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Investigating the Predictive Validity of Implicit and Explicit Measures of Motivation on
Condom Use, Physical Activity, and Healthy Eating

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Abstract

1
2 The literature on health-related behaviors and motivation is replete with research involving
3 explicit processes and their relations with intentions and behavior. Recently, interest has
4 focused on the impact of implicit processes and measures on health-related behaviors. Dual-
5 systems models have been proposed to provide a framework for understanding the effects of
6 explicit or deliberative and implicit or impulsive processes on health behaviors. Informed by the
7 dual-systems approach and self-determination theory, the aim of the present study was to test
8 the effects of implicit and explicit motivation on three health-related behaviors in a sample of
9 undergraduate students (N=162). Implicit motives were hypothesized to predict behavior
10 independent of intentions while explicit motives would be mediated by intentions. Regression
11 analyses indicated implicit motivation predicted physical activity behavior only. Across all
12 behaviors, intention mediated the effects of explicit motivational variables from self-
13 determination theory. This study provides limited support for dual-systems models and the role
14 of implicit motivation in the prediction of health-related behavior. Future research could seek
15 to further test the role of implicit motivational constructs in predicting health behavior by
16 manipulating motives using priming methods.
17

1 Investigating the Predictive Validity of Implicit and Explicit Measures of Motivation on
2 Condom Use, Physical Activity, and Healthy Eating

3 Traditionally, research examining the motivational antecedents of individuals' health-
4 related behavior (e.g., physical activity, following a healthy diet, quitting smoking, reducing
5 alcohol consumption) has adopted an *explicit* approach. Such approaches assume that
6 behavioral engagement is a rational, deliberative process with the antecedents measured
7 explicitly through self-report measures. Based on trends in this explicit-oriented research,
8 components of intervention strategies have mainly focused on changing these explicitly-
9 conceptualized constructs to evoke behavior change and promote health-related outcomes
10 (Chatzisarantis & Hagger, 2009; Hardeman et al., 2002; Silva et al., 2008). Existing theoretical
11 approaches and interventions have been most effective in the prediction and manipulation of
12 behaviors that are explicitly goal-oriented or planned (e.g., physical activity, following a
13 healthy diet). However, behaviors that are more likely to have a spontaneous or impulsive
14 component (e.g., condom use, smoking) have proved more difficult to predict and more
15 resilient to intervention strategies. Consequently, theoretical models focusing solely on
16 explicit, rational processes have been criticized for not accounting for the more impulsive
17 processes that lead to action (e.g., Ingham, 1994).

18 Recent research has provided increasing support for the role of implicit, automatic
19 processes in motivation and subsequent initiation of behaviors e.g., (Banting, Dimmock, &
20 Lay, 2009; Czopp, Monteith, Zimmerman, & Lynam, 2004; Marsh, Johnson, & Scott-Sheldon,
21 2001; Sherman, Chassin, Presson, Seo, & Macy, 2009). The process by which implicit and
22 explicit processes affect health-related behaviors has typically been explained in terms of *dual-*
23 *systems models* (Hofmann, Friese, & Strack, 2009; Strack & Deutsch, 2004). The aim of the
24 current research was to provide an important advancement to this literature by developing and
25 testing hypotheses derived from a dual-systems model, based on Strack and Deutsch's (2004)
26 reflective-impulsive model, to investigate the independent effects of implicit and explicit

1 motivation on health-related behavior. Specifically, this investigation tested a motivational
2 model examining the relative contribution of the reflective and impulsive systems in explaining
3 variance in three prominent health-related behaviors: condom use, regular physical activity,
4 and adequate fruit and vegetable consumption. The implicit association test (IAT; Greenwald,
5 McGhee, & Schwartz, 1998) was adapted to measure individuals' motivation orientation
6 according to dimensions set-out in Deci and Ryan's (2008) self-determination theory.

7 **Self-Determination Theory (SDT)**

8 Self-determination theory, an organismic theory of human motivation, has been applied
9 extensively to health-related behaviors such as physical activity (Biddle, Soos, &
10 Chatzisarantis, 1999; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003), eating a healthy
11 diet (Hagger, Chatzisarantis, & Harris, 2006b; Pelletier, Dion, Slovinec-D'Angelo, & Reid,
12 2004), and smoking cessation (Joseph, Grimshaw, Amjad, & Stanton, 2005; Williams et al.,
13 2006). A key premise of SDT is that individuals' needs and social agents act synergistically to
14 account for the motivation that drives behavioral engagement. The quality of individuals'
15 motivation is also central to SDT, the focal distinction being between two main forms of
16 motivation, *autonomous* and *controlled*. Individuals engaging in behavior for autonomous or
17 self-determined motives do so for the inherent interest, enjoyment, and satisfaction of
18 performing the behavior and are likely to persist with that behavior without external incentive
19 or contingency. In contrast, individuals may perform behaviors for controlled or heteronomous
20 motives and do so due to pressures perceived to lie outside the individual or for the attainment
21 of external rewards (e.g., money, recognition). Self-determination theory, and interventions
22 based on the theory, are attractive to researchers and practitioners interested in promoting
23 health behavior because fostering autonomous motivation toward key health-related behaviors
24 (e.g., physical activity, following a healthy diet) is likely to lead to adherence to those
25 behaviors without the need for external reinforcement or contingencies (Chatzisarantis &
26 Hagger, 2009; Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003). This means that

1 individuals will be more effective in self-regulating their behavior without the need for
2 clinicians and health workers prompting, reminding, or cajoling them to persist.

3 These forms of motivation, from more autonomous to more controlled, are
4 conceptualized as lying on a continuum, the *perceived locus of causality* (PLOC; Ryan &
5 Connell, 1989). Externally-referenced behaviors may be adopted and endorsed so that they
6 become part of a person's repertoire of behaviors that satisfy psychological needs. The PLOC
7 outlines how this degree of internalization and integration of behavior with personally held
8 values also reflects changes in the types of underlying motivation. *Intrinsic motivation* is
9 situated at one extreme of the continuum and represents feelings of autonomy and stimulates
10 performance of a task due to its inherent merits. *Integrated regulation* lies immediately
11 adjacent to intrinsic motivation and is the most self-determined of the extrinsic motivation
12 subtypes, relating to behaviors fully integrated into an individual's sense of self, but still
13 conducted for external contingencies. *Identified regulation* is situated adjacent to integrated
14 regulation and relates to performing behavior for outcomes that are deemed personally
15 important. *Introjected regulation* is a less autonomous form of motivation than identified
16 regulation and is characterized as performing behaviors in order to avoid negative internal
17 states (e.g., shame, guilt). Finally, *external regulation*, is the most controlled form of
18 motivation, and lies at the opposite extreme pole of the continuum relative to intrinsic
19 motivation. External regulation is the prototypical form of extrinsic motivation, reflecting
20 behaviors performed solely for external reinforcement (e.g., money, rewards). Persistence
21 increases for behaviors that are performed for more autonomous reasons, and the continuum
22 charts how some behaviors can be 'taken in' or internalized such that perceptions about them
23 change from being externally-referenced and controlled to internally-referenced and
24 autonomous.

25 A further premise of self-determination theory is that individuals exhibit individual
26 differences in dispositional motivational orientations, which are also conceptualized as

1 autonomous or controlling. Differences in these relatively-enduring motivational orientations
2 are outlined in General Causality Orientations theory (Deci & Ryan, 1985). These differences
3 in orientations illustrate a generalized tendency to interpret situations as autonomous or
4 controlling across a range of behavioral contexts. Motivational orientations may moderate the
5 effect of external contingencies and environmental factors on individuals' motivation and
6 hence subsequent behavioral engagement. For example, individuals with an autonomous
7 orientation will be more likely to interpret behaviors as internally-referenced and emanating
8 from the self (i.e., self-determined), and thus persist longer (Hagger & Chatzisarantis, 2011). In
9 terms of health-related behaviors, autonomously-oriented individuals are likely to engage and
10 maintain healthy behaviors without the need for external reinforcement (Deci & Ryan, 1985).
11 However, causality orientations are likely to be a distal influence more proximal motivational
12 factors that influence health-related behavior in specific contexts, such as PLOC constructs, for
13 behaviors like dieting, physical activity, reducing alcohol intake, and smoking cessation. It is
14 also possible that generalized motivational constructs like causality orientations affect behavior
15 outside of conscious awareness (Bargh & Ferguson, 2000; Bargh, Gollwitzer, Lee-Chai,
16 Barndollar, & Trötschel, 2001). Implicitly-measured motivational orientations predicated on
17 associative learning, such as the implicit association test, should be well-positioned to provide
18 valid measurement of these underlying dispositional motivational orientations and permit the
19 testing of models that incorporate such motives alongside more traditional explicit measures
20 (Kehr, 2004).

21 Previous research has investigated the link between implicit processes and underlying
22 chronic dispositional motivational orientations like those represented in General Causality
23 Orientations theory (Levesque & Pelletier, 2003). Levesque and Pelletier demonstrated that
24 priming autonomous or controlled orientations led to performance similar to individuals who
25 were chronically oriented toward autonomous or controlled motivation. It was also shown that
26 individuals with chronic autonomous or controlled motivational orientations were not affected

1 by priming manipulations. This gives preliminary support for the theory that implicit
2 motivational constructs exert unique effects on behavior. Furthermore, as priming autonomous
3 or controlled motivation leads to similar behavioral outcomes as individuals with chronic
4 autonomous or controlled orientations, this provides support for the generalized, trait-like, and
5 relatively stable and enduring nature of the implicit motivational constructs. Therefore, the
6 implicit measure (IAT score) of self-determined motivation adopted in the current research is
7 expected to represent generalized, dispositional motivational orientations and would be
8 expected to provide generalized predictions of behavior in all three health-related contexts.

9 An alternative approach to measuring implicit motivation may be to develop measures
10 that focus on the context of the specific content domain. This form of implicit measure is
11 frequently adopted in the implicit attitude literature (Greenwald et al., 1998; Greenwald &
12 Nosek, 2001; Richetin, Perugini, Prestwich, & O’Gorman, 2007). However, with respect to
13 implicit motivation measurement, obtaining a context-specific measure presents additional
14 challenges due to the need for three categories to be simultaneously measured (‘self’,
15 ‘motivation’ and ‘behavior’). To the authors’ knowledge, no such measure is currently
16 available. An alternative possibility may be to prime the contexts by presenting a picture of a
17 particular behavior as a backdrop to the IAT trial screen. In the current research we adopted a
18 traditional two-category IAT to measure implicit motivational orientations from SDT. The
19 implicit measure should, therefore, reflect more global, trait-like motivation orientations and
20 the present study will investigate whether these orientations predict engagement across a range
21 of behaviors, rather than using several context-specific implicit measures. While the implicit
22 measures and explicit measures are different in terms of generality, the present investigation
23 allows us to study the generalizability of the globally-measured implicit motivational processes
24 across behavioral domains beyond the impact of context-specific explicit motivational factors¹.

25 **Combining Self-Determination Theory and Implicit Processes**

1 A growing number of studies have examined the role of implicit motives as an
2 influence on behavior and behavioral outcomes in the context of self-determination theory
3 (Banting et al., 2009; Burton, Lydon, D'Alessandro, & Koestner, 2006; Levesque & Brown,
4 2007; Levesque, Copeland, & Sutcliffe, 2008; Levesque & Pelletier, 2003). For example,
5 Burton and colleagues (2006) studied the effect of implicit intrinsic and identified forms of
6 motivation, tapped using a lexical decision task, on students' well-being and exam
7 performance. Results supported the significant contribution of implicit forms autonomous
8 motivation in the prediction of exam performance, providing preliminary support for the
9 predictive validity of implicit measures of autonomous motivation. However, a limitation of
10 this research was that more widely-used and validated implicit measures (e.g., IAT,
11 Greenwald, McGhee, & Schwartz, 1998; or single-category IAT, Karpinski & Steinman,
12 2006) were not employed, and it did not investigate the relative contributions of implicit and
13 explicit measures in the explanation of behavior and behavioral outcomes in the context of
14 dual-route models of behavior.

15 Further research into the relationship between implicit processes and motivation was
16 conducted by Levesque and Brown (2007). In their research, an IAT was developed to measure
17 implicit self-determined motivation. The relationship between implicit and explicit measures of
18 motivation was investigated, as well as the possibility of a moderator, *mindfulness* – the degree
19 to which an individual has a dispositionally elevated level of attention and awareness. Results
20 indicated that implicit autonomy orientation provided significant prediction of day-to-day
21 behavioral motivation for participants with lower levels of mindfulness. Levesque and Brown's
22 research provides further support for the important role of implicit motivation in the prediction
23 of behavior in the context of self-determination theory. However, Levesque and Brown did not
24 integrate their research with theoretical models of behavior that incorporate both implicit and
25 explicit constructs as influencing behavior, such as dual-route models (see Strack & Deutsch,

1 2004; Hoffman, Freise, & Wiers, 2009) which may have elucidated further the psychological
2 processes underpinning their findings.

3 Additional research on the relationship between implicit and explicit measures of
4 motivation has also been investigated (e.g., Brunstein & Schmitt, 2004; Thrash, Elliot, &
5 Schultheiss, 2007). For example, Brunstein and Schmitt investigated the relationship between
6 implicit measures of motivation and self-reported task enjoyment. Implicit achievement
7 motivation, measured by an IAT, predicted performance, but failed to predict self-reported task
8 enjoyment. This provides some indication that implicit and explicit measures may provide
9 prediction of independent aspects of behavior. Similarly, Thrash and colleagues suggested
10 several methodological (e.g., correspondence of content) and dispositional (e.g., access to
11 implicit motives, concern with social environment) factors that predicted the degree of
12 congruence between implicitly and explicitly measured achievement motivation. In their
13 research a picture task was used to assess implicit motivation and such imagery tasks have
14 been shown to promote congruence between implicit motives and explicit goals (Schultheiss &
15 Brunstein, 1999). It is important, therefore, to determine the relationship implicit and explicit
16 measures on motivation and behavior in health related contexts.

17 **Dual-Systems Models**

18 Several models of the direct and multiplicative effects of explicit and implicit processes
19 on behavior have been proposed (Back, Schulke, & Egloff, 2009; Fazio & Towles-Schwen,
20 1999; Strack & Deutsch, 2004; Wilson, Lindsey, & Schooler, 2000). Drawing on the existing
21 literature, Strack and Deutsch (2004) developed the reflective impulsive model (RIM), which
22 comprehensively and parsimoniously accounts for explicit and implicit processes that lead to
23 behavior, which are conceptualized as the reflective and impulsive system, respectively. In the
24 model, the reflective system encompasses those processes that are deliberative, based on the
25 consideration of available information and intended future states. The impulsive system, in
26 contrast, comprises processes that arise from reflective or perceptual input and schemata

1 underpinned by associative networks. To this extent, explicit measures are proposed to provide
2 an account of the reflective system, while implicit measures gauge the impulsive system. A
3 further relevant benefit of this model is the inclusion of motivational orientations into the
4 processes. Essentially, the impulsive system may be oriented toward either approach or
5 avoidance. Furthermore, the model outlines that compatibility between the dominant
6 motivation orientation and environmental or reflective input leads to facilitation of processing,
7 possibly leading to a reduction in cognitive depletion and more effective self-regulation
8 (Hagger, Wood, Stiff, & Chatzisarantis, 2009, 2010; Kehr, 2004).

9 Research in health behavior contexts has adopted this dual-systems model to establish
10 the relative contribution of impulsive and reflective processes on health-related behavioral
11 engagement and outcomes (Back et al., 2009; Hofmann & Friese, 2008; Marsh et al., 2001).
12 For example, Perugini (2005) examined the efficacy of different models to explain the pattern
13 of effects of implicit and explicit constructs on health related behavior. Perugini provided
14 support for multiplicative (interactions between the two systems) and double-dissociation
15 (implicit influences spontaneous behavior, whereas explicit influences deliberative behavior)
16 models. These findings are consistent with dual-systems models, such that the two systems
17 may provide unique effects on behavior. As implicit motives tend to reflect more generalized,
18 trait-like influences (Levesque & Pelletier, 2003), it follows that such factors are likely to
19 determine whether behavior is perceived as being more congruent with psychological needs,
20 thus more autonomous, or incongruent with needs, thus, more controlling.

21 **The Present Study**

22 The aim of the present study was to evaluate the role of implicit and explicit measures
23 of self-determined motivation in the prediction of health-behaviors using a dual-systems model
24 as a framework. A model, based on previous examples in the literature (Back et al., 2009), was
25 developed to provide an account of the expected relationships between implicit motivation,
26 explicit motivation, and health-related behavior. From this framework, a number of hypotheses

1 were derived. First (H_1), it was predicted that an implicitly-measured autonomous motivation
2 construct would have a direct, unique effect on behavior, independent of explicitly-measured
3 motivational constructs. This hypothesis was based on previous studies indicating direct effects
4 of implicit measures on health-related behaviors (Czopp et al., 2004; Marsh et al., 2001).
5 Second (H_2), it was predicted that intention would provide valid prediction of behavior. This
6 hypothesis is based on previous research adopting social cognitive models such as the theory of
7 planned behavior (Ajzen, 1991; Ajzen & Fishbein, 2009), which propose that intentions are the
8 most proximal determinant of behavior in the reflective system and will provide consistently
9 valid prediction of behavior (Ajzen & Fishbein, 2009). A further hypothesis (H_3) was that
10 intention would mediate the effect of explicitly-measured motivational constructs on behavior
11 based on the hypotheses of intentional theories and supported by empirical findings (Ajzen &
12 Fishbein, 2009; Back et al., 2009; Bagozzi, Baumgartner, & Yi, 1989).

13 Method

14 Participants

15 Undergraduate students ($N = 162$; 101 female, 61 male, $M_{\text{age}} = 22.12$, range: 18-44
16 years) participated in the current study. Only 150 participants' data were analyzed, due to
17 twelve failing to complete the follow-up. Further analyses indicated no significant differences
18 in age ($t(160) = 0.27, p = .83$) and gender ($\chi^2(1) = 3.44, p = .14$) for those who responded and
19 those who did not. Students eligible to participate in the study were contacted via email with
20 study details and provided with the opportunity to participate. An €5 inconvenience allowance
21 was administered in return for participation. The study protocol was approved by the School of
22 Psychology Ethics Internal Review Board at the University of [location omitted for peer
23 review].

24 Materials and Procedure

25 **Implicit autonomous and controlled motivation.** Implicit autonomous and controlled
26 motivational orientations were measured using the implicit association test (IAT). Words

1 representing intrinsic (choice, free, spontaneous, willing, authentic) and extrinsic (pressured,
2 restricted, forced, should, controlled) motivation were taken from research conducted by
3 Levesque and Brown (2007). These words were shown to offer a distinct representation of the
4 two orientations. Words pertaining to ‘self’ (I, me, my, mine, self) and ‘others’ (others, they,
5 them, their, theirs) were also adopted from Levesque and Brown’s lists. The label ‘others’ was
6 adopted because it was more easy to distinguish from the label ‘self’ than ‘non-self’ was from
7 ‘self’. Previous researchers have also used these category headings in the context of the IAT
8 (e.g., Brunstein & Schmitt, 2004). The category ‘others’ was fully explained to participants as
9 reflecting a ‘not-self’ category, rather than a more generalized social-comparison category. The
10 standard five-step IAT was used in which blocks 1, 2, and 4 were practice, each lasting 20
11 trials; test blocks (3 and 5) comprised 60 trials – 20 practice and 40 test (see Table 1). The IAT
12 measure was calculated using the improved *D*-score algorithm (Greenwald, Nosek, & Banaji,
13 2003). Coding was such that higher scores were indicative of an autonomous motivational
14 orientation.

15 **Perceived locus of causality.** Participants’ explicit contextual-level forms of motivation
16 based on the perceived locus of causality (PLOC) was measured through an adaption of Ryan
17 and Connell’s (1989) PLOC scale. It was deemed important to evaluate the implicit measure
18 alongside previously-adopted explicit measures in order to gain insight into the extent to which
19 the implicit measure explains unique variance beyond the explicit measures. This would then
20 have direct implications for advancing knowledge of the areas as it will provide some evidence
21 to evaluate the extent to which the findings from previous research using these explicit
22 measures would differ were implicit measures of autonomous motivation included (see
23 McClelland, 1985). A common stem for each behavior was given (e.g., “I exercise regularly
24 (3-4 times a week) because...”). A series of reasons, four per regulation type, relating to the
25 various forms of motivation was then listed (e.g., intrinsic motivation: “I enjoy ...”; identified
26 regulation: “I think it is important to...”; introjected regulation: “I feel under pressure to...”;

1 extrinsic regulation: “I will feel ashamed if I do not...”). These were measured on a four-point
2 Likert-type scale ranging from *not true at all* (1) to *very true* (4).

3 The PLOC scales were converted into weighted means representing controlled and
4 autonomous motivation. The index for controlled motivation was calculated as the extrinsic
5 regulation items, weighted by a factor of 2, added to introjected regulation items. This
6 calculation was then repeated for the index of autonomous motivation; items measuring
7 intrinsic motivation were weighted by 2, and added to an identified regulation items. This
8 produced separate scales for each motivational form and reduced the number of overall
9 variables making interpretation of analysis clearer. For example, autonomous motivation item
10 1 = (identified item 1 x 1) + (intrinsic item 1 x 2); autonomous motivation item 2 = (identified
11 item 2 x 1) + (intrinsic item 2 x 2) and so on. The same analysis was conducted for controlled
12 motivation items (Cronbach’s α for both scales = .71).

13 **Intention.** Intentions to perform the behaviors were measured using two items (e.g., “I
14 intend to...” and “I plan to...”; inter-item correlations for all behaviors were > .90). Responses
15 were given on seven-point Likert-type scales from *unlikely* (1), to *very likely* (7).

16 **Self-reported behavior.** Participants gave self-reports of their performance for each of
17 the behaviors (e.g., “In the past 4 weeks, how often have you eaten at least five portions of fruit
18 and vegetables?”) using seven-point Likert-type scales from *never* (1) to *almost everyday* (7).
19 The criterion and concurrent validity of this measure has been verified against objective
20 measures (Chatzisarantis, Hagger, Smith, & Phoenix, 2004; Hagger, Chatzisarantis, & Harris,
21 2006a; Norman et al., 2010).

22 **Procedure**

23 The study adopted a prospective design with psychological measures administered at an
24 initial time point and follow-up self-reported measures of behavior taken at a second point in
25 time, four weeks later. All participants were tested in isolation in a sound-proofed experimental
26 cubicle. After information on the experimental requirements was given, and informed consent

1 gained, they were left to complete the study. A researcher was close-by at all times in case
2 further assistance was required. Participants completed the IAT administered using E-Prime
3 experimental software. Further instructions and guidance was offered through the E-Prime
4 introduction screens, as well as the standard practice trials within the program. The IAT
5 procedure lasted approximately five minutes. After completion of the implicit measure,
6 participants were asked to move on to the questionnaire, also administered using the E-Prime
7 software, which lasted approximately 20 minutes. Trials were fully counterbalanced such that
8 half the participants conducted the implicit measure first, while the remainder completed the
9 explicit measures first. Participants were contacted via email or telephone, depending on
10 personal preference, and their performance of the behaviors was subsequently assessed, four
11 weeks later. After completion of the follow-up questionnaire, the aim of the study was
12 explained and any further questions answered to the satisfaction of all participants.

13 **Results**

14 **Preliminary analyses**

15 The improved scoring algorithm (Greenwald et al., 2003) was used to calculate the
16 implicit motivation score from the IAT data. No participants were eliminated due to having
17 more than 10% of scores sub-300 ms; no values exceeded 10,000ms. *D*-scores were calculated
18 such that higher scores were indicative of a higher level of implicit autonomous motivation
19 orientation. Zero-order correlations (see Table 1) were computed between the implicit measure
20 of self-determined motivation (IAT-*D* score), explicit measures of self-determined and
21 controlled motivation, and outcome behaviors. For all behaviors, intention and explicit
22 measures of motivation were significantly correlated. The implicit measure (IAT-*D* score) of
23 autonomous motivation correlated significantly with explicit controlled motivation for the
24 condom use and physical activity behaviors.

25 **Predicting Behavior**

1 Hierarchical regression analyses were conducted to assess the unique contribution of
2 the implicit and explicit motivational measures (step 1) and intention (step 2). Standardized
3 regression coefficients and R^2 values from the regression analyses are shown in Table 2². Sobel
4 (1982) tests were used to provide a formal test of the indirect effect of explicit measures of
5 autonomous and controlled motivation on behavior through intention³.

6 **Condom use.** The effect of the hypothesized predictor variables on condom use in the first step
7 was significant ($R^2 = .26, p < .001, F(3, 73) = 8.37, p < .001$). The effect of the implicit
8 measure (IAT score) on condom use behavior did not reach the 0.05 alpha criterion for
9 significance and on this basis our hypothesis (H_1) had to be rejected⁴. The explicit autonomous
10 motivation scale was not a significant predictor of behavior, but explicit controlled motivation
11 provided a significant prediction ($\beta = .41, p < .001$). There was a significant change in R^2 in the
12 second step ($\Delta R^2 = .23, p < .001, F(4, 73) = 16.56, p < .001$). Intention was the sole significant
13 predictor of behavior ($\beta = .61, p < .001$), while explicit controlled motivation was no longer a
14 predictor. This indicated that condom use was determined by explicitly-measured intention as
15 predicted (H_2). Sobel (1982) tests indicated that intention mediated the relationship between
16 explicitly-measured autonomous motivation and behavior (standardized regression
17 coefficients: autonomous motivation \rightarrow intention, $\beta = .24, p = .003$; intention \rightarrow behavior, $\beta =$
18 $.61, p < .001$, autonomous motivation \rightarrow behavior, $\beta = -.03, p = .76$; autonomous
19 motivation \rightarrow intention \rightarrow behavior = $.15, p = .052$). Intention also significantly mediated the
20 effect of explicitly-measured controlled motivation on behavior (standardized regression
21 coefficients: controlled motivation \rightarrow intention, $\beta = .36, p < .001$; intention \rightarrow behavior, $\beta = .61,$
22 $p < .001$; controlled motivation \rightarrow behavior, $\beta = .13, p = .23$; controlled
23 motivation \rightarrow intention \rightarrow behavior = $.22, p < .001$). Hypothesis (H_3) was therefore supported for
24 condom use as intention mediated the relationship between both autonomous and controlled
25 motivation and behavior.

1 **Physical activity.** There was a significant effect of the hypothesized predictors and physical
2 activity behavior in the first step ($R^2 = .22, p < .001$), $F(3, 149) = 13.51, p < .001$. The
3 regression coefficient for implicit autonomous motivation was significant ($\beta = .19, p = .01$),
4 supporting hypothesis (H_1). The explicit controlled measure did not significantly predict
5 physical activity behavior. Explicit autonomous motivation, however, did a significantly
6 predict behavior ($\beta = .37, p < .001$). There was a significant change in R^2 in the second step
7 ($\Delta R^2 = .01, p < .001$), $F(4, 149) = 16.65, p < .001$. Intention provided a significant prediction
8 of behavior ($\beta = .49, p < .001$), as hypothesized (H_2). Sobel (1982) tests indicated intention
9 significantly mediated the relationship between explicitly-measured autonomous motivation
10 and behavior (standardized regression coefficients: autonomous motivation \rightarrow intention, $\beta = .68,$
11 $p < .001$; intention \rightarrow behavior, $\beta = .49, p < .001$, autonomous motivation \rightarrow behavior, $\beta = .03, p$
12 $= .76$; autonomous motivation \rightarrow intention \rightarrow behavior = $.33, p < .001$). Intention also
13 significantly mediated explicitly-measured controlled motivation (standardized regression
14 coefficients: controlled motivation \rightarrow intention, $\beta = .17, p < .001$; intention \rightarrow behavior, $\beta = .49,$
15 $p < .001$; controlled motivation \rightarrow behavior, $\beta = .04, p = .58$; controlled
16 motivation \rightarrow intention \rightarrow behavior = $.08, p < .001$). This provides support for hypothesis (H_3),
17 as intention mediated the explicit measure-behavior relationship

18 **Fruit and vegetable consumption.** The effect of the hypothesized predictor variables on fruit
19 and vegetable consumption resulted in a significant regression equation in the first step ($R^2 =$
20 $.22, p < .001$), $F(3, 149) = 14.94, p < .001$. The implicit measure of motivation did not provide
21 significant prediction of behavior, thus failing to support hypothesis (H_1). Explicit autonomous
22 motivation significantly predicted behavior ($\beta = .49, p < .001$). There was a significant change
23 in R^2 in the second step ($\Delta R^2 = .08, p < .001$), $F(4, 149) = 16.27, p < .001$. Intention
24 significantly predicted behavior ($\beta = .39, p < .001$), as hypothesized (H_2); explicit autonomous
25 motivation also remained a significant predictor of behavior ($\beta = .22, p = .03$). Sobel (1982)
26 tests indicated that intention partially mediated the relationship between explicitly-measured

1 autonomous motivation and behavior (standardized regression coefficients: autonomous
2 motivation → intention, $\beta = .69, p < .001$; intention → behavior, $\beta = .40, p < .001$, autonomous
3 motivation → behavior, $\beta = .22, p = .03$; autonomous motivation → intention → behavior = $.28, p$
4 $< .001$). Intention, however, did not significantly mediate explicitly-measured controlled
5 motivation (standardized regression coefficients: controlled motivation on intention, $\beta = .07, p$
6 $= .24$; intention on behavior, $\beta = .40, p < .001$; controlled motivation on behavior, $\beta = -.04, p$
7 $= .63$; controlled motivation → intention → behavior = $.03, p > .05$). This provides only partial
8 support for our hypothesis (H_3).

9 **Discussion**

10 The aim of the present research was to examine the independent effects of implicit and
11 explicit measures of autonomous and controlled motivation on health-behaviors using a dual-
12 systems model (Strack & Deutsch, 2004) as a framework. A series of hypotheses, based on
13 dual-systems models and self-determination theory, were proposed and systematically tested in
14 a prospective study of three health-related behaviors: condom use, physical activity, and fruit
15 and vegetable consumption. Our first hypothesis (H_1) was that implicit measures of
16 autonomous motivation (measured by the IAT) would provide unique and independent
17 prediction of behavior. A significant effect was found for the effect of implicitly-measures
18 autonomous motivation for physical activity behavior and there was a trend toward an effect
19 for condom use, but the study was not sufficiently powered. No effect was found for implicit
20 autonomous motivation on fruit and vegetable consumption. Present findings did not provide
21 unequivocal support for the impulsive route to behavior, derived from dual-systems models, as
22 the effect was significant in only one of the behaviors investigated. Intention consistently
23 predicted all behaviors, supporting our second hypothesis (H_2). This corroborates previous
24 research that intention is the most proximal predictor of planned behavior, predictions (Ajzen,
25 1991; Ajzen & Fishbein, 2009; Back et al., 2009). Sobel tests also indicated that intention
26 significantly mediated the relationship between explicitly-measured motivational constructs

1 and behavior for all but one of the hypothesized paths, supporting hypothesis (H₃) and previous
2 research (Ajzen & Fishbein, 2009; Hagger et al., 2006a).

3 The present research provides only limited support for the RIM (Strack & Deutsch,
4 2004). The prediction of behavior by implicit autonomous motivation was confined to physical
5 activity in the present study and suggests that enactment of this behavior may, in part, be
6 influenced by non-conscious, automatic processes. However, the implicit association test for
7 autonomous motivation developed and used in the present study did not predict condom use
8 and fruit and vegetable consumption. A possible reason for this is that neither of these
9 behaviors are strongly influenced by generalized, dispositional, and distal motivational
10 orientations that affect behavior beyond an individuals' awareness, as measured by the implicit
11 motivational orientation. Instead, these behaviors are likely to be predominately determined by
12 contextual, proximal influences that are planned and consciously determined. This is also
13 generally the case with physical activity, which was also predicted by explicit autonomous
14 motivation alongside the implicit route. This suggests that this particular behavior may have
15 both implicit and explicit routes to behavioral enactment.

16 On the surface, the lack of consistent behavioral prediction for the implicit motives
17 seems to suggest that the predictive validity of the implicit measure of autonomous motivation
18 was relatively limited compared to the explicit measures of autonomous and controlled
19 motivation. However, this does not mean impulsive routes and the RIM model can be
20 unequivocally rejected on the basis of the present data. There are several possible explanations
21 for this bias toward greater predictive validity of explicit measures of motivation. First, using
22 self-reported measures of behavior may have introduced systematic bias. Self-reports are
23 inherently reflective as they require deliberation over future courses of action and are therefore
24 more likely to correspond better with explicit measures. Related to this, the types of behavior
25 being investigated may bias measurement validity, as outlined. Behaviors like eating sufficient
26 fruit and vegetables require a substantial degree of planning beforehand (e.g., selecting the

1 correct foods when shopping, packing the correct lunch etc.). Given the inherently deliberative
2 nature of some behaviors, this may create a bias in favor of explicitly-measured motivation.
3 Furthermore, some behaviors may encompass antagonistic explicit and implicit motives. For
4 instance, condom use may be endorsed and valued explicitly, but these values may be negated
5 in more spontaneous contexts such as when a person engages in unplanned sexual intercourse
6 or engages in sexual intercourse when inebriated (Marsh et al., 2001). However, the self-report
7 follow-up measures used in the current study tended to correspond with explicit deliberation
8 over previous behavior engagement, rather than spontaneous decisions made ‘on the fly’. In
9 addition, the measures of intention and behavior, both being self-report with the same items
10 and anchors, had the potential to introduce common method variance to the data. This
11 limitation could have been allayed by introducing a time gap between measurements of
12 intention and behavior. This is a common strategy to minimize common method variance
13 (Hagger et al., 2003). Another approach would have been to include ‘filler’ tasks between the
14 items. Future research should seek to investigate this issue. Finally, the implicit measure of
15 autonomous motivation reflected a more generalized, global motivational construct, whereas
16 the perceived locus of causality (Ryan & Connell, 1989) was a direct measure of participant’s
17 motivation toward particular behaviors, thus creating a closer correspondence.

18 Intention is proposed as the final mechanism in the reflective system (Strack &
19 Deutsch, 2004) and, consistent with this hypothesis, the inclusion of intention in the regression
20 analyses in the current study resulted in the most pervasive prediction of behavior, especially
21 behaviors likely to require planning in terms of when to conduct the behavior and what actions
22 are needed to conduct the behavior. For example, the indirect, intention-mediated path for
23 physical activity indicated that the effect of explicit autonomous motives to pursue physical
24 activity was a deliberative process. Physical activity, like going to the gym, or playing a game
25 of football entails planning equipment to use and making arrangements and there is, therefore,
26 a stage of deliberative planning before performance of the activity as implied by the mediated

1 path from autonomous motivation via intentions. Similarly, for fruit and vegetable
2 consumption, the explicit autonomous motivation measure and behavior relationship was
3 significant, indicating partial mediation by intention. As with physical activity, the indirect
4 path suggests that those motivated to eat fruit and vegetables for autonomous motives need to
5 engage in deliberative, intentional thought prior to engaging in behavior. An explanation of the
6 direct relationship may be that intentions did not adequately capture the effects of the explicit
7 motivational orientation on behavior; or, this reflected more spontaneous, less deliberative
8 influences of motives on behavior (Hagger et al., 2006a). These results suggest that it is
9 important to identify the characteristics of the behavior being investigated in terms of the
10 inherent level of deliberation or spontaneity required for its enactment. Variation in terms of
11 some behaviors being more spontaneous (e.g., having another drink at a bar when offered)
12 compared to others that are more deliberative (e.g., attending a gym for a workout), should be
13 taken into account in studies comparing the relative strength of the effects of implicit and
14 explicit measures of motivation on behavior.

15 **Limitations and Future Directions**

16 There is a general lack of consistency in the literature in the types of measurement
17 instrument used to assess implicit processes (Jung & Lee, 2009). This limitation may also
18 apply to the current research. Essentially, the IAT developed for the current study may not
19 have adequately captured implicit motives from SDT. Though the current implicit measure of
20 motivation was based on previous examples in the literature (Levesque & Brown, 2007),
21 definitive comparisons are difficult to make due to inconsistencies and limitations of the
22 measures of implicit constructs used in previous research (e.g., stimuli used, analyses
23 conducted). Future research should seek to corroborate the current approach using
24 differentiated implicit and explicit motivational constructs and different behavioral contexts to
25 support the unique prediction of the two types of motivation and generalizability of these
26 findings across behavioral contexts (Hagger, Biddle, Chow, Stambulova, & Kavussanu, 2003).

1 In addition, research may seek to include multiple measures of implicit constructs to offer more
2 direct comparisons between implicit measures. One such development could be to include
3 measures that include some reference to the specific content domain (e.g., presenting a
4 background picture during each of the IATs to prime context). A further development could be
5 to use single-category implicit measures, for example: the go/no-go association task; (Nosek &
6 Banaji, 2001); or single-category IAT, (Karpinski & Steinman, 2006). These measures would
7 allow parallel autonomous and controlled motivation scores to look for congruence patterns.

8 In addition, future research should investigate the effects of these differentiated implicit
9 and explicit motivational constructs on different behaviors and contexts classified as
10 predominantly implicit or explicit in nature. This would greatly aid understanding of the
11 relative contribution of implicit and explicit motivational orientations and serve to provide
12 further evidence for their predictive validity. Finally, use of other implicit techniques to
13 manipulate implicit constructs, such as priming autonomous and controlled motivation, and
14 examining their effects on behavior, as in Levesque and Pelletier's (2003) studies, could also
15 assist in furthering understanding of the role of implicit processes. As priming should affect the
16 same associative perceptions measured by the IAT, testing whether priming affects implicit
17 measures would provide possible further validation of the implicit measure.

18 In terms of practical recommendations emerging from the current research, the results
19 may be used to inform health interventions. Traditionally, health interventions have adopted an
20 explicit approach, encouraging individuals to reflect on their current behavior and develop
21 plans and aims to attain successful changes (Bryan, Aiken, & West, 1996; Markland, Ryan,
22 Tobin, & Rollnick, 2005; Silva et al., 2008). While this has been largely successful, training
23 (e.g., how to cope in spontaneous decision making situations) and reinforcement aimed at
24 managing implicit effects may improve the overall efficacy of health interventions for some
25 behaviors. In addition, the current research may indicate that some individuals are more
26 vulnerable to autonomous explicit forms of motivation, which would indicate that they would

1 be better able to respond to interventions designed to target explicit forms of motivation.
2 However, it must be stressed that given the highly consistent effects of explicit, deliberative
3 forms of autonomous motivation on behavior across the health-related contexts in the present
4 study, it seems that interventions targeting explicit forms of autonomous motivation are likely
5 to have the most pervasive generalized effect on promoting behavioral engagement in multiple
6 contexts.

7 **Conclusion**

8 In conclusion, the current study provided only limited support for the predictive validity
9 of implicit measures of autonomous motivation and the dual-systems models in on the
10 prediction of health-related behavior in three contexts. Current data demonstrate that health-
11 related behaviors are more effectively predicted on the basis of explicit motivational constructs
12 from self-determination theory relative to implicitly-measured motivational constructs.
13 However, findings also indicate that implicit motivational orientations explain variance in
14 behavior in at least one of the contexts (physical activity) and demonstrated a significant trend
15 in another (condom use). There is a need to further explore this relatively new area in the
16 context of self-determination theory and dual process models of behavior. Future research
17 should examine the relative contribution of implicit and explicit motivational orientations from
18 self-determination theory to the prediction of behavior in sets of behaviors considered to vary
19 in the extent to which they are inherently planned or spontaneous in their enactment
20 (McClelland, 1985). While health-related behavior has traditionally been researched within an
21 explicit framework, the current research follows a growing trend in the literature, supporting
22 the role of implicit processes. Future research should seek to extend this important area through
23 the manipulation of implicit motivational orientations using priming techniques.

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Footnotes

¹In additional analyses, explicit generalized measures (Generalized Causality Orientations Scale; Deci & Ryan, 1985) were entered into the regressions. These were not correlated with any of the behaviors, and did not offer significant predictions for any behavior. This demonstrates that generalized explicit motivational orientations do not have any efficacy in predicting behavior, which means it is only context-specific explicit motivation that has any effect. The current data suggests the same may not apply to implicit measures, such as the IAT, which provided only a generalized measure of autonomous motivation.

²We thank an anonymous reviewer for highlighting the possible problem of scale correspondence, in terms of aggregated and disaggregated implicit and explicit measures. Essentially, the IAT provided a relative measure of implicit autonomous motivation, whereas separate explicit measures of autonomous and controlled motivation were tested. The pattern of effects was therefore tested using an alternative scaled version of the explicit measures to produce relative autonomy indices (RAI), which overcomes this difference in scale measurements. The pattern of effects for each behavior was similar as for the separate motivation construct. Additional analyses are available from the first author.

³In all Sobel analyses testing for significant indirect effects, the following criteria proposed by Baron and Kenny (1986) were met: (1) significant correlations between the dependent variable and the independent (predictor) variable(s); (2) significant correlations between the mediator and the independent variable(s); (3) a significant unique effect of the mediator on the dependent variable when it is included alongside the independent variable(s) in a multivariate test of these relationships; and (4) the significant effect of independent variable on the dependent is attenuated or extinguished when the mediator is included as an independent predictor of the dependent variable.

⁴It should be noted that the size of the effect ($\beta = .18$) and associated probability value ($p = .09$) indicated that the effect did, in fact, exist but the present study was underpowered.

1 Table 1

2

3 *Zero-Order Correlations Among Study Variables*

Variable	1	2	3	4
1. Autonomous Motivation (Explicit)	–			
2. Controlled Motivation (Explicit)	.52**			
	.30**	–		
	.39**			
3.IAT (Implicit)	-.04	.17*		
	-.02	-.02	–	
	.09	.03		
4. Intention	.43**	.50**	.13	
	.73**	.37**	.05	–
	.73**	.34**	.11	
5. Behavior	.24*	.47**	-.13	.69**
	.41**	.24**	.18*	.53**
	.48**	.19*	.05	.54**

4 *Note.* In each cell, row 1 = condom use (N= 73), row 2 = physical activity (N = 150), row 3 =5 fruit and vegetable consumption (N = 150); IAT = Implicit Association Test *D*-score

6 representing generalized implicit measure of autonomous motivation; Intention = mean of

7 intention and planning to conduct behavior over a 4-week period; Behavior – self-reported

8 behavioral enactment over a four-week period.

9 ** $p < .05$. * $p < .01$

1 Table 2

2

3 *Hierarchical Multiple Regression Analyses predicting Condom use, Physical Activity, and Fruit and Vegetable Consumption*

Predictor	Condom			Physical Activity			FruitVeg		
	R ²	β	<i>t</i> , <i>p</i> values	R ²	β	<i>t</i> , <i>p</i> values	R ²	β	<i>t</i> , <i>p</i> values
Step 1	.26			.22			.23		
IAT		.18	<i>t</i> = 1.75, <i>p</i> = .09		.19*	<i>t</i> = 2.53, <i>p</i> = .01		-.01	<i>t</i> = -.17, <i>p</i> = .86
Aut		.10	<i>t</i> = 0.87, <i>p</i> = .39		.37**	<i>t</i> = 4.82, <i>p</i> < .01		.49**	<i>t</i> = 6.13, <i>p</i> < .001
Con		.41**	<i>t</i> = 3.44, <i>p</i> < .001		.13	<i>t</i> = 1.69, <i>p</i> = .09		-.01	<i>t</i> = -.10, <i>p</i> = .92
Step 2	.49			.31			.31		
IAT		.09	<i>t</i> = 1.04, <i>p</i> = .30		.17*	<i>t</i> = 2.47, <i>p</i> = .02		-.04	<i>t</i> = -.52, <i>p</i> = .60
Aut		-.03	<i>t</i> = -0.31, <i>p</i> = .76		.03	<i>t</i> = 0.30, <i>p</i> = .76		.22*	<i>t</i> = 2.19, <i>p</i> = .03
Con		.13	<i>t</i> = 1.20, <i>p</i> = .23		.04	<i>t</i> = 0.56, <i>p</i> = .58		-.04	<i>t</i> = -.49, <i>p</i> = .63
Intention		.61**	<i>t</i> = 5.53, <i>p</i> < .001		.49**	<i>t</i> = 4.54, <i>p</i> < .001		.39**	<i>t</i> = 3.97, <i>p</i> < .001
<i>n</i>	73			150			150		

4 *Note.* IAT = Implicit Association Test *D*-score representing generalized implicit measure of autonomous motivation. Aut = explicit measure of
5 autonomous motivation; Con = explicit measure of controlled motivation; Intention = behavioral intention to conduct behavior over a 4-week
6 period; Condom – Condom use over a four-week period; Physical Activity = regular exercise over a four-week period; FruitVeg – Eaten at least 5
7 portion of fruit and vegetables, per day, over a four-week period. It should also be noted that the IAT score was a generalized score of individuals’
8 implicit motivation, rather than a domain-specific score. Furthermore, non-corresponding content-domain correlations are excluded from the table.
9 ** *p* < .05. *** *p* < .01.