# Investigating the predictive validity of implicit and explicit measures of motivation on condom use, physical activity and healthy eating

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The literature on health-related behaviours and motivation is replete with research involving explicit processes and their relations with intentions and behaviour. Recently, interest has been focused on the impact of implicit processes and measures on health-related behaviours. Dual-systems models have been proposed to provide a framework for understanding the effects of explicit or deliberative and implicit or impulsive processes on health behaviours. Informed by a dual-systems approach and self-determination theory, the aim of this study was to test the effects of implicit and explicit motivation on three health-related behaviours in a sample of undergraduate students ($N = 162$). Implicit motives were hypothesised to predict behaviour independent of intentions while explicit motives would be mediated by intentions. Regression analyses indicated that implicit motivation predicted physical activity behaviour only. Across all behaviours, intention mediated the effects of explicit motivational variables from self-determination theory. This study provides limited support for dual-systems models and the role of implicit motivation in the prediction of health-related behaviour. Suggestions for future research into the role of implicit processes in motivation are outlined.

**Keywords:** self-determination theory; implicit; dual-systems models; health behaviours

## Introduction

Traditionally, research examining the motivational antecedents of individuals' health-related behaviour (e.g. physical activity, following a healthy diet, quitting smoking, reducing alcohol consumption) has adopted an *explicit* approach. Such approaches assume that behavioural engagement is a rational, deliberative process with the antecedents measured explicitly through self-report measures. Based on trends in this explicit-oriented research, components of intervention strategies have mainly focused on changing these explicitly conceptualised constructs to evoke behaviour change and promote health-related outcomes (Chatzisarantis & Hagger, 2009; Hardeman et al., 2002; Silva et al., 2008). Existing theoretical approaches and

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interventions have been effective in the prediction and manipulation of behaviours that are explicitly goal-oriented or planned (e.g. physical activity, following a healthy diet). However, behaviours that are more likely to have a spontaneous or impulsive component (e.g. condom use, smoking) have proved more difficult to predict and more resilient to intervention strategies. Consequently, theoretical models focusing solely on explicit, rational processes have been criticised for not accounting for the more impulsive processes that lead to action (e.g. Hagger, 2010; Hagger & Chatzisarantis, 2007; Hagger, Wood, Stiff, & Chatzisarantis, 2009; Hall & Fong, 2010; Ingham, 1994).

Recent research has provided increasing support for the role of implicit, automatic processes in motivation and subsequent initiation of behaviours (e.g. Banting, Dimmock, & Lay, 2009; Czopp, Monteith, Zimmerman, & Lynam, 2004; Marsh, Johnson, & Scott-Sheldon, 2001; Sherman, Chassin, Presson, Seo, & Macy, 2009). The process by which implicit and explicit processes affect health-related behaviours has typically been explained in terms of *dual-systems models* (Hofmann, Friese, & Strack, 2009; Hofmann, Friese, & Wiers, 2008; Strack & Deutsch, 2004). The aim of this research was to provide an important advancement to this literature by developing and testing hypotheses derived from a dual-systems model, based on Strack and Deutsch's (2004) reflective-impulsive model (RIM), to investigate the independent effects of implicit and explicit motivation on health-related behaviour. Specifically, this investigation tested a motivational model examining the relative contribution of the reflective and impulsive systems in explaining variance in three prominent health-related behaviours: condom use, regular physical activity and adequate fruit and vegetable consumption. The implicit association test (IAT; Greenwald, McGhee, & Schwartz, 1998) was adapted to measure individuals' motivation orientation according to dimensions set-out in Deci and Ryan's (2008) self-determination theory (SDT).

### Self-determination theory

SDT, an organismic theory of human motivation, has been applied extensively to health-related behaviours such as physical activity (Biddle, Soos, & Chatzisarantis, 1999; Hagger, Chatzisarantis, Culverhouse, & Biddle, 2003), eating a healthy diet (Hagger, Chatzisarantis, & Harris, 2006b; Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004) and smoking cessation (Joseph, Grimshaw, Amjad, & Stanton, 2005; Williams et al., 2006). A key premise of SDT is that individuals' needs and social agents act synergistically to account for the motivation that drives behavioural engagement. The quality of individuals' motivation is also central to SDT, the focal distinction being between two main forms of motivation, *autonomous* and *controlled*. Individuals engaging in behaviour for autonomous or self-determined motives do so for the inherent interest, enjoyment and satisfaction of performing the behaviour and are likely to persist with that behaviour without external incentive or contingency. In contrast, individuals may perform behaviours for controlled or heteronomous motives and do so due to pressures perceived to lie outside the individual or for the attainment of external rewards (e.g. money, recognition). SDT and interventions based on the theory, are attractive to researchers and practitioners interested in promoting health behaviour because fostering autonomous motivation towards key health-related behaviours (e.g. physical activity, following a healthy diet) is likely to

lead to adherence to those behaviours without the need for external reinforcement or contingencies (Chatzisarantis & Hagger, 2009; Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003). This means that individuals will be more effective in self-regulating their behaviour without the need for clinicians and health workers prompting, reminding or cajoling them to persist.

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

A further premise of SDT is that individuals exhibit individual differences in dispositional motivational orientations, which are also conceptualised as autonomous or controlling. Differences in these relatively enduring motivational orientations are outlined in General Causality Orientations theory (Deci & Ryan, 1985). These differences in orientations illustrate a generalised tendency to interpret situations as autonomous or controlling across a range of behavioural contexts. Motivational orientations may moderate the effect of external contingencies and environmental factors on individuals' motivation and hence subsequent behavioural engagement. For example, individuals with an autonomous orientation will be more likely to interpret behaviours as internally referenced and emanating from the self (i.e. self-determined) and thus persist longer (Hagger & Chatzisarantis, 2011). In terms of health-related behaviours, autonomously oriented individuals are likely to engage and maintain healthy behaviours without the need for external reinforcement (Deci & Ryan, 1985). Causality orientations are likely to be a distal influence; however, more proximal motivational factors, such as PLOC constructs, are more likely to have greater influence on health-related behaviour in specific contexts, like dieting, physical activity, reducing alcohol intake and smoking cessation. It is also possible that generalised motivational constructs from SDT, like causality orientations, affect behaviour outside of conscious awareness (Bargh & Ferguson, 2000; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001;

McLachlan & Hagger, 2010, 2011). Implicitly measured motivational orientations predicated on associative learning, such as the IAT, should be well-positioned to provide valid measurement of these underlying dispositional motivational orientations and permit the testing of models that incorporate such motives alongside more traditional explicit measures (Kehr, 2004).

Previous research has investigated the link between implicit processes and underlying chronic dispositional motivational orientations like those represented in General Causality Orientations theory (Levesque & Pelletier, 2003). Levesque and Pelletier demonstrated that priming autonomous or controlled orientations led to performance similar to individuals who were chronically oriented towards autonomous or controlled motivation. It was also shown that individuals with chronic autonomous or controlled motivational orientations were not affected by priming manipulations. This gives preliminary support for the theory that implicit motivational constructs exert unique effects on behaviour. Furthermore, as priming autonomous or controlled motivation leads to similar behavioural outcomes as individuals with chronic autonomous or controlled orientations, this provides support for the generalised, trait-like and relatively stable and enduring nature of the implicit motivational constructs. Therefore, the implicit measure (IAT score) of self-determined motivation adopted in this research is expected to represent generalised, dispositional motivational orientations and would be expected to provide generalised predictions of behaviour in all three health-related contexts.

An alternative approach to measuring implicit motivation may be to develop measures that focus on the context of the specific content domain. This form of implicit measure is frequently adopted in the implicit attitude literature (Greenwald & Nosek, 2001; Greenwald et al., 1998; Richetin, Perugini, Prestwich, & O'Gorman, 2007). However, with respect to implicit motivation measurement, obtaining a context-specific measure presents additional challenges due to the need for three categories to be simultaneously measured ('self', 'motivation' and 'behaviour'). To the authors' knowledge, no such measure is currently available. In this research, we adopted a traditional two-category IAT to measure implicit motivational orientations from SDT. The implicit measure should, therefore, reflect more global, trait-like motivation orientations and this study will investigate whether these orientations predict engagement across a range of behaviours, rather than using several context-specific implicit measures. While the implicit measures and explicit measures are different in terms of generality, this investigation allows us to study the generalisability of the globally measured implicit motivational processes across behavioural domains beyond the impact of context-specific explicit motivational factors.[1]

## Combining SDT and implicit processes

A growing number of studies have examined the role of implicit motives as an influence on behaviour and behavioural outcomes in the context of SDT (Banting et al., 2009; Burton, Lydon, D'Alessandro, & Koestner, 2006; Levesque & Brown, 2007; Levesque, Copeland, & Sutcliffe, 2008; Levesque & Pelletier, 2003). For example, Burton et al. (2006) studied the effect of implicit intrinsic forms of motivation, tapped using a lexical decision task, on students' well-being and exam performance. Results supported the significant contribution of implicit forms of

autonomous motivation in the prediction of exam performance, providing preliminary support for the predictive validity of implicit measures of autonomous motivation. However, a limitation of this research was that more widely used and validated implicit measures (e.g. IAT, Greenwald et al., 1998; or single-category IAT, Karpinski & Steinman, 2006) were not employed, and it did not investigate the relative contributions of implicit and explicit measures in the explanation of behaviour and behavioural outcomes in the context of dual-route models of behaviour.

Further research into the relationship between implicit processes and motivation was conducted by Levesque and Brown (2007). In their research, an IAT was developed to measure implicit self-determined motivation. The relationship between implicit and explicit measures of motivation was investigated, as well as the possibility of a moderator, *mindfulness* – the degree to which an individual has a dispositionally elevated level of attention and awareness. Results indicated that implicit autonomy orientation provided significant prediction of day-to-day behavioural motivation for participants with lower levels of mindfulness. Levesque and Brown's research provides further support for the important role of implicit motivation in the prediction of behaviour in the context of SDT. However, Levesque and Brown did not integrate their research with theoretical models of behaviour that incorporate both implicit and explicit constructs as influencing behaviour, such as dual-route models (Hoffman et al., 2009; Strack & Deutsch, 2004), which may have elucidated further the psychological processes underpinning their findings.

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

### Dual-systems models

Several models of the direct and multiplicative effects of explicit and implicit processes on behaviour have been proposed (Back, Schmulke, & Egloff, 2009; Fazio & Towles-Schwen, 1999; Strack & Deutsch, 2004; Wilson, Lindsey, & Schooler, 2000). Drawing on the existing literature, Strack and Deutsch (2004) developed the RIM, which comprehensively and parsimoniously accounts for explicit and implicit processes that lead to behaviour, which are conceptualised as the reflective and impulsive system, respectively. In the model, the reflective system encompasses those

processes that are deliberative, based on the consideration of available information and intended future states. The impulsive system, in contrast, comprises processes that arise from reflective or perceptual input and schemata underpinned by associative networks. To this extent, explicit measures are proposed to provide an account of the reflective system, while implicit measures gauge the impulsive system. A further relevant benefit of this model is the inclusion of motivational orientations into the process. Essentially, the impulsive system may be oriented towards either approach or avoidance. Furthermore, the model outlines that compatibility between the dominant motivation orientation and environmental or reflective input leads to the facilitation of processing, possibly leading to a reduction in cognitive depletion and more effective self-regulation (Hagger, Wood, Stiff, & Chatzisarantis, 2010; Hagger et al., 2009; Kehr, 2004).

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

### The present study

The aim of this study was to evaluate the role of implicit and explicit measures of self-determined motivation in the prediction of health behaviours using a dual-systems model as a framework. A model, based on previous examples in the literature (Back et al., 2009), was developed to provide an account of the expected relationships between implicit motivation, explicit motivation and health-related behaviour. From this framework, a number of hypotheses were derived. First, it was predicted that an implicitly measured autonomous motivation construct would have a direct, unique effect on behaviour, independent of explicitly measured motivational constructs (H1). This hypothesis was based on previous studies indicating direct effects of implicit measures on health-related behaviours (Czopp et al., 2004; Marsh et al., 2001). Second, it was predicted that intention would provide a valid prediction of behaviour (H2). This hypothesis is based on previous research adopting social cognitive models such as the theory of planned behaviour (Ajzen, 1991), which has demonstrated that intentions are the most proximal determinant of behaviour in the reflective system and will provide consistently valid prediction of behaviour (Fishbein & Ajzen, 2009; Hagger & Chatzisarantis, 2009; Hagger, Chatzisarantis, & Biddle, 2002; McEachan, Conner, Taylor, & Lawton, 2011). A further hypothesis (H3) was that intention would mediate the effect of explicitly measured motivational constructs on behaviour based on the hypotheses of intentional theories and

supported by empirical findings (Back et al., 2009; Bagozzi, Baumgartner, & Yi, 1989; Fishbein & Ajzen, 2009).

## Method

### Participants

Undergraduate students ($N = 162$; 101 female, 61 male, $M_{age} = 22.12$, range: 18–44 years) participated in the current study. Only 150 participants' data were analysed, due to 12 failing to complete the follow-up. Further analyses indicated no significant differences in age ($t$ (160) $= 0.27$, $p = 0.83$) and gender ($\chi^2$ (1) $= 3.44$, $p = 0.14$) for those who responded and those who did not. Students eligible to participate in the study were contacted via email with study details and provided with the opportunity to participate. An €5 inconvenience allowance was administered in return for participation. The study protocol was approved by the School of Psychology Ethics Internal Review Board at the University of Nottingham.

### Materials and procedure

#### Implicit autonomous and controlled motivation

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

#### Perceived locus of causality

Participants' explicit contextual-level forms of motivation based on the PLOC were measured through an adaptation of Ryan and Connell's (1989) PLOC scale. It was deemed important to evaluate the implicit measure alongside previously adopted explicit measures in order to gain insight into the extent to which the implicit measure explains unique variance beyond the explicit measures. This would then have direct implications for advancing knowledge of the areas as it will provide some evidence to evaluate the extent to which the findings from previous research using these explicit measures would differ were implicit measures of autonomous motivation included (McClelland, 1985). A common stem for each behaviour was given (e.g. 'I exercise regularly (3–4 times a week) because...'). A series of reasons,

Table 1. Zero-order correlations among study variables.

| Variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Autonomous motivation (explicit) | – | | | |
| 2. Controlled motivation (explicit) | 0.52** | | | |
| | 0.30** | – | | |
| | 0.39** | | | |
| 3. IAT (implicit) | −0.04 | 0.17* | | |
| | −0.02 | −0.02 | – | |
| | 0.09 | 0.03 | | |
| 4. Intention | 0.43** | 0.50** | 0.13 | |
| | 0.73** | 0.37** | 0.05 | – |
| | 0.73** | 0.34** | 0.11 | |
| 5. Behaviour | 0.24* | 0.47** | −0.13 | 0.69** |
| | 0.41** | 0.24** | 0.18* | 0.53** |
| | 0.48** | 0.19* | 0.05 | 0.54** |

Notes: In each cell, row 1 = condom use ($N = 73$), row 2 = physical activity ($N = 150$), row 3 = fruit and vegetable consumption ($N = 150$); IAT = Implicit Association Test $D$-score representing generalised implicit measure of autonomous motivation; Intention = mean of intention and planning to conduct behaviour over a 4-week period; Behaviour – self-reported behavioural enactment over a 4-week period.
*$p < 0.05$ and **$p < 0.01$.

four per regulation type, relating to the various forms of motivation were then listed (e.g. intrinsic motivation: 'I enjoy . . .'; indentified regulation: 'I think it is important to . . .'; introjected regulation: 'I feel under pressure to . . .'; extrinsic regulation: 'I will feel ashamed if I do not . . .'). These were measured on a four-point Likert-type scale ranging from *not true at all* (1) to *very true* (4).

The PLOC scales were converted into weighted means representing controlled and autonomous motivation. The index for controlled motivation was calculated as the extrinsic regulation items, weighted by a factor of 2, added to introjected regulation items. This calculation was then repeated for the index of autonomous motivation; items measuring intrinsic motivation were weighted by 2, and added to an identified regulation items. This produced separate scales for each motivational form and reduced the number of overall variables making interpretation of analysis clearer. For example, autonomous motivation item 1 = (identified item $1 \times 1$) + (intrinsic item $1 \times 2$); autonomous motivation item 2 = (identified item $2 \times 1$) + (intrinsic item $2 \times 2$) and so on. The same analysis was conducted for controlled motivation items (Cronbach's $\alpha$ for both scales = 0.71).

*Intention*

Intentions to perform the behaviours were measured using two items (e.g. 'I intend to . . .' and 'I plan to . . .'; inter-item correlations for all behaviours were $> 0.90$). Responses were given on seven-point Likert-type scales from *unlikely* (1) to *very likely* (7).

*Self-reported behaviour*

Participants gave self-reports of their performance for each of the behaviours (e.g. 'In the past 4 weeks, how often have you eaten at least five portions of fruit and

vegetables?') using seven-point Likert-type scales from *never* (1) to *almost everyday* (7). The criterion and concurrent validity of this measure has been verified against objective measures (Chatzisarantis, Hagger, Smith, & Phoenix, 2004; Hagger, Chatzisarantis, & Harris, 2006a; Norman et al., 2010).

## Procedure

The study adopted a prospective design with psychological measures administered at an initial time point and follow-up self-reported measures of behaviour taken at a second point in time, 4 weeks later. All participants were tested in isolation in a sound-proofed experimental cubicle. After information on the experimental requirements was given, and informed consent gained, they were left to complete the study. A researcher was close-by at all times in case further assistance was required. Participants completed the IAT administered using E-Prime experimental software. Further instructions and guidance was offered through the E-Prime introduction screens, as well as the standard practice trials within the program. The IAT procedure lasted approximately 5 min. After completion of the implicit measure, participants were asked to move on to the questionnaire, also administered using the E-Prime software, which lasted approximately 20 min. Trials were fully counter-balanced such that half the participants completed the implicit measure first, while the remainder completed the explicit measures first. Participants were contacted via email or telephone, depending on personal preference, and their performance of the behaviours was subsequently assessed, 4 weeks later. After completion of the follow-up questionnaire, the aim of the study was explained and any further questions answered to the satisfaction of all participants.

## Results

### Preliminary analyses

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

### Predicting behaviour

Hierarchical regression analyses were conducted to assess the unique contribution of the implicit and explicit motivational measures (step 1) and intention (step 2). Standardised regression coefficients and $R^2$ values from the regression analyses are shown in Table 2.[2] Sobel (1982) tests were used to provide a formal test of the

Table 2. Hierarchical multiple regression analyses predicting condom use, physical activity, and fruit and vegetable consumption.

| Predictor | Condom | | | Physical activity | | | FruitVeg | | |
|---|---|---|---|---|---|---|---|---|---|
| | $R^2$ | $\beta$ | $t$, $p$ values | $R^2$ | $\beta$ | $t$, $p$ values | $R^2$ | $\beta$ | $t$, $p$ values |
| Step 1 | 0.26 | | | 0.22 | | | 0.23 | | |
| IAT | | 0.18 | $t=1.75$, $p=0.09$ | | 0.19* | $t=2.53$, $p=0.01$ | | −0.01 | $t=-0.17$, $p=0.86$ |
| Aut | | 0.10 | $t=0.87$, $p=0.39$ | | 0.37** | $t=4.82$, $p<0.01$ | | 0.49** | $t=6.13$, $p<0.001$ |
| Con | | 0.41** | $t=3.44$, $p<0.001$ | | 0.13 | $t=1.69$, $p=0.09$ | | −0.01 | $t=-0.10$, $p=0.92$ |
| Step 2 | 0.49 | | | 0.31 | | | 0.31 | | |
| IAT | | 0.09 | $t=1.04$, $p=0.30$ | | 0.17* | $t=2.47$, $p=0.02$ | | −0.04 | $t=-0.52$, $p=0.60$ |
| Aut | | −0.03 | $t=-0.31$, $p=0.76$ | | 0.03 | $t=0.30$, $p=0.76$ | | 0.22* | $t=2.19$, $p=0.03$ |
| Con | | 0.13 | $t=1.20$, $p=0.23$ | | 0.04 | $t=0.56$, $p=0.58$ | | −0.04 | $t=-0.49$, $p=0.63$ |
| Intention | | 0.61** | $t=5.53$, $p<0.001$ | | 0.49** | $t=4.54$, $p<0.001$ | | 0.39** | $t=3.97$, $p<0.001$ |
| $n$ | 73 | | | 150 | | | 150 | | |

Notes: IAT = Implicit Association Test *D*-score representing generalised implicit measure of autonomous motivation; Aut = explicit measure of autonomous motivation; Con = explicit measure of controlled motivation; Intention = behavioural intention to conduct behaviour over a 4-week period; Condom – Condom use over a 4-week period; Physical activity = regular exercise over a 4-week period; FruitVeg – Eaten at least five portion of fruit and vegetables, per day, over a 4-week period. It should also be noted that the IAT score was a generalised score of individuals' implicit motivation, rather than a domain-specific score. Furthermore, non-corresponding content-domain correlations are excluded from the table.
*$p < 0.05$ and **$p < 0.01$.

indirect effect of explicit measures of autonomous and controlled motivation on behaviour through intention.[3]

*Condom use*

The effect of the hypothesised predictor variables on condom use in the first step was significant ($R^2 = 0.26$, $p < 0.001$), $F(3, 73) = 8.37$, $p < 0.001$. The effect of the implicit measure (IAT score) on condom use behaviour did not reach the 0.05 alpha criterion for significance and on this basis our hypothesis (H1) had to be rejected.[4] The explicit autonomous motivation scale was not a significant predictor of behaviour, but explicit controlled motivation provided a significant prediction ($\beta = 0.41$, $p < 0.001$). There was a significant change in $R^2$ in the second step ($\Delta R^2 = 0.23$, $p < 0.001$), $F(4, 73) = 16.56$, $p < 0.001$. Intention was the sole significant predictor of behaviour ($\beta = 0.61$, $p < 0.001$), while explicit controlled motivation was no longer a predictor. This indicated that condom use was determined by explicitly measured intention as predicted (H2). Sobel (1982) tests provided confirmation that intention mediated the relationship between explicitly measured autonomous motivation and behaviour (standardised regression coefficients: autonomous motivation → intention, $\beta = 0.24$, $p = 0.003$; intention → behaviour, $\beta = 0.61$, $p < 0.001$, autonomous motivation → behaviour, $\beta = -0.03$, $p = 0.76$; autonomous motivation → behaviour (indirect effect mediated by intention) $\beta = 0.15$, $p > 0.05$; $z = 1.94$, $p > 0.05$). Intention also significantly mediated the effect of explicitly measured controlled motivation on behaviour (standardised regression coefficients: controlled motivation → intention, $\beta = 0.36$, $p < 0.001$; intention → behaviour, $\beta = 0.61$, $p < 0.001$; controlled motivation → behaviour, $\beta = 0.13$, $p = 0.23$; controlled motivation → behaviour (indirect effect mediated by intention) $\beta = 0.22$, $p < 0.001$; $z = 3.24$, $p < 0.001$). Hypothesis (H3) was therefore supported for condom use as intention mediated the relationship between both autonomous and controlled motivation and behaviour.

*Physical activity*

There was a significant effect of the hypothesised predictors and physical activity behaviour in the first step ($R^2 = 0.22$, $p < 0.001$), $F(3, 149) = 13.51$, $p < 0.001$. The regression coefficient for implicit autonomous motivation was significant ($\beta = 0.19$, $p = 0.01$), supporting hypothesis (H1). The explicit controlled measure did not significantly predict physical activity behaviour. Explicit autonomous motivation, however, did significantly predict behaviour ($\beta = 0.37$, $p < 0.001$). There was a significant change in $R^2$ in the second step ($\Delta R^2 = 0.01$, $p < 0.001$), $F(4, 149) = 16.65$, $p < 0.001$. Intention provided a significant prediction of behaviour ($\beta = 0.49$, $p < 0.001$), as hypothesised (H2). Sobel (1982) tests indicated intention significantly mediated the relationship between explicitly measured autonomous motivation and behaviour (standardised regression coefficients: autonomous motivation → intention, $\beta = 0.68$, $p < 0.001$; intention → behaviour, $\beta = 0.49$, $p < 0.001$, autonomous motivation → behaviour, $\beta = 0.03$, $p = 0.76$; autonomous motivation → behaviour (indirect effect mediated by intention) $\beta = 0.33$, $p < 0.001$; $z = 3.79$, $p < 0.001$). Intention also significantly mediated explicitly measured controlled motivation (standardised regression coefficients: controlled motivation → intention, $\beta = 0.17$, $p < 0.001$; intention → behaviour, $\beta = 0.49$, $p < 0.001$; controlled motivation → behaviour, $\beta = 0.04$, $p = 0.58$; controlled motivation → behaviour (indirect effect

mediated by intention) $\beta = 0.08$, $p < 0.001$; $z = 2.73$, $p < 0.001$). This provides support for hypothesis (H3), as intention mediated the explicit measure–behaviour relationship.

*Fruit and vegetable consumption*

The effect of the hypothesised predictor variables on fruit and vegetable consumption resulted in a significant regression equation in the first step ($R^2 = 0.22$, $p < 0.001$), $F(3, 149) = 14.94$, $p < 0.001$. The implicit measure of motivation did not provide significant prediction of behaviour, thus failing to support hypothesis (H1). Explicit autonomous motivation significantly predicted behaviour ($\beta = 0.49$, $p < 0.001$). There was a significant change in $R^2$ in the second step ($\Delta R^2 = 0.08$, $p < 0.001$), $F(4, 149) = 16.27$, $p < 0.001$. Intention significantly predicted behaviour ($\beta = 0.39$, $p < 0.001$), as hypothesised (H2); explicit autonomous motivation also remained a significant predictor of behaviour ($\beta = 0.22$, $p = 0.03$). Sobel (1982) tests indicated that intention partially mediated the relationship between explicitly measured autonomous motivation and behaviour (standardised regression coefficients: autonomous motivation $\rightarrow$ intention, $\beta = 0.69$, $p < 0.001$; intention $\rightarrow$ behaviour, $\beta = 0.40$, $p < 0.001$, autonomous motivation $\rightarrow$ behaviour, $\beta = 0.22$, $p = 0.03$; autonomous motivation $\rightarrow$ behaviour (indirect effect mediated by intention) $\beta = 0.28$, $p < 0.001$; $z = 2.88$, $p < 0.001$). Intention, however, did not significantly mediate explicitly measured controlled motivation (standardised regression coefficients: controlled motivation on intention, $\beta = 0.07$, $p = 0.24$; intention on behaviour, $\beta = 0.40$, $p < 0.001$; controlled motivation on behaviour, $\beta = -0.04$, $p = 0.63$; controlled motivation $\rightarrow$ behaviour (indirect effect mediated by intention) $\beta = 0.03$, $p > 0.05$; $z = 1.45$, $p > 0.05$). This provides only partial support for our hypothesis (H3).

**Discussion**

The aim of this research was to examine the independent effects of implicit and explicit measures of autonomous and controlled motivation on health behaviours using a dual-systems model (Strack & Deutsch, 2004) as a framework. A series of hypotheses, based on a dual-systems model and SDT, were proposed and systematically tested in a prospective study of three health-related behaviours: condom use, physical activity and fruit and vegetable consumption. Our first hypothesis (H1) was that implicit measures of autonomous motivation (measured by the IAT) would provide unique and independent prediction of behaviour. A significant effect was found for the effect of implicitly measured autonomous motivation for physical activity behaviour and there was a trend towards an effect for condom use, but the study was not sufficiently powered. No effect was found for implicit autonomous motivation on fruit and vegetable consumption. Present findings did not provide unequivocal support for the impulsive route to behaviour, derived from dual-systems models, as the effect was significant in only one of the behaviours investigated. Intention consistently predicted all behaviours, supporting our second hypothesis (H2). This corroborates previous research that intention is the most proximal predictor of planned behaviour, predictions (Ajzen, 1991; Back et al., 2009; Fishbein & Ajzen, 2009). Sobel tests also indicated that intention significantly mediated the relationship between explicitly measured motivational constructs and behaviour for all but one of the hypothesised paths, providing good support for

hypothesis (H3) and previous research (Fishbein & Ajzen, 2009; Hagger et al., 2006a).

This research provides only limited support for the RIM (Strack & Deutsch, 2004). The prediction of behaviour by implicit autonomous motivation was confined to physical activity in this study and suggests that enactment of this behaviour may, in part, be influenced by non-conscious, automatic processes. However, the IAT for autonomous motivation developed and used in this study did not predict condom use and fruit and vegetable consumption. A possible reason for this is that neither of these behaviours are strongly influenced by generalised, dispositional and distal motivational orientations that affect behaviour beyond an individuals' awareness, as measured by the implicit motivational orientation. Instead, these behaviours are likely to be predominately determined by contextual, proximal influences that are planned and consciously determined. This is also generally the case with physical activity, which was also predicted by explicit autonomous motivation alongside the implicit route. This suggests that this particular behaviour may have both implicit and explicit routes to behavioural enactment.

On the surface, the lack of consistent behavioural prediction for the implicit motives seems to suggest that the predictive validity of the implicit measure of autonomous motivation was relatively limited compared to the explicit measures of autonomous and controlled motivation. However, this does not mean impulsive routes and the RIM model can be unequivocally rejected on the basis of the present data. There are several possible explanations for this bias towards greater predictive validity of explicit measures of motivation. First, using self-reported measures of behaviour may have introduced systematic bias. Self-reports are inherently reflective as they require deliberation over future courses of action and are therefore more likely to correspond better with explicit measures. Related to this, the types of behaviour being investigated may bias measurement validity, as outlined. Behaviours like eating sufficient fruit and vegetables require a substantial degree of planning beforehand (e.g. selecting the correct foods when shopping, packing the correct lunch, etc.). Given the inherently deliberative nature of some behaviours, this may create a bias in favour of explicitly measured motivation. Furthermore, some behaviours may encompass antagonistic explicit and implicit motives. For instance, condom use may be endorsed and valued explicitly, but these values may be negated in more spontaneous contexts such as when a person engages in unplanned sexual intercourse or engages in sexual intercourse when inebriated (Marsh et al., 2001). However, the self-report follow-up measures used in this study tended to correspond with explicit deliberation over previous behaviour engagement, rather than spontaneous decisions made 'on the fly'. In addition, the measures of intention and behaviour, both being self-report with the same items and anchors, had the potential to introduce common method variance to the data. This limitation could have been allayed by introducing a time gap between measurements of intention and behaviour. This is a common strategy to minimise common method variance (Hagger et al., 2003). Another approach would have been to include 'filler' tasks between the items. Future research should seek to investigate this issue. Finally, the implicit measure of autonomous motivation reflected a more generalised, global motivational construct, whereas the PLOC (Ryan & Connell, 1989) was a direct measure of participant's motivation towards particular behaviours, thus creating a closer correspondence.

Intention is proposed as the final mechanism in the reflective system (Strack & Deutsch, 2004) and, consistent with this hypothesis, the inclusion of intention in the

regression analyses in this study resulted in the most pervasive prediction of behaviour, especially behaviours likely to require planning in terms of when to conduct the behaviour and what actions are needed to conduct the behaviour. For example, the indirect, intention-mediated path for physical activity indicated that the effect of explicit autonomous motives to pursue physical activity was a deliberative process. Physical activity, like going to the gym, or playing a game of football entails planning equipment to use and making arrangements and there is, therefore, a stage of deliberative planning before performance of the activity as implied by the mediated path from autonomous motivation via intentions. Similarly, for fruit and vegetable consumption, the explicit autonomous motivation measure and behaviour relationship was significant, indicating partial mediation by intention. As with physical activity, the indirect path suggests that those motivated to eat fruit and vegetables for autonomous motives need to engage in deliberative, intentional thought prior to engaging in behaviour. An explanation of the direct relationship may be that intentions did not adequately capture the effects of the explicit motivational orientation on behaviour; or, this reflected more spontaneous, less deliberative influences of motives on behaviour (Hagger et al., 2006a). These results suggest that it is important to identify the characteristics of the behaviour being investigated in terms of the inherent level of deliberation or spontaneity required for its enactment. Variation in terms of some behaviours being more spontaneous (e.g. having another drink at a bar when offered) compared to others that are more deliberative (e.g. attending a gym for a workout), should be taken into account in studies comparing the relative strength of the effects of implicit and explicit measures of motivation on behaviour.

### Limitations and future directions

There is a general lack of consistency in the literature in the types of measurement instrument used to assess implicit processes (Jung & Lee, 2009). This limitation may also apply to this research. Essentially, the IAT developed for this study may not have adequately captured implicit motives from SDT. Though the current implicit measure of motivation was based on previous examples in the literature (Levesque & Brown, 2007), definitive comparisons are difficult to make due to inconsistencies and limitations of the measures of implicit constructs used in previous research (e.g. stimuli used, analyses conducted). Future research should seek to corroborate the current approach using differentiated implicit and explicit motivational constructs and different behavioural contexts to support the unique prediction of the two types of motivation and generalisability of these findings across behavioural contexts (Hagger, Biddle, Chow, Stambulova, & Kavussanu, 2003). In addition, research may seek to include multiple measures of implicit constructs to offer more direct comparisons between implicit measures. One such development could be to include measures that include some reference to the specific content domain (e.g. presenting a background picture during each of the IATs to prime context). A further development could be to use single-category implicit measures, for example: the go/no-go association task (Nosek & Banaji, 2001) or single-category IAT (Karpinski & Steinman, 2006). These measures would allow parallel autonomous and controlled motivation scores to look for congruence patterns.

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

In terms of practical recommendations emerging from this research, the results may be used to inform health interventions. Traditionally, health interventions have adopted an explicit approach, encouraging individuals to reflect on their current behaviour and develop plans and aims to attain successful changes (Bryan, Aiken, & West, 1996; Markland, Ryan, Tobin, & Rollnick, 2005; Silva et al., 2008). While this has been largely successful, training (e.g. how to cope in spontaneous decision making situations) and reinforcement aimed at managing implicit effects may improve the overall efficacy of health interventions for some behaviours. In addition, this research may indicate that some individuals are more vulnerable to autonomous explicit forms of motivation, which would indicate that they would be better able to respond to interventions designed to target explicit forms of motivation. However, it must be stressed that given the highly consistent effects of explicit, deliberative forms of autonomous motivation on behaviour across the health-related contexts in this study, it seems that interventions targeting explicit forms of autonomous motivation are likely to have the most pervasive generalised effect on promoting behavioural engagement in multiple contexts (Chatzisarantis & Hagger, 2009).

### Conclusions

In conclusion, this study provided only limited support for the predictive validity of implicit measures of autonomous motivation and the dual-systems models on the prediction of health-related behaviour in three contexts. Current data demonstrate that health-related behaviours are more effectively predicted on the basis of explicit motivational constructs from SDT relative to implicitly measured motivational constructs. However, findings also indicate that implicit motivational orientations explain variance in behaviour in at least one of the contexts (physical activity) and demonstrated a significant trend in another (condom use). There is a need to further explore this relatively new area in the context of SDT and dual process models of behaviour. Future research should examine the relative contribution of implicit and explicit motivational orientations from SDT to the prediction of behaviour in sets of behaviours considered to vary in the extent to which they are inherently planned or spontaneous in their enactment (McClelland, 1985). While health-related behaviour has traditionally been researched within an explicit framework, this research follows a growing trend in the literature, supporting the role of implicit processes. While this research follows the trend of investigating the predictive validity of implicit measures, future research could aim to investigate the relationship between implicit motivation orientation and manipulation of these implicit orientations,

through priming. Essentially, research exists showing the effect of explicit motivation orientation on priming manipulations (Levesque & Pelletier, 2003); however, it is important to see whether individuals' implicit orientation has a similar effect.

### Notes

1. In additional analyses, explicit generalised measures (Generalised Causality Orientations Scale; Deci & Ryan, 1985) were entered into the regressions. These were not correlated with any of the behaviours, and did not offer significant predictions for any behaviour. This demonstrates that generalised explicit motivational orientations do not have efficacy in predicting behaviour, 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 generalised measure of autonomous motivation.
2. We 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, which overcomes this difference in scale measurements. The pattern of effects for each behaviour was similar as for the separate motivation construct. Details of these additional analyses are available from the first author.
3. In 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.
4. It should be noted that the size of the effect ($\beta = 0.18$) and associated probability value ($p = 0.09$) indicated that the effect did, in fact, exist but the present study was underpowered.

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