes, 1999; Feldman, 1999; Kamber et al.,1999).

It is creatine's apparent ability to promote an increase in body mass that " . . . is being vigorously exploited lately with commercial purpose worldwide" (Silber, 1999, p. 179). As indicated by Demant and Rhodes (1999), "[w]hile much of the research into the effects of creatine supplementation has involved running or cycling protocols, much of the marketing of the packaged product is geared toward weight training" (p. 57). Partly as a result of this marketing, which generally accentuates creatine's ability to increase muscle mass, creatine has become extremely popular among amateur athletes. At the time of Feldman's review (1999), no data currently existed on creatine use by amateur athletes or on the age or gender distribution of users. However, in a more recently published study, LaBotz and Smith (1999) have reported that among 750 NCAA Division I athletes at one university, 48% of men and 4% of women reported having used creatine. Additionally, all but two men's teams reported at least 30% of their team members had a history of creatine use. "Increased strength and muscle size were the most common effects the athletes expected and perceived from creatine use" (p. 167). This data suggests that among amateur athletes, creatine is used primarily by men who seek to increase their strength and muscle mass.

Finally, in a review of the potential harm of creatine supplementation, Silber (1999) cites a 1997 *USA Today* article associating several deaths among collegiate athletes with excessive creatine supplementation. He further states: "In the U.S. . . serious steps are underway at the NCAA, which may lead to administrative ban toward use of pure Cr-H2O (creatine) as an ergogenic aid, at all levels of intercollegiate and olympic sport" (p. 187).

In summary, there does seem to be some evidence to support the effectiveness of creatine supplementation in improving performance on high-intensity, short-term movement tasks. However, a report from the American College of Sports Medicine roundtable discussion (2000) authored by several of the leading creatine researchers states, "The apparent high expectations for performance enhancement, evident by the extensive use of creatine supplementation, are inordinate" (Terjung, et. al.). In addition, Poortmans and Francaux's study (1999) is the first to measure potential side-effects of long-term creatine use. Silber (1999) maintains that creatine is " . . . a drug which is being vigorously and deceitfully promoted by the manufacturers to the sport market as a nutrition supplement" (p. 187). Clearly, more research is needed as controversy remains concerning the efficacy and safety of creatine supplementation.

<u>Determinants of Creatine Use</u>

Before any further discussion, it is necessary to note that the present research is not concerned with the simple behavior of creatine supplementation. Rather, in this paper creatine use is defined as <u>the dietary supplementation of creatine for the purpose of improving exercise</u>

performance. Amid the controversy concerning its safety and efficacy, it is important to take the initial steps in the investigation of why individuals choose to engage in creatine use. Social cognitive theory (SCT) posits that behavioral, personal, and environmental factors operate within an interdependent causal structure (Bandura, 1997). Through triadic reciprocal causation, behavior is both determined by, and acts as a determinant of personal and environmental factors (Bandura, 1997). Human perceptions of personal and environmental factors influence behavior. Therefore, one of the goals of SCT is to examine how these perceptual/cognitive variables help to explain behavior. The present study examines creatine use with respect to the social cognitive variables of self-efficacy and valued outcome expectancies.

Although to date, no research has taken a theoretical approach to the explanation of creatine use, there is some evidence that SCT provides an appropriate framework for such an investigation (LaBotz & Smith, 1999; Lovstakken, Peterson, & Homer, 1999; Massad, Shier, Koceja, & Ellis, 1995; and Sobal & Marquart, 1994). The specific nature of this supporting evidence is discussed below, within the context of each social cognitive variable currently under investigation.

Self-Efficacy

Bandura (1997) defines self-efficacy as “beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). He further contends that “. . . in judging their efficacy, individuals necessarily unite personal agency with means” (p.283). That is, one will not be confident in one’s ability to produce given attainments, if one does not believe that the prescribed courses of action are likely to produce those attainments. Therefore, in the context of creatine use, self-efficacy may be seen as confidence in ability to successfully use creatine (execute a course of action) to improve exercise performance (produce a given attainment).

Although self-efficacy typically purports to reflect beliefs in one’s ability to carry out all the courses of action that might produce a given attainment (Bandura, 1997), the only course of action that is of interest here is creatine use. Therefore, in the present research, the construct of self-efficacy will focus on one's perceived ability to improve exercise performance through creatine use.

In measuring such a construct, it is important to evaluate the extent to which individuals believe that creatine is increasing their ability to improve their workout performance. For example confidence in ability to improve workout performance while using creatine may simply reflect confidence in ability to improve workout performance in any case. Therefore, for the sake of clarity, the definition of self-efficacy (SECR) will be refined further to reflect belief in ability to use creatine to improve workout performance above and beyond what would be expected without using creatine.

Sobal and Marquart (1994) surveyed 742 high school athletes from nine schools in one rural county. They found that athletes who believed that they could improve their athletic performance through the use of dietary supplements were more likely to use supplements, and use them more frequently and for a longer period of time. These results provide some evidence that self-efficacy is able to predict supplement use. Based on these findings, one would expect that those who have increased SECR will be more likely to use creatine, and to use it more frequently.

In SECR, the courses of action required to bring about improved exercise performance are limited to creatine use. However, when the courses of action required to produce a given attainment are limited to all actions, except for creatine use, a distinct self-efficacy construct emerges. This second self-efficacy construct (SEWO), may be defined as belief in ability to improve workout performance (produce given attainments) without the use of creatine (course of action).

In a study of supplement use among 509 high school athletes from six Indiana high schools, the most cited reason for non-use was “[d]o not believe in them/feel there is no need” (Massad et al., 1995). One reason why these athletes might feel that there is no need for dietary supplements is that they feel that they can improve their performance without them. If this is true, then one would expect that those who have higher SEWO will be less likely to use creatine.

Valued Outcome Expectancies

According to social cognitive theory, outcome expectancies are the perceived likelihood of positive and negative physical, social, and self-evaluative outcomes that might flow from a given attainment (Bandura, 1997). Therefore, in the context of creatine use, outcome expectancies are the perceived likelihood of outcomes that might occur as a result of improving exercise performance. Bandura also maintains, "[t]he motivating potential of anticipated outcomes is, of course, determined largely by the subjective value placed on them" (p. 23). Therefore, from a social cognitive framework, outcome values are also important to the prediction of behavior. In this case, the subjective value placed on possible outcomes of improved exercise performance, such as increased strength or muscle soreness, will predict creatine use. However, if it is not believed that a particular outcome is likely to occur as a result of a given attainment, then that outcome will not influence behavior no matter how high a value is placed on it. Similarly, if there is no value placed on an outcome then it will not influence behavior no matter how likely the outcome is perceived to be. Therefore, the influence of outcome expectancies and outcome values on behavior is interactive (Rotter, 1982). As a result, all outcome expectancies and outcome values will be analyzed as the integrated constructs of valued outcome expectancies.

In the present study, there are three valued outcome expectancy constructs. Positive valued outcome expectancies (PVOE) reflect the perceived likelihood and value of positive outcomes that might flow from improved exercise performance. Negative expectancies are divided into two classes. Negative valued outcome expectancies (NVOE) reflect the perceived likelihood and value of negative outcomes that might flow from improved exercise performance. Disincentives for creatine use (DCR) reflect the perceived likelihood and value of negative outcomes that might flow directly from the use of creatine.

LaBotz and Smith (1999) found increased muscle size and increased strength to be the most expected effects of creatine use. However, these expectancies were measured only among those who had used creatine. Lovstakken et al.(1999) found that among college students increased expectancies of the positive effects of steroid use predicted higher risk of steroid use. On the other hand higher expectations of negative effects of steroids predicted lower risk of steroid use. Since steroids and creatine are both used by many amateur weight-lifters to increase muscle size and strength (National Institute of Drug Abuse, 1991; LaBotz & Smith, 1999) this evidence suggests that expectations of more positive outcomes and fewer negative outcomes would predict creatine use.

A Social Cognitive Model of Creatine Use

The main purpose of the present study was to test an explanatory social cognitive model of creatine use (Figure 1). The model included the social cognitive variables discussed above, namely SECR, SEWO, PVOE, NVOE, and DCR. Each of the variables was expected to contribute to the explanation of creatine use.

In addition, the mediational role of valued outcome expectancies was examined. A variable functions as a mediator " . . . to the extent that it account for the relation between the predictor and the criterion (Baron and Kenny, 1986, p. 1176). According to Bandura (1997), outcomes are not expected to result from attainments that cannot be produced. Thus, in this scenario, the relationship between SECR, SEWO, and creatine use can be partially explained by PVOE, NVOE, and DCR. In other words, confidence in ability to improve exercise performance leads to creatine use, partially because of the change in expected outcomes that flow from increased confidence.

CHAPTER 2 METHOD

Participants

Participants consisted of 178 male undergraduate students enrolled in psychology courses at Virginia Tech. Participants were recruited by means of a folder, containing a brief description of the study, and a sign up sheet. They were asked to attend two sessions that were held one week apart. The sign up sheet also requested that students sign up only if they lifted weights at least twice a week in an attempt to improve muscle development, gain strength or endurance, or increase muscle mass for non-professional purposes (i.e., they are not involved in professional body building). Seven questionnaire packets were not utilized in the data analysis because the participants did not report any weight-lifting. Creatine was not mentioned anywhere on the recruitment folder, so as to obtain a less biased estimate of the rate of creatine use among undergraduate, male, recreational weight-lifters. Participants gained extra credit in their psychology class for participating in the study.

Measures

Background Information

This thirteen-item questionnaire was designed to gather some demographic information such as age, height, weight, ethnicity, and participation in intercollegiate athletics. The questionnaire also contained some general questions concerning awareness of the existence of creatine as a dietary supplement, sources of information about creatine, and the past and current use of dietary supplements other than creatine. Each of these items showed good test-retest reliability (Table 1).

Creatine Use

Creatine use was measured in two ways. First, on the Background Information questionnaire, participants were asked to respond to two questions asking them whether or not they had ever used creatine and whether or not they currently use creatine. Based on their responses, participants were grouped into three mutually exclusive categories of creatine use (CCU): Current use; past, but not current use; and non-use.

Second, frequency of creatine use (FCU) among creatine users was measured with the Timeline Follow-Back for Dietary Supplements. The Timeline Follow-Back method, initially created by Sobell and Sobell (1992), has shown good reliability in interview form for a number of different behaviors including alcohol use (Sobell & Sobell, 1992), smoking (Brown, Burgess, Sales, Whitely, Evans, & Miller, 1998) and cocaine use (Hersh, Mulgrew, Van Kirk, and Kranzler, 1999). In a pilot study (Williams & Anderson, 1999), a paper and pencil version of the self-report measure showed good reliability among undergraduate dietary supplement users (TLFB-DS). In the present study, the TLFB-DS was used to measure FCU by summing the number of days of use over the previous four weeks.

SECR and SEWO

Participants were asked to indicate how they determine that their workout performance has improved by completing the sentence: My workout performance would be improved if . . . They were then instructed to refer to their own definition of improved workout performance to aid them in filling out three self-efficacy items. A single item was developed to assess the extent (from 0 to 100) of participants' perceived confidence in their ability to improve their workout performance without using creatine (SEWO). SEWO displayed poor test-retest reliability ($r = .414$, $p < .01$). Two additional items were developed to assess participants' beliefs in their ability to use creatine to improve their workout performance above and beyond what they would expect without using creatine (SECR). Above and beyond was operationalized as faster and even more. SECR displayed good test-retest reliability ($r = .855$, $p < .01$).

SECR displayed much higher test-retest reliability than SEWO despite the fact that both measures required participants to refer to their own definition of improved exercise performance. Moreover, it is doubtful that SEWO's relatively low reliability can be attributed to the single-item nature of the measure, as SECR had only two items, but displayed adequate reliability. The best explanation for SEWO's low reliability is that participants were confused by the request to rate their efficacy without the use of creatine. Perhaps a rephrasing, and more in-depth written and oral instructions would increase the reliability of SEWO.

Derivation of the PVOE, NVOE, and DCR Scales

Participants responded to forty items that were grouped into three scales representing PVOE, NVOE, and DCR. Seventeen PVOE and fifteen NVOE items were developed by the investigator through consultation with a weight-lifter with over 30 years of experience. Examples of PVOE items included: "I will increase my muscle strength…" "I will improve how I feel about myself…" and "I will be admired for my physical appearance…" Examples of NVOE items included: "I will experience unwanted muscle soreness…" "I will have less chance of further improvement…" and "My friends will think I am overly obsessed with weight-lifting…" Eight DCR items were developed by the investigator with the aid of qualitative data obtained in a pilot study (Williams and Anderson, 1999). Examples of DCR items included: "I will experience muscle cramps…" "I will feel that I am doing something unnatural to my body…" and "My friends will criticize me…"

Participants were asked to rate the “Likelihood” and “Importance” of each outcome on a scale from 0 (not at all likely/important) to 100 (extremely likely/important). Prior to responding to PVOE and NVOE items, participants were orally instructed to refer to their own definition of improved workout performance to aid them in responding to these items.

Responses to “Likelihood” and “Importance” questions were multiplied for each item to yield an item score. All of the PVOE, NVOE, and DCR item scores were subjected to principle axis factoring with oblique rotation to investigate the factor structure of the items. Results yielded three factor-based scales (Table 2) that were consistent with the original grouping of the items. One DCR item was dropped because it had a factor loading lower than .4. Item scores were then averaged for each scale to yield PVOE, NVOE, and DCR scale scores. Reliability analyses indicated good internal consistency for PVOE ($\alpha = .9063$), NVOE ($\alpha = .8593$), and DCR ($\alpha = .8210$). Each of the three scales also exhibited good test-retest reliability: PVOE ($r = .817$, $p < .01$), NVOE ($r = .793$, $p < .01$), and DCR ($r = .846$, $p < .01$).

The Aerobics Center Physical Activity Questionnaire

This self-report questionnaire measured the average duration and frequency of specified categories of physical activities, including weight-lifting, over the course of one week. The measure has shown good reliability and validity (Oliviera, Kohl, Trichopoulos, & Blair, 1996).

Procedures

Participants met in a classroom at Virginia Tech for two sessions that were held approximately one week apart. During each session, they were asked to fill out a series of questionnaires. The investigator read aloud the instructions for each of the individual scales within the packet. In addition, the first item of each scale was read aloud, and further clarification was provided if necessary. Questionnaire packets were coded to match the participants' responses across sessions.

Data Analyses

Testing the Social Cognitive Model of Creatine Use

In order to decide upon the number of levels of CCU that should be used in further analyses, analysis of variance was conducted to test for differences in CCU with respect to all social cognitive variables. Post hoc analyses were conducted and effect size comparisons were made between each of the three groups of creatine use for all significant Fs. Results of these analyses determined the number of levels of the dependent variable (CCU) for the following analyses.

Hierarchical logistic regression was then conducted in an attempt to explain creatine use in the context of the hypothesized social cognitive model. On step one, CCU was regressed on SECR and SEWO. On step two, PVOE, NVOE, and DCR were entered into the equation. This was done to allow for the examination of any decrease in the contribution of the self-efficacy variables to the prediction of CCU after the valued outcome-expectancy variables were entered into the equation. Such a decrease would suggest a mediational relationship. Finally, each of the valued outcome expectancy variables was regressed on the self-efficacy variables in an attempt to explain the mediational relationship.

A relatively small number (23) of those reporting creatine use in the past 28 days, yielded insufficient power to conduct any analyses examining the explanation of FCU among creatine users.

Exploratory Analyses

Chi Square analyses were conducted to explore differences in CCU with respect to varsity status, ethnicity, means through which participants first heard of creatine, and means through which participants receive most of their information about creatine. Analysis of variance was used to explore differences in CCU with respect to number of performance-enhancing dietary supplements (other than creatine) currently used, number of performance-enhancing dietary supplements used in the past, number of other dietary supplements currently taken, and duration of weight-lifting per week (derived from sessions per week multiplied by duration per session). Post hoc multiple comparisons were conducted for all significant Fs produced by the ANOVAs.

CHAPTER 3 RESULTS

Descriptive Statistics

Of the 171 participants, 45 reported ethnicity consistent with minority status. Only two indicated that they were vegetarians, while 22 reported membership on a collegiate varsity athletic team. Of 171 participants, 86 % reported that they had used creatine at some point, whereas only 16 % reported current use (Table 3). Means, standard deviations, and ranges for all social cognitive variables are displayed in Table 4. Mean ratings for SEWO and SECR indicated that participants were very confident in their ability to improve their workout performance without creatine, and moderately, but somewhat less confident in their ability to improve even more and faster by using creatine. Means for outcome expectancies and values indicated that participants rated positive outcomes as very likely and important, while ratings for likelihood and importance of negative outcomes were moderate. Similar mean ratings for each component within the scales indicated that perceived expectancies and values contributed equally to PVOE and NVOE scale scores. Mean ratings for likelihood and importance of possible disincentives were both moderate. However, higher ratings for importance of the disincentives suggests that values placed on possible disincentives may be perceived as slightly higher than expectancies that they will occur.

Evaluation of the Social cognitive Model

Means plots indicated linear relationships for all of the variables across the three categories of creatine use. Analysis of variance yielded significant differences among CCU for SECR, F (2, 168) = 14.735, $p < .001$, and DCR F (2, 168) = 20.140, $p < .001$. Nearly significant differences were found for SEWO, F (2, 168) = 2.984, $p = .053$, and PVOE, F (2, 168) = 2.839, $p = .061$. Bonferroni multiple comparisons of means for SECR and DCR yielded significant differences between the non-use and current use groups, $p < .001$, and the non-use and past use groups, $p < .001$, but not between the past use and current use groups. For SECR and DCR effect size estimates revealed smaller differences between past users and current users ($\eta^2 = .040$; $\eta^2 = .077$) than between non-users and current users ($\eta^2 = .139$; $\eta^2 = .195$), and non-users and past users ($\eta^2 = .107$; $\eta^2 = .131$). Results of multiple comparisons of means and effect size analyses indicated that past creatine users and current creatine users responded similarly to the social cognitive measures. Based on these results, these two categories were collapsed into one group, yielding a dichotomous variable of CCU.

Results of the hierarchical logistic regression analysis (Table 5) showed that the social cognitive model was moderately successful in predicting CCU (Nagelkerke's $R^2 = .372$). Odds of having used creatine in the past increased for those who scored higher on SECR and PVOE. Odds of being in the creatine use category decreased for those who scored higher on DCR and SEWO. Within the model, NVOE did not display a unique contribution to the prediction of creatine use.

Within the hierarchical logistic regression analysis in can be seen that SECR's contribution to the prediction of creatine use prior to controlling for PVOE, NVOE, and DCR (Odds ratio = 1.0304, $p < .0001$) decreased slightly (Odds ratio = 1.0209, $p < .0054$) after these variables were entered into the equation. However, SEWO's contribution to the prediction of CCU improved after all the variables were entered into the equation (Step1, Odds ratio = .9822, $\underline{p}$ = .0439; Step 2, Odds ratio = .9764, $\underline{p}$ = .0150).

Finally, linear multiple regression analyses (Table 6) revealed significant unique contribution to the prediction of PVOE by both SECR (β = .341, $\underline{p} < .001$) and SEWO (β = .230, $\underline{p}$ = .002). Results also indicated significant unique contribution to the prediction of DCR by SECR (β = -.242, $\underline{p}$ = .002).

Exploratory Analyses

Of those who had used creatine, most reported using for a total of more than one month (Table 7) during one to two periods of use (Table 8). "Friends and family" was the most cited source of first knowledge about creatine (Table 9), while "friends and family" and "magazines" were indicated as the sources where the greatest number of participants get most of their information about creatine (Table 10). Protein was reported as the performance-enhancing dietary supplement most used both currently and in the past (Table 11).

For all exploratory analyses, the three-level CCU variable was the dependent variable. Results of chi-square analyses indicated significant differences in categories of creatine users with respect to varsity status, χ^2 (6, $\underline{N}$ = 170) = 10.149, $\underline{p}$ = .006 (Table 12), source of first knowledge of creatine, χ^2 (15, $\underline{N}$ = 155) = 20.077, $\underline{p}$ = .010 (Table 9), and source of most information about creatine, χ^2 (15, $\underline{N}$ = 157) = 18.053, $\underline{p}$ = .021 (Table 10). Specifically, those who first heard of creatine through "friends and family" or "trainer" are more likely to have used creatine at some point. Additionally, those who receive most of their information from "friends and family," "magazines," and "the gym" are more likely to have used creatine at some point. Results yielded nearly significant differences in ethnicity, χ^2 (6, $\underline{N}$ = 170) = 5.909, $\underline{p}$ = .052, (with minority categories combined) across creatine use (Table 13), indicating that those of minority status may be less likely to use creatine.

Analysis of variance yielded significant differences in categories of creatine users with respect to number of past performance-enhancers used, F (2, 168) = 19.209, $p < .001$, and number of current performance-enhancers used, F (2, 168) = 10.314, $p < .001$. Games-Howell multiple comparisons of means for non-homogeneous variances yielded significant differences for both variables between the non-use and current use groups ($p < .05$), and the non-use and past use groups ($p < .05$), but not between the past use and current use groups. Nearly significant results were found for height, F (2, 168) = 2.896, $p = .058$ and number of other supplements currently taken, F (2, 167) = 2.945, $p = .055$. No significant differences were found for age, weight, or duration of weight-lifting per week.

CHAPTER 4 DISCUSSION

The Social Cognitive Model

The present study yielded three reliable factor-based scales that purported to measure both positive and negative valued outcome expectancies for improved exercise performance, and disincentives for creatine use. These scales were used in the context of an explanatory social cognitive model of creatine use. Overall, the model was moderately successful in explaining why participants either had, or had not used creatine.

Specifically, both self-efficacy variables (i.e., SECR and SEWO) contributed uniquely to the prediction of creatine use. Those with higher SECR were more likely to have used creatine. This was consistent with Sobal and Marquart (1994), who found that high school athletes who believed that they could improve their performance through the use of supplements were more likely to use them. Furthermore, the present findings displayed evidence that the theoretical self-efficacy-behavior relationship (Bandura, 1997) operates within the domain of creatine use.

Conversely, those with higher SEWO were less likely to have creatine. No previous studies had directly investigated such a relationship. However, Massad et al. (1995) found that those who did not use supplements felt that they were not necessary. It can be argued that non-supplement users feel that there is no need for supplement use because they believe that they can improve their performance without them. Regardless of the validity of the latter statement, the present results do indicate that those who believe that they can improve their performance without creatine are less likely to use it. This finding is also consistent with social cognitive theory in that higher self-efficacy for improving performance without creatine positively predicted non-creatine use. The significance of SEWO's contribution to the prediction of creatine use is somewhat surprising given the low test-retest reliability of SEWO. Perhaps a better measure of SEWO would be even more predictive of creatine use.

PVOE and DCR also contributed to the prediction of creatine use in the context of the social cognitive model. However, the NVOE scale contributed little to the prediction of creatine use. This indicates that the negative outcomes expected to occur as a direct result of creatine use are more predictive of its use then those expected to occur as a result of improved performance. Although descriptive statistics (Table 4) indicated that mean ratings of both perceived expectations and values of NVOE were moderate, they did not display the change across groups that was evident for DCR. This makes intuitive sense, in that participants were more likely to attribute the direct negative outcomes of creatine use to creatine use than those expected to occur as a result of improved performance.

The present findings concerning PVOE and DCR further support the application of social cognitive theory to creatine use. Furthermore, these findings are consistent with those of Lovstakken et al. (1999) who found similar relationships between steroid use and expectations of the effects of its use. The parallel findings exhibited by the present study and that of Lovstakken et al. concerning positive and negative outcome expectancies provide preliminary evidence that some of the same social cognitive processes might operate in steroid and creatine use.

SECR's contribution to the prediction of creatine use was slightly diminished when PVOE, NVOE, and DCR were added to the equation. This, in combination with the results of the linear regression analyses, lends some support to the theorized mediational relationships (Bandura, 1997). Specifically, results indicate that PVOE and DCR partially mediate the relationship between SECR and creatine use. This is consistent with Bandura's (1997) argument that " . . . where efficacy beliefs foretell the expected outcomes, the outcomes become a redundant predictor" (p. 24). PVOE and DCR items (Appendix A) are in most cases directly tied to improved performance and creatine use, respectively. Therefore, PVOE and DCR serve as partially redundant predictors of creatine use, and cause SECR's predictive power to decrease when they are added to the model.

Exploratory Analyses

The 50% rate of past creatine use (86 of 171) found among the present sample of collegiate weight-lifters is similar to the 48% rate found among Division I athletes in 1999 (LaBotz and Smith). These findings, coupled with the trend exhibited in the current study, suggesting that varsity athletes are more likely to have used creatine, provide tentative evidence that creatine use may be on the rise for college-level athletes. Although the small number of varsity athletes involved in the current study (22) precludes firm conclusions, the results suggest that this may be an issue for further study.

Approximately 26% of the sample were of minority status. Interestingly, minority status was shown to be nearly significantly related to creatine use. Specifically, those of minority status were less likely to have used creatine in the past. This is especially true among Asian-Americans, of whom only 2 out of 16 had used creatine. This finding suggests that there may be cultural influences that impact one's decision to use or not use creatine.

Also related to past creatine use was the number of performance-enhancing dietary supplements used both in the past and presently, as well as the number of other dietary supplements (i.e. vitamins, minerals, and herbal supplements) taken. It is possible that there are certain factors that lead one to use all types of dietary supplements. However, it is also possible that experimentation with dietary supplements progresses along a continuum. One may start by taking vitamins and herbal supplements, and then begin supplementing protein, which in turn leads to the use of performance-enhancers such as creatine and andro-, and eventually to harmful anabolic steroids. Without longitudinal data this idea is nothing more than speculation. However, the relationships exhibited in the present study do encourage further research on the patterns of all dietary supplementation over time.

Finally, chi-square analyses revealed relationships between source of information about creatine and creatine use. Data show that those who get most of their information about creatine from magazines, the gym, or a trainer are more likely to use creatine. A potential explanation for one source of information is that varsity athletes are more likely to get information from a trainer, who then recommends use, thus increasing their chances of use. Those who get information about creatine from magazines are likely exposed to the circus of advertisements for performance-enhancing dietary supplements that according to illustrations can make a man lean, mean, and surrounded by bikini-clad women in a matter of days. Exposure to this type of modeling is sure to increase the perceived likelihood and value of potential outcomes of improved workouts.

Limitations

A few key limitations of the present study should be noted. Most importantly, the cross-sectional nature of the data makes reverse causation a danger. That is, it is possible that those who use creatine are more likely to have confidence in their ability to improve their workout performance through creatine use, rather than vice versa. The cross-sectional design of this study is a very serious limitation, and it should lead one to view any interpretations of directional relationships with caution. Future research in this area should move toward establishing the explanatory power of the model through longitudinal designs.

Other limitations include, but are not limited to, the relatively small number of participants with minority and varsity status, and the absence of females. There is obviously more room for research within those domains. Finally, although creatine was not mentioned in the recruitment materials, it is possible that the nature of the study leaked out, as it was carried out over the course of several months. This may have led those with more of an interest in creatine to participate in the study. Those individuals in turn, may have been more likely to have used creatine in the past. This could have led to an artificial inflation of the number of past creatine users.

Implications

The present study has only begun to show evidence for an explanatory model of creatine use. Further research may uncover the constructs that influence self-efficacy and valued outcome expectancies. Some of these constructs might be represented by the modeling that occurs through exposure to the outrageous marketing tactics of creatine and other supplements like it. Understanding why individuals choose to use creatine may tell us something about male perceptions of body image. Furthermore, it could possibly lead to an understanding of why males turn to more dangerous substances such as steroids. Ultimately, a model that helps us predict and explain the use of performance enhancing supplements and drugs, may aid in the design of interventions that will help men make healthy, informed choices about what they use to supplement their diet. It is hoped that this study will lay the groundwork for the further investigation of the psychological determinants of creatine use and the use of other performance-enhancing dietary supplements.

REFERENCES

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51(6), 1173-1182.

Balsom, P. D., Soderlund, K., & Ekblom, B. (1994). Creatine in humans with special reference to creatine supplementation. Sports Medicine, 18, 268-280.

Bandura, A. (1997). Self-Efficacy: The Exercise of Control. New York: W. H. Freeman and Company.

Brenner, M. B., Meyer, T. W., & Hostetter, T. H. (1982). Dietary protein intake and the progressive nature of kidney disease: The role of hemodynamically mediated glomerular injury in the pathogenesis of progressive glomerular sclerosis in aging, renal ablation, and intrinsic renal disease. New England Journal of Medicine, 307, 652-659.

Brown, R. A., Burgess, E. S., Sales, S. D., Whitely, J. A., Evans, D. M., & Miller, I. W. (1998). Reliability and validity of a smoking timeline follow-back interview. Psychology of Addictive Behaviors, 12(2), 101-112.

Clarkson, P. M., & Rawson, E. S. (1999). Nutritional supplements to increase muscle mass. Critical Reviews in Food Science and Nutrition, 39(4), 317-328.

Demant, T. W., Rhodes, E. C. (1999). Effects of creatine supplementation on exercise performance. Sports Medicine, 28(1), 49-60.

Dietary Supplement Health and Education Act, 108 Statute 4325, Public law 103-417, United States Congress (1994).

Feldman, E. B. (1999). Creatine: a dietary supplement and ergogenic aid. Nutrition Reviews, 57(2), 45-50.

Greenhaff, P. L. (1994). Effects of oral creatine supplementation on skeletal muscle phosphocreatine resynthesis. American Journal of Physiology, 266, 725-730.

Greenhaff, P. L. (1996). Creatine supplementation: recent developments. British Journal of Sports Medicine, 30, 276-277.

Hersh, D., Mulgrew, C. L., Van Kirk, J., & Kranzler, H. R. (1999). The validity of self-reported cocaine use in two groups of cocaine abusers. Journal of Consulting and Clinical Psychology, 67(1), 37-42.

Hultman, E., Soderlund, K., Timmons, J. A., Cederbald, & Greenhaff, P. L. (1996). Muscle creatine loading in men. Journal of Applied Physiology, 81(1), 232-237.

Kamber, M., Koster, M., Kreis, R., Walker, G., Boesch, C., & Hoppeler, H. (1999). Creatine supplementation-Part I: performance, clinical chemistry, and muscle volume. Medicine and Science in Sports and Exercise, 31(4), 1763-1769.

Kraemer, W. J., & Volek, J. S. (1999) Creatine supplementation: Its role in human performance. Clinics in Sports Medicine, 18(3), 651-666.

Kreis, R., Kamber, M., Koster, M., Felblinger, J., Slotboom, J., Hoppeler, H., & Boesch, C. (1999). Creatine supplementation – Part II: in vivo magnetic resonance spectroscopy. Medicine and Science in Sports and Exercise, 31(3), 1770-1777.

LaBotz, M., & Smith, B. W. (1999). Creatine supplement use in an NCAA Division I athletic program. Clinical Journal of Sports Medicine, 9(3), 167-169.

Lovstakken, K., Peterson, L., & Homer, A. L. (1999). Risk factors for anabolic steroid use in college students and the role of expectancy. Addictive Behaviors, 24(3), 425-430.

Massad, S. J., Shier, N. W., Koceja, D. M., & Ellis, N. T. (1995). High school athletes and nutritional supplements: A study of knowledge and use. International Journal of Sport Nutrition, 5, 232-245

McKenna, M. J., Morton, J., Selig, S. E., & Snow, R. J. (1999). Creatine supplementation increases muscle total creatine but not maximal intermittent exercise performance. Journal of Applied Physiology, 87(6), 2244-2252.

National Institute of Drug Abuse. (1991). Anabolic steroids: A threat to body and mind. Washington DC: U.S. Department of Health and Human Services, Public Health Services.

Nesheim, M. C. (1999). What is the research base for the use of dietary supplements? Public Health Nutrition, 2(1), 35-38.

Oliviera, S. A., Kohl, H. W., Trichopoulos, D., & Blair, S. N. (1996). The association between cardiorespiratory fitness and prostate cancer. Medicine and Science in Sports and Exercise, 28(1), 97-104.

Poortmans, J. R., & Francaux, M. (1999). Long-term oral creatine supplementation does not impair renal function in healthy athletes. Medicine and Science in Sports and Exercise, 31(3), 1108-1110.

Pritchard, N. R., & Kaira, P. A. (1998). Renal dysfunction accompanying oral creatine supplements. Lancet, 351, 1252-1253.Rotter, J. B. (1982). The context of social learning theory. In N. T. Feather (Ed.), Expectations and Actions: Expectancy Value Models in Psychology (pp. 241-260). New Hillsdale, NJ: Lawrence Erlbaum Associates.

Schedel, J. M., Tanaka, H., Kiyonaga, A., Shindo, M., & Schutz, Y. (1999). Acute creatine ingestion in human: Consequences on serum creatine and creatinine concentrations. Life Sciences, 65(23), 2463-2470.

Silber, M. L. (1999). Scientific facts behind creatine monohydrate as sport nutrition supplement. Journal of Sports Medicine and Physical Fitness, 39, 179-188.

Sobal, J. Marquart, L. F. (1994). Vitamin/mineral supplement use among high school athletes. Adolescence, 29(116), 835-843.

Sobell, L. C., Sobell, M. B. (1992). Timeline Follow-Back: A technique for assessing self-reported alcohol consumption. In R. Litten & J. Allen (Eds.), Measuring Alcohol Consumption. (pp. 41-72). City, State: The Human Press Inc.

Terjung, R. L., Clarkson, P., Eichner, E. R., Greenhaff, P. L., Hespel, P. J., Israel, R. G., Kraemer, W. J., Meyer, R. A., Spriet, L. L., Tarnopolsky, M. A., Wagenmakers, A. J., & Williams, M. H. (2000). American College of Sports Medicine roundtable. The physiological and health effects of oral creatine supplementation. Medicine and Science in Sports and Exercise, 32(3), 706-717.

Vandenberghe, K., Van Hecke, P., Van Leemputte, M., Vanstapel, F., & Hespel, P. (1999). Phosphocreatine resynthesis is not affected by creatine loading. Medicine and Science in Sports and Exercise, 31(1), 236-242.

Volek, J. S., Duncan, N. D., Mazzetti, S. A., Staron, R. S., Putukian, M., Gomez, A. L., Pearson, D. R., Fink, W. J., & Kraemer, W. J. (1999). Performance and muscle fiber adaptations to creatine supplementation and heavy resistance training. Medicine and Science in Sports and Exercise, 31(3), 1147-1156.

Williams, M. H., & Branch, J. D. (1998). Creatine supplementation and exercise performance: an update. Journal of the American College of Nutrition, 17, 216-234.

Williams, D. M., & Anderson, E. S. (2000, March). Reliability of a Timeline Follow-Back Questionnaire for Dietary Supplement Use. Poster presented at the Society of Behavioral Medicine, Nashville, TN.

Table 1

Test-Retest Reliability

Variable	n	r
Past creatine use[a]	92	.935*
Current creatine use[a]	90	.852*
Number of past performance enhancers used	92	.919*
Number of current performance enhancers used	90	.852*
Number of other supplements currently taken	92	.919*
Duration of weight-lifting per week (minutes)	84	.876*
SECR	92	.855*
SEWO	91	.414*
PVOE	92	.817*
NVOE	92	.793*
DCR	92	.846*

[a] Categories not mutually exclusive

* $p < .01$

Table 2

Principle Axis Factoring – Structure Matrix

Item	1	2	3
PVOE6	.736	.241	-.144
PVOE12	.711	.263	-.123
PVOE16	.694	.113	.256
PVOE10	.691	.155	
PVOE4	.656	.154	
PVOE8	.631		
PVOE13	.631	.137	.256
PVOE3	.611	.253	-.151
PVOE7	.601	.312	-.256
PVOE1	.593		
PVOE11	.592	.232	
PVOE9	.570	.302	-.227
PVOE14	.561		.223
PVOE5	.560	.334	-.219
PVOE2	.532	.221	
PVOE15	.529	.223	
PVOE17	.421	.182	.179
NVOE10		.681	.229
NVOE1	.184	.668	.223
NVOE3	.116	.665	.122
NVOE12	.126	.613	.271
NVOE2	.162	.593	.139
NVOE6	.122	.530	
NVOE4		.517	
NVOE8		.498	.137
NVOE15	.110	.495	
NVOE9	.152	.489	.220
NVOE13	.139	.478	
NVOE14	.267	.468	.186
NVOE11	.258	.464	
NVOE7	.162	.421	.142
NVOE5	.181	.419	
DCR8	.219	.326	
DCR3		.225	.715
DCR5		.110	.652
DCR6			.603
DCR2	.134	.171	.596
DCR1	.200	.245	.534
DCR7		.303	.493
DCR4		.121	.477

Table 3

Past Creatine Use & Current Creatine Use as Reported on Background Information Questionnaire

	No. Responses	
	No	Yes
Past Creatine Use	85	86
Current Creatine Use	155	16

Note. Categories not mutually exclusive

Table 4

Descriptive Statistics for all Social Cognitive Variables Across Creatine Use Category

	Total			Never Used			Past Use			Current Use		
Variable	n	M	SD	n	M	SD	n	M	SD	n	M	SD
SECR	171	65.8	27.4	85	50.3	18.7	70	73.7	22.9	16	85.2	17.6
SEWO	171	81.2	18.8	85	84.5	18.4	69	78.6	17.8	16	74.8	22.5
PVOE	171	5674	1641	85	5379	1608	70	5936	1657	16	6090	1559
Expectancy	171	72.3	12.4	85	71.0	12.1	70	73.3	12.9	16	74.6	11.3
Value	171	73.1	13.8	85	69.7	14.3	70	76.4	12.6	16	76.2	12.2
NVOE	171	2633	1380	85	2597	1281	70	2653	1426	16	2733	1736
Expectancy	171	45.2	15.6	85	45.9	15.1	70	45.0	15.7	16	42.8	18.2
Value	171	49.6	18.1	85	47.9	16.2	70	51.3	19.9	16	51.9	19.8
DCR	171	3170	1887	85	3943	1874	70	2614	1504	16	1501	1577
Expectancy	171	41.9	19.8	85	50.3	18.7	70	35.7	16.3	16	24.3	19.0
Value	171	64.0	20.3	85	67.9	20.1	70	62.3	18.5	16	51.1	23.7

Table 5

Hierarchical Logistic Regression for Creatine Use - Have Used vs. Never Used (N = 46)

	B	SE B	p	Odds Ratio	95% CI
Step 1					
SEWO	- .0179	.0089	.0439	.9822	.9652 - .9995
SECR	.0299	.0067	.0000	1.0304	1.0170 – 1.0440
Step 2					
SECR	.0207	.0074	.0054	1.0209	1.0061 – 1.0359
SEWO	- .0239	.0098	.0150	.9764	.9578 - .9954
PVOE	.0003	.0001	.0435	1.0003	1.0000 – 1.0005
NVOE	.0000	.0001	.8212	1.0000	.9997 – 1.0003
DCR	- .0005	.0001	.0000	.9995	.9993 - .9997

Note. R^2 = .208 for Step 1; R^2 = .372 for Step 2 (ps < .01)

Table 6

Linear Multiple Regression for PVOE, NVOE, and DCR on SECR and SEWO

		B	SE B	β	r	p
PVOE	SECR	20.366	4.267	.341	.320	.000
	SEWO	20.068	6.235	.230	.198	.002
NVOE	SECR	7.518	3.864	.149	.151	.053
	SEWO	-.960	5.646	-.013	-.027	.865
DCR	SECR	-16.625	5.181	-.242	-.245	.002
	SEWO	3.359	7.570	.033	.056	.658

Note. R^2 = .155 for PVOE; R^2 = .023 for NVOE; R^2 = .061 for DCR

Table 7

Duration of Creatine Use Among Past Creatine Users (N = 86)

	Duration of Creatine Use				
	< 1 week	1-2 weeks	2-4 weeks	1-2 months	> 2 months
No. Responses	2	9	12	35	28

Table 8

Cycles of Creatine Use Among Past Creatine Users (N = 84)

	Cycles of Creatine Use				
	1	2	3	4	> 4
No. Responses	26	24	16	4	14

Table 9

Number of Participants Reporting Source of First Knowledge About Creatine by Category of Creatine Use

Category of Creatine Use	Friends / Family	Magazine	Gym	Trainer	Other	Total
Never	41	13	8	0	11	73
Past, Not Current	47	3	5	7	5	67
Current	7	2	1	3	2	15
Total	95	18	14	10	18	155

Table 10

Number of Participants Reporting Source of Most Information About Creatine by Category of Creatine Use

Category of Creatine Use	Friends / Family	Magazine	Gym	Trainer	Other	Total
Never	38	17	4	3	12	74
Past, Not Current	16	18	8	13	12	67
Current	4	4	1	3	4	16
Total	58	39	13	19	28	157

Table 11

Types of Current and Past Performance Enhancers Taken

	No. Responses	
Performance Enhancer	Current[a]	Past[b]
Amino Acids[c]	5	16
DHEA	1	5
Andro-	3	10
HMB	1	2
Pyruvate	0	4
Ultimate Orange	3	10
Protein[c]	31	65
Hydroxycut	1	5
Ripped Fuel	0	5
Other	7	11

[a] 40 participants reported currently using at least one

[b] 83 participants reported using at least one in the past

[c] No participants reported using both Amino Acids and Protein, therefore there is no overlap

Table 12

Number of Participants Reporting Varsity Status by Category of Creatine Use

Category of Creatine Use	Varsity Status		
	Yes	No	Total
Never	7	77	84
Past, Not Current	9	61	70
Current	6	10	16
Total	22	148	170

Table 13

Number of Participants Reporting Ethnicity by Category of Creatine Use

Category of Creatine Use	Ethnicity					
	Af-Am	Asian	Cauc	Hisp	Other	Total
Never	8	14	55	1	6	84
Past, Not Current	4	2	56	4	4	70
Current	1	0	14	0	1	16
Total	13	16	125	5	11	170

APPENDIX A NEWLY CONSTRUCTED MEASURES

Background Information

Age ______ yrs. **Height:** ______feet ______ inches

Weight (in pounds) _______

Do you participate in Virginia Tech *Varsity, Intercollegiate* Athletics?

Yes ____ No ____

If yes, which sport(s)?

____

Ethnicity (circle one)

African-American Asian Caucasian Hispanic Other

Are you a vegetarian?

Yes ____ No ____

Creatine

Have you ever heard of creatine?

Yes ____ No ____

If yes, where did you first hear of creatine?

Friends/Family Magazine At the gym Trainer Other _________________

From where do you get most of your information about creatine?

Friends/Family Magazine At the gym Trainer Other _________________

Creatine Use

Have you ever used creatine?

Yes ____ No ____

If yes, for how long did you use creatine? (circle one)

Less than 1 week   1-2 weeks   2-4 weeks   1-2 months   more than 2 months

People sometimes cycle their use of creatine. For example, they may use it for three months, stop using it for one month, and then begin using it again.
During how many different time periods have you used creatine?
(at least two weeks between periods of use)

1   2   3   4   more than 4

Do you *currently* use creatine? Yes ____ No ____

Current Use of Other Performance Enhancing Dietary Supplements

Performance enhancing dietary supplements may be defined as those supplements that are taken for the purpose of increasing muscle mass, improving workout performance, getting stronger, etc. Creatine is an example of a performance enhancing dietary supplement.

Do you *currently* take any *other* performance-enhancing dietary supplements?

Yes ____ No ____

Which ones? (Circle all that apply)

Amino Acids	HMB	Protein	Others ____________________
DHEA	Pyruvate		____________________
Andro-	Ultimate Orange		____________________
			____________________

Past Use of Performance Enhancing Dietary Supplements

Have you used any performance-enhancing dietary supplements in the past?

Yes ____ No ____

Which ones?

Amino Acids	HMB	Protein	Others ____________________
DHEA	Pyruvate		____________________
Andro-	Ultimate Orange		____________________
			____________________

Other Dietary Supplement Use

Do you currently take any other dietary supplements (e.g. Vitamin C, Echinacea)**?**

Yes ____ No ____

Please list all other supplements you are currently taking.

Vitamins & Minerals	Herbal Supplements	Other
1)	1)	1)
2)	2)	2)
3)	3)	3)
4)	4)	4)
5)	5)	5)

Improved Workout Performance

People gauge their performance during a workout in many different ways. For example, some people count the number of repetitions they can do on a given exercise or exercises, while others may consider the amount of weight they are able to lift. In the space below, write down how you determine that you have improved your workout performance.

Samples:

My workout performance would be improved if:

Sample # 1 I could lift more weight on bench press.
Sample # 2 I could do more repetitions on most exercises.

My workout performance would be improved if:

____

____

____

Confidence in Workout Performance & Creatine

Now, use your definition of improved work out performance to respond to the following items. In each space rank your confidence from 0 - 100.

0 . . . . . 10 . . . . . 20 . . . . . 30 . . . . . 40 . . . . . 50 . . . . . 60 . . . . . 70 . . . . . 80 . . . . . 90 100

0	20	50	80	100
Not at all Confident	Somewhat Confident	Moderately Confident	Very Confident	Extremely Confident

---

How Confident

1. How confident am I that I can improve my workout performance *without* using creatine ………………………………………………………….. 1. ______

2. How confident am I that I can improve my workout performance *faster* by using creatine …………………………… ……………………………………. 2. ______

3. How confident am I that I can improve my workout performance *even more* by using creatine …………………………... ………………………………… 3. ______

Expected Outcomes of Improved Workouts

Below is a list of possible outcomes of improved workout performance.

Using your definition of improved performance, please rate each possible outcome twice.
• Under the heading "**How Likely**" please indicate *how likely it is* that you would experience each of the outcomes below.
• Under the heading "**How Important**" please indicate *how much it would matter to you* if each of the outcomes below occurred.

In each space indicate How Likely and How Important from 0 - 100.

0 . . . . . 10 . . . . . 20 . . . . . 30 . . . . . 40 . . . . . 50 . . . . . 60 . . . . . 70 . . . . . 80 . . . . . 90 100

Not at all Likely/ Important	Somewhat Likely/ Important	Moderately Likely/ Important	Very Likely/ Important	Extremely Likely/ Important

Possible Positive Outcomes

If I improve my performance during workouts:

	How Likely	How Important
1. I will increase my muscle strength……………………..	1. ______	1. ______
2. I will achieve desired weight gain/loss…………………	2. ______	2. ______
3. I will improve how I feel about myself…………………	3. ______	3. ______
4. I will increase my muscle density………………………	4. ______	4. ______
5. I will be admired because of my strength ……………..	5. ______	5. ______
6. I will improve my physical appearance ……………….	6. ______	6. ______
7. I will be admired for my physical appearance …………	7. ______	7. ______
8. I will increase my muscle mass..………………………	8. ______	8. ______
9. I will be more attractive……..………………………..	9. ______	9. ______
10. I will improve my muscle tone…………………………	10. ______	10. ______
11. I will feel better about my body……..………………..	11. ______	11. ______
12. I will feel better about how I look…..………………….	12. ______	12. ______

If I improve my performance during workouts:

	How Likely	**How Important**
13. I will reduce my muscle fatigue when I am working out………………………………….	13. ______	13. ______
14. I will have increased energy …………………………..	14. ______	14. ______
15. I will not plateau in my workouts……………………..	15. ______	15. ______
16. I will increase my muscular endurance ……………….	16. ______	16. ______
17. I will decrease my risk of physical injury……………...	17. ______	17. ______

Possible Negative Outcomes

If I improve my performance during workouts:

	How Likely	**How Important**
1. I will need to work out longer to maintain my performance level………………………	1. ______	1. ______
2. I will experience unwanted muscle soreness………..	2. ______	2. ______
3. I will have less chance of further improvement……	3. ______	3. ______
4. I will experience *undesired* weight gain/loss………	4. ______	4. ______
5. I will feel the need to change my diet……………….	5. ______	5. ______
6. I will be too tired to do other things…………………	6. ______	6. ______
7. I will have less time to do other things………………	7. ______	7. ______
8. I will increase my chances of injury while working out…………………………………..	8. ______	8. ______
9. I will need to work harder to maintain my performance level……………………………….	9. ______	9. ______
10. I will experience more muscle pain during my workouts………………………………….	10. ______	10. ______
11. I will have to be more focused during my workouts………………………………….	11. ______	11. ______

If I improve my performance during workouts:

	How Likely	How Important
12. I will be more tired after my workouts………………	12. ______	12. ______
13. My friends will think that I am overly obsessed with weight-lifting…………………………	13. ______	13. ______
14. I will discover my performance limitations…………	14. ______	14. ______
15. I will not be able to improve past a certain point……	15. ______	15. ______

Outcomes of Creatine Use

Below is a list of possible negative outcomes of using creatine.

Please rate each possible outcome twice.
• Under the heading "**How Likely**" please indicate *how likely it is* that you would experience each of the outcomes below.
• Under the heading "**How Important**" please indicate *how much it would matter to you* if each of the outcomes below occurred.

In each space indicate How Likely and How Important from 0 - 100.

0 . . . . . 10 . . . . . 20 . . . . . 30 . . . . . 40 . . . . . 50 . . . . . 60 . . . . . 70 . . . . . 80 . . . . . 90 100

0	20	50	80	100
Not at all Likely/ Important	Somewhat Likely/ Important	Moderately Likely/ Important	Very Likely/ Important	Extremely Likely/ Important

---

If I use creatine:

	How Likely	**How Important**
1. I will experience muscle cramps……………...………..	1. ______	1. ______
2. My body will often be dehydrated……..……………….	2. ______	2. ______
3. I will experience kidney problems later in life………..	3. ______	3. ______
4. I will not be able to buy other things because of the money I have spent on creatine………..	4. ______	4. ______
5. I will feel that my workout achievements are not my own…………………………………………	5. ______	5. ______
6. I will feel that I am doing something unnatural to my body…………………………………..	6. ______	6. ______
7. My friends will criticize me……………………………	7. ______	7. ______
8. I will feel happy about sharing the experience with others who use creatine……………………………	8. ______	8. ______

APPENDIX B INFORMED CONSENT FOR PARTICIPANTS

Informed Consent for Participants

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Title of Project: Lifestyles of Male Weightlifters
Investigators: David M. Williams, B. S. & Richard A. Winett, Ph.D.

I. Purpose of Project

This study aims to investigate the lifestyles of male weightlifters.

II. Procedures

You will be asked to attend two sessions over the course of one week. The sessions will be held in classrooms at Virginia Tech. During the sessions you will be asked to complete a series of questionnaires involving lifestyles of male weightlifters. It should take you approximately one hour or less to complete these questionnaires.

III. Risks

There will be no risk for any of the participants. Questions do not ask for any sensitive information, and you will not be asked to answer any questions that make you uncomfortable. All responses will be kept confidential.

IV. Benefits

You will receive one extra credit point for attending each of the two sessions. In addition, you will help researchers gain a better understanding of the lifestyles of male, weightlifters.

V. Extent of Anonymity and Confidentiality

Your responses to the questionnaires will be kept confidential. You will not be asked to put your name on any questionnaires. However, you will be asked to indicate the last four numbers of your student identification number on the questionnaires that you respond to. This procedure is necessary to match responses across testing sessions; however, these numbers will at no time be matched with names.

VI. Compensation

You will receive one extra credit point for each of the two sessions. There will be no additional compensation for participating in this project.

VII. Freedom to Withdraw

You are free to withdraw from the study at any time without any resulting penalty. You are also free to omit any items on the questionnaire without any resulting penalty.

VIII. Approval of Research
This research project has been approved, as required, by the Institutional Review Board for Research Involving Human Subjects at Virginia Polytechnic and State University and by the Department of Psychology.

IX. Participant's Responsibilities
I voluntarily agree to participate in this study. I agree to provide accurate information to the best of my ability.

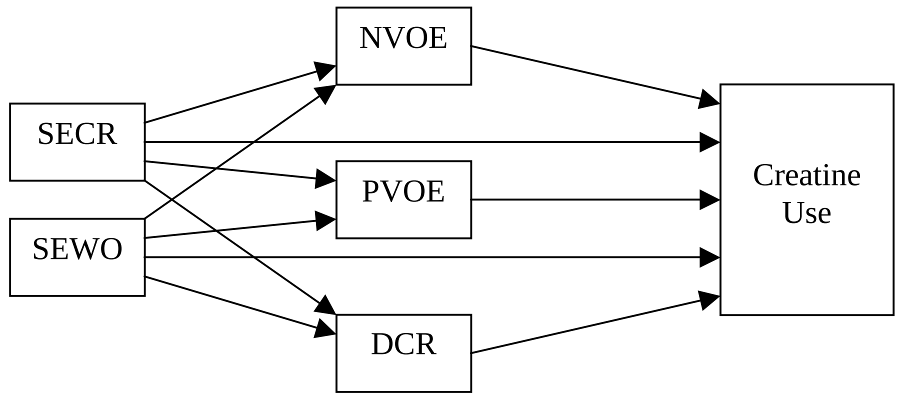
X. Participant's Permission
I have read and understand the informed consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project. If I participate, I may withdraw at any time without penalty. I agree to abide by the rules of this project.

______________________	______________________
Signature	Date
______________________	______________________
Print Name	Study ID number (Office use only)

Should you have any questions about this project or its conduct, please contact:

David Williams, B.S.	(540) 231-8746
Richard A. Winett, Ph.D.	(540) 231-8747
Dave Harrison, Ph.D., HSC	(540) 231-4422
Thomas Hurd, Chair, IRB	(540) 231-9359

FIGURE 1 A SOCIAL COGNITIVE MODEL OF CREATINE USE



CURRICULUM VITA

David Williams
1600 Foxhunt Lane, NW, Apt A
Blacksburg, VA 24060
(540) 951-1895
dawilli9@vt.edu

Education

8/98 – 12/00	Virginia Polytechnic Institute and State University Master of Science in Clinical Psychology QCA 3.56
9/94 – 5/98	The Richard Stockton College of New Jersey (RSC), Pomona, NJ Bachelor of Science in Psychology Minor in Political Science GPA 3.87 Psych GPA 3.91 Graduated Magna Cum Laude with Program Distinction

Research

4/00	Williams, D. M., Anderson, E. S., (2000). *Reliability of a Timeline Follow-Back Questionnaire for Dietary Supplement Use.* Poster presented at the Society of Behavioral Medicine.
11/99	Whitely, J. A., Winett, R. A., Winett, S. G., Bajzek, W., Rovniak, L. S., & Williams, D. (1999). *The Application of Social Cognitive Theory to the Dissemination of Eat-4-Life: An Internet-Based Health Behavior Program for Rural Adolescents.* Poster presented at Association of Advancement for Behavior Therapy.
7/99	Williams, D. (1999). Factors Affecting Romantic Behavior: An Experimental Study. From Kiesler, S. B., & Baral, R. L. (1970). *The Search for a Romantic Partner: The Effects of Self-Esteem and Physical Attractiveness on Romantic Behavior.* Personality and Social Behavior, pages 155-164. In Exploring Psychology: Reader Workbook. Chandler, H.K., Finney, J.W. (Eds.), pages 3-5.
7/99	Williams, D. (1999). Associations Between Variables: Is Aggression Caused by Heat? From Reifman, A. S., Larrick, R. P., & Fein, S. (1991). *Temper and Temperature on the Diamond: The Heat Agression Relationship in Major League Baseball.* Personality and Social Psychology Bulletin, 17(5), 580 585. In Exploring Psychology: Reader Workbook. Chandler, H. K. Finney, J. W. (Eds.), pages 3-5.

12/97	Williams, D. M. (1997). Certainty of Uncertainty (Senior Thesis). Presented for RSC Psychology Faculty. Program distinction earned.
8/97	Williams, D. M., Gupta, C. (1997). Math Attitudes. Presented at: Math Across the Curriculum Regional Conference, Richard Stockton College of NJ.

Relevant Employment

8/99 – present	Virginia Tech, Department of Institutional Research - Research Assistant
8/99 – 8/00	Virginia Tech, Department of Psychology - Research Assistant
8/99 - 5/00	Virginia Tech, Psychological Services Center - Intellectual/Psychological Assessment Team
5/99 - 8/99	Virginia Tech, Psychological Services Center - Therapist
8/98 - 5/99	Virginia Tech, Department of Psychology - Graduate Teaching Assistant - Research Assistant
5/98 - 8/98	Police Athletic League Day Camp, Bricktown, NJ - Camp Counselor
9/96 – 5/98	Skills Center, The Richard Stockton College of NJ - Statistics Tutor
9/96 – 5/98	The Richard Stockton College of NJ - Research Assistant - Student Research Assistant for the National Science Foundation-funded QUAD (Quantitative Reasoning Across the Disciplines) Program

Clinical Experience

10/00 – present	Therapist at Cook Counseling Center, Virginia Tech
5/00 – 8/00	Over 50 client-contact hours as therapist at Carilion New River Valley Medical Center, Department of Rehabilitation
8/98 - 5/00	Over 150 client-contact hours as therapist at Virginia Tech, Psychological Services Center
5/97 - 8/97	Volunteer for the Joan Valentine House, Point Pleasant Beach, NJ Men's Group Discussion Leader among mentally ill residents
5/97 - 8/97	Volunteer for the Community Companion Program sponsored by The Mental Health Assoc. in Ocean County, Lakewood, NJ
1/97 - 5/97	Student Intern at Ancora Psychiatric Hospital, Ancora, NJ

Activities

9/94 – 5/98	Varsity Soccer Athlete at Richard Stockton College of NJ - Three NCAA Tournament appearances

Honors

	Scholarships
1997	- RSC College Scholars II
1996	- RSC College Scholars Award
1995	- RSC College Scholars Award - South Shore Foundation Scholarship
1994	- Seaside Business Association Scholarship - Toms River North Soccer Boosters Scholar-Athlete Scholarship - Richard Stockton College (RSC) Early Decision Scholar
	Awards
1995 - 1998	Scholar Athlete Award (4)
1994 - 1998	Dean's List (8)
	Honorary Societies
1997, 1998	Who's Who in American Colleges and Universities
1997	Psi Chi - National Honor Society of the American Psychological Association