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Relations between Implicit and Explicit Measures of Attitudes and Measures of Behavior: Evidence of Moderation by Individual Difference Variables

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Abstract

In two studies we assessed the moderating role of two individual difference variables (Self-Reported Habit Index, SRHI; Need For Cognition, NFC) on the relationship between implicit (Implicit Association Test, IAT; Extrinsic Affective Simon Test, EAST) or explicit measures of attitudes and measures of behavior. A clear dissociation pattern was apparent in both studies on a self-report diary measure of behavior. For study 1, the relationship between EAST and behavior was moderated by SRHI, while the relationship between explicit measures of attitude and behavior was moderated by NFC. For study 2, the relationship between IAT and behavior was moderated by SRHI, while the relationship between explicit measures of attitude and behavior was moderated by NFC. Higher levels of SRHI and NFC were associated respectively, with stronger relationships between the implicit or explicit measures of attitude and the measure of behavior. In Study 2 the SRHI by IAT interaction was replicated for an objective measure of behavior. Implications for understanding the relationship between implicit and explicit measures of attitudes and measures of behavior are discussed.

KEYWORDS: implicit measures, attitude, behavior, moderators, predictive validity

There is a long history of research in social psychology on the relationship between measures of attitudes and behaviors. This research has been reinvigorated in recent years by theoretical accounts that specify a role for implicit and explicit measures of attitudes in determining behavior (e.g., Fazio & Olson, 2003; Strack & Deutsch, 2004; Wilson, Lindsay, & Schooler, 2000). Such models differ in a number of ways, although they all assume an important role for both automatic and deliberative processes as basic determinants of human actions. These models allow for the possibility that variables might moderate the impact of either or both of these automatic or deliberative processes influencing behavior. While considerable research has examined moderators of the relationship between explicit measures of attitudes and measures of behavior (e.g., Kraus, 1990), only a modest amount of research has examined moderators of the relationship between implicit measures of attitudes and measures of behavior (e.g., Banse & Fischer, 2002). The present research examined two individual difference moderators of the simultaneous relationship between implicit and explicit measures of attitudes and measures of behavior: the habitualness of the behavior for the individual and the individual level of need for cognition. The pattern of moderation (symmetric or asymmetric effects for implicit and explicit measures on behavior) can provide insights into theoretical accounts of how implicit and explicit measures of attitudes determine behavior.

A number of theories now provide accounts of the role of implicit and explicit measures of attitudes in determining behavior (e.g., Fazio, 1990; Fazio & Olson, 2003; Strack & Deutsch, 2004; Wilson et al., 2000). Although these models differ in a number of ways, including the extent to which implicit and explicit measures are assumed to tap different attitudes (e.g., Wilson et al., 2000) or are upstream versus downstream measurement of the same attitude (Fazio & Olson, 2003), they all assume an important role for both automatic and deliberative processes as basic determinants of human actions. One such theory is the proposal by Wilson et al. (2000) of a model of dual attitudes, defined as different evaluations, one implicit and one explicit, of the same attitude object. Wilson et al.'s model explicitly allows for the co-existence in memory of implicit and explicit attitudes

toward the same attitude object. They distinguish between four main cases (repression, independent systems, motivated overriding, automatic overriding), corresponding to the combination of awareness of the implicit measure of attitude, once activated, and the amount of motivation and cognitive effort needed for the explicit attitude to override the implicit one. In relation to predictions of behavior, implicit attitudes are assumed to influence responses described as automatic, spontaneous, implicit or uncontrolled, while explicit attitudes are assumed to influence responses described as non-automatic, deliberative, explicit or controlled. This double dissociation pattern of effects has been confirmed in a number of studies (e.g., Dovidio, Kawakami, & Gardner, 2002; Fazio, Jackson, Dunton, & Williams, 1995; Perugini, 2005, study 2), but not all (e.g., Karpinski & Hilton, 2001). In support of this view, the meta-analysis by Hofmann, Gawronski, Gschwender, Le, and Schmitt (2005) identified increasing spontaneity of self-reports as significantly increasing the correlation between IAT measures and explicit self-reports (including behavior).

However, one weakness with such evidence is that the responses or behaviors that are compared may differ not only in terms of how spontaneous or deliberative they are but also in terms of other relevant characteristics (e.g., importance). Useful complementary evidence that avoids this problem might focus on a single behavior but examine predictions for individuals for whom the behavior is more spontaneous or automatic with those individuals for whom the behavior is more deliberative. One individual difference variable that taps this dimension is the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003). The SRHI measures meta-cognitions on the history of repetition, lack of awareness, difficulty to control and mental efficiency of the behavior. As such it defines a habitual behavior as one having the characteristics of an automatic or spontaneous behavior (Aarts & Dijksterhuis, 2000; Aarts, Verplanken, & van Knippenberg, 1998; Bargh, 1994; Verplanken & Aarts, 1999; Wood, Quinn, & Kashy, 2002). Therefore one might expect SRHI to moderate the relationship between implicit and explicit measures of attitude and measures of behavior such that when the behavior is habitual (automatic) implicit measures are stronger than

explicit measures of attitude in predicting behavior, while when the behavior is non-habitual (deliberative) the reverse pattern of prediction will hold.

The SRHI measure has been shown to be reliable (Verplanken & Orbell, 2003) and to have content, discriminant and predictive validity for a variety of habits (see Verplanken, 2006 for a review) including various eating behaviors (e.g., Brug, de Vet, Wind, de Nooijer, & Verplanken, 2004) as studied here. Verplanken (2006) showed the SRHI to have discriminant validity over a measure of frequency of past behavior in three studies, while Verplanken, Friborg, Wang, Trafimow, and Woolf (in press) used the SRHI to examine negative self-thinking as a mental habit. We predicted that the SRHI would moderate the relationship between implicit and explicit measures of attitudes and behavior, such that high compared to low habit would be associated with behavior that is more under the control of implicit measures and less under the control of explicit measures (symmetric prediction of moderation). This would be consistent with the double dissociation effect that has received significant support (Hofmann et al., 2005), with implicit measures having stronger relationships with spontaneous behaviors and explicit measures of attitudes having stronger relationships with deliberative behaviors. However, rather than the spontaneous and deliberative behaviors being different, the same behavior would be viewed as becoming more spontaneous and less deliberative in nature as habit increases (thus controlling for other dimensions on which comparison behaviors may differ). This would represent a useful additional test of the double dissociation hypothesis because it does not require the ad hoc selection of behaviors as spontaneous or deliberative but allows us to test the effects on the majority of behaviors that lie between these two extremes.

A considerable number of variables have been considered as moderators of the relationship between explicit measures of attitudes and behavior (see Ajzen & Fishbein, 2005 for a recent review). The main individual difference variables that have been considered as moderators are, "self-monitoring tendency, self-consciousness or self-awareness, and need for cognition" (Ajzen, & Fishbein, 2005, p. 179). Need for Cognition (NFC) taps individual differences in degree of being

more thoughtful and reflective. This variable is of particular interest in relation to the relative predictive power of explicit and implicit measures of attitude on behavior because of its central role in dual process models such as the Elaboration Likelihood Model (ELM; Petty & Cacioppo, 1986) for persuasion and Fazio's (1990) MODE (Motivation and Opportunity DEtermine behavior) model of how attitudes influence behavior. Increasing levels of NFC are assumed to be associated with more systematic, deliberative and effortful processing of persuasive messages in the ELM (e.g., Cacioppo & Petty, 1982; Cacioppo, Petty, Feinstein, Blair, & Jarvis, 1996). In the MODE model increasing levels of NFC are assumed to promote the relationship between attitudes and behavior in a more deliberative manner through increasing motivation and opportunity to reflect on one's attitude. Although NFC has been primarily tested as a moderator of the influence of persuasion on attitude change (Haugvtvedt & Petty, 1992), it has also been shown to moderate the influence of intention on behavior (Pieters & Verplanken, 1995). More central to our reasoning, NFC is associated with greater search for information and processing of attitude-relevant arguments (Petty, Haugtvedt, & Smith, 1995) and in general to more elaborated and stronger attitudes (for a review, see Cacioppo et al., 1996). Indeed, NFC was developed as an individual difference variable meant to reflect at a dispositional level greater reliance on the central as opposed to the peripheral route to message elaboration specified by the ELM (Cacioppo & Petty, 1982; Petty & Cacioppo, 1986). Given that higher NFC is associated with a stronger attitude and stronger attitudes are more predictive of behavior (Petty, Haugtvedt, & Smith, 1995), an implication is that higher NFC should moderate the relation between attitudes and behavior. This hypothesis was supported by the findings of Cacioppo, Petty, Kao, and Rodriguez (1986). More specifically, in their second study, they found that individuals who were high in NFC had a stronger relation between attitude to political candidates and voting behavior ($\underline{r}$ = .87) than individuals who were low in NFC ($\underline{r}$ = .46). To our knowledge no study has ascertained whether such a moderation effect is present when controlling for implicit measures of attitude.

In addition, Epstein (1990) suggests NFC as key moderator in his Cognitive-Experiential

Self-Theory (Epstein, 1990). According to this theory, "the rational and experiential modes [of thinking] represent two fundamental ways in which people process information and thereby adapt to the environment" (Epstein, Pacini, Denes-Raj, & Heier, 1996, p. 392). Rational thinking is equated with deliberative, effortful, intentional or systematic processing; while the experiential thinking is equated with intuitive, automatic or heuristic processing. NFC is assumed to tap a tendency to engage in rational thinking respectively and in support Epstein et al. (1996) demonstrated that high NFC was associated with less heuristic thinking[1].

Thus several converging lines of evidence suggest that NFC should moderate the relationship between explicit measures of attitudes and behavior such that a preference for rational processing (high NFC) would lead to a stronger relationship between explicit measures of attitudes and behavior. In contrast, the relevant theoretical and empirical data do not suggest that NFC is a moderator of the relationship between implicit measures of attitude and behavior. Hence, we predicted an asymmetric pattern of moderation for NFC with significant moderating effects on the relationship between explicit measures of attitude and behavior, but no effect on the relationship between implicit measures of attitude and behavior.

In summary, the present paper examined the moderating role of two individual difference variables (SRHI, NFC) on the relationship between implicit measures and explicit measures of attitudes and subsequent behavior. We predicted that the SRHI would moderate both the implicit measure of attitude-behavior relationship (positively) and the explicit measure of attitude-behavior relationship (negatively), i.e., a symmetric moderation pattern; and that NFC (positively) would moderate the explicit measure of attitude-behavior relationship but not affect the implicit measure of attitude-behavior relationship, i.e., an asymmetric moderation pattern. These effects were tested in two studies using variants of implicit measures of attitudes (Implicit Association Test [IAT]: Greenwald, McGhee, & Schwartz, 1998; for a review see Greenwald & Nosek, 2001; Extrinsic Affective Simon Task [EAST]: De Houwer, 2003; De Houwer, Crombez, Koster, & De Beul, 2004; Huijding & de Jong, 2005, 2006) and explicit measures of attitudes (attitudes towards one target

versus the difference in attitudes towards two targets). The behavior focused on in the studies was the consumption of candy (including chocolate bars and bagged candy), collectively referred to as chocolate/sweets in the UK. This is a behavior that contributes significantly to both fat and sugar consumption in the UK both of which have significant implications for cardiovascular and dental health (e.g., Committee on Medical Aspects of Food Policy, 1991). We also selected this behavior as one where there is considerable individual variation in consumption levels and one that might reflect both automatic and deliberative correlates of behavior. For example, for one individual chocolate/sweets consumption might be relatively automatic because it is consistently performed in a similar context in a relatively automatic way, while for another individual it is performed in a more deliberative manner in differing contexts. As such this behavior provided a useful test bed for assessing our predictions about these moderators.

Study 1

Study 1 tested our predictions in relation to eating chocolate/sweets. Along with an explicit measure of attitudes we employed two implicit measures of attitudes. The first was an Implicit Association Test (IAT; Greenwald et al., 1998) with a neutral comparison category (shapes). The second was the Extrinsic Affective Simon Task (EAST; De Houwer, 2003). The two moderators considered were the Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003) and the Need for Cognition (NFC; Cacioppo et al., 1996).

Method

Participants

A total of 123 participants (47 males, 76 females, mean age=23.7, SD=5.8) were recruited on a University campus in southern England through an email mailing list of people who had earlier signed up for notice of experiments. They were paid £14 (approximately $25) for participating.

Materials

Explicit Measure of Attitudes

The target behavior in the study was eating sweets which were defined as chocolate bars such as Snickers, Kit-Kat, Mars, etc., and small bagged sweets such as Maltesers, Skittles, M&Ms, etc. The set of sweets were selected from a pilot study asking individuals to list five highly popular examples of chocolate bars and sweets. The explicit attitudes measure consisted of a standard semantic differential measure of attitude to this behavior on seven bipolar scales ('I think that for me to EAT SWEETS is…', bad-good, foolish-wise, unpleasant-pleasant, negative-positive, unenjoyable-enjoyable, unhealthy-healthy, unattractive-attractive), anchored with very at each end above the extreme values and intermediate over the center value. Explicit attitude was scored as the mean of these seven items (score 1 to 7) with higher scores indicating more positive attitudes towards eating sweets (Cronbach's $\alpha = .77$).

Implicit Measures of Attitudes

Both an IAT and an EAST were employed to assess implicit measures of attitudes. Our implementation of the IAT followed the established format (cf. Greenwald et al., 1998) of 5 steps, with the first, second and fourth steps being practice and the third and fifth steps being the critical test phases. In the test phases, participants must categorize exemplar stimuli by pressing one of two buttons on a response box to indicate to which two paired categories the exemplar belongs. Each response button is assigned to one of two attribute categories and one of two target categories, which thus creates a cognitive pairing between an attribute category and a target category for that test phase. In step 5, the pairings from step 3 are reversed, such that the attribute category remains assigned to the same response button but the target categories are switched. An IAT score can be computed from the difference between performance on the two test phases. Error feedback was provided and an inter-trial interval of 400ms used.

The target category pairing was sweets (Snickers, Kit-Kat, Mars, Maltesers, Skittles, M&Ms) and shapes (circle, square, rectangle, triangle, cube, shape) was used as a neutral "contrast" category. The attribute categories were positive (good, life, pleasure, pretty, friend, love) and negative (evil, death, pain, ugly, enemy, hate) words. There were 16 practice trials for step 1, step 2,

the practice component of step 3, step 4, and the practice component of step 5. There were 62 test trials in step 3 and again in step 5, with the first two being dummy trials (to be discarded). The IAT score was calculated using the D algorithm (Greenwald, Nosek, & Banaji, 2003), such that positive values indicated a preference for sweets.

The EAST is a modified IAT that allows for a comparison of performance on the same task, rather than on different tasks as is the case with the IAT (De Houwer, 2003). Participants are presented in each trial with either an attribute exemplar (indicated by a white font color), which must be categorized by meaning (positive or negative), or with a target exemplar that must be categorized by its color (blue or green). Participants indicate to which category the exemplars belonged by pressing one of two buttons on a response box. The extrinsic pairing of valence (in the form of the assigned attribute) with a specific response button (and the corresponding labeling of the response buttons as good and bad) allows one to examine the valence for a target concept, even though the concept exemplars are not categorized as positive or negative, but rather by color. In other words, if on the colored trials the extrinsically positive response was given more quickly than the extrinsically negative response, it can be inferred that the attitude towards the stimulus presented on those trials was positive.

Following De Houwer's (2003) approach, our EAST had 20 practice trials, followed by 4 blocks of 62 test trials, with the first two test trials in each block being dummy trials. The target (colored) concept exemplars were Snickers, Kit-Kat, Mars, Maltesers, Skittles, and M&Ms. The positive attribute exemplars were healthy, honest, smart, funny, outstanding, and love, while the negative attribute exemplars were evil, horrible, mean, vulgar, repulsive, and hate. The attribute exemplars were the same as used by De Houwer (2003), with the addition of love and hate. We deliberately increased the number of trials (to 80 overall from around 40 in typical applications of the EAST) and avoided the measurement of multiple targets, with the aim of increasing the internal consistency of the resulting score. The EAST score was calculated in the same way as De Houwer (2003). We considered only correct answers and calculated a score by subtracting the mean log-

transformed reaction times in which the correct response was positive from the ones in which it was negative, such that positive values reflected a preference for sweets[2]. Error feedback was provided and an inter-trial interval of 1200ms employed. In all other ways our procedures followed those of De Houwer (2003).

Behavior measures

A self-reported diary of daily sweet consumption (DSC) completed after the first laboratory session required participants to record their consumption of sweets each day over a one week period. The diary had 11 available pre-numbered entries per day, plus spare sheets to use if the snacks consumed exceeded the set value. Instructions explained exactly how to complete an entry. Participants were required to enter the item they ate and the date/time they ate it. This measure was scored as number of sweets consumed per week.

Moderator Variables

The Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003) is a 12 item measure of meta-cognitions on the history of repetition, lack of awareness, difficulty to control, and mental efficiency of a behavior (e.g., 'In general, eating sweets and chocolate bars is something I do without thinking'). Items were rated on a 6-point Likert scale from strongly disagree to strongly agree (score 1 to 6). Verplanken and Orbell (2003) report Cronbach's α values greater than .85 across 4 different studies as well as a high test-retest correlation ($r = .91$, $p < .001$). Items were scored such that higher scores indicated greater habit and a mean computed ($\alpha = .89$).

Need for Cognition (NFC) was assessed using the 5-item NFC subscale from the Rational-Experiential Inventory Scale (Epstein et al., 1996). Participants responded on a 5-point Likert scale, anchored with completely false and completely true (e.g., 'I prefer complex to simple problems'). Epstein et al. (1996) reported Cronbach's α values of .73 for the NFC measure. Items were scored such that higher scores indicated greater NFC and a mean computed. The initial Cronbach's α for the NFC measure was .69; however, excluding one item in the NFC subscale improved the α to .75, so we dropped that item[3].

Procedure

Participants attended for two sessions. For the initial session, they were led to the testing booth, where they were given a brief overview of the study, instructed on the use of the computer and then requested to attend carefully to the instructions. They completed the explicit attitudes measure, followed by the IAT and the EAST (the order of the IAT and EAST was counterbalanced between participants, with a one-minute pause between each to reduce carryover effects and fatigue) on IBM-compatible PCs, with 15-inch displays set at a resolution of 1024 x 758, color depth set at 16 bit and refresh rate at 72Hz. using Inquisit psychological testing software (version 1.33). Participants responded by use of the computer keyboard and a Cedrus response box (model RB-730). On completion of the computerized section, the participants were told, via on-screen instructions, to return to the experimenter's office to complete the first session. On arrival at the experimenter's office, they were instructed in the use of the diary then were scheduled for the following week's participation. On returning for the second session a week later, participants returned their diaries (DSC) and were taken to the computer testing booths to complete, in computerized format, SRHI, NFC and several filler tasks.

Results and Discussion

Three participants were dropped (2 males, 1 female) from the analysis; one did not complete the initial experimental session, one did not return for the second session, and one participant had incomplete data. For the remaining 120 participants, both the IAT (M = .54, SD = .34) and explicit attitudes measure (M = 4.09, SD = .83) indicated a slightly positive attitude towards sweets while the EAST showed a slight negative attitude (M = -.02, SD = .07). Mean sweets consumption based on the diary measure (DSC) was 5.46 (SD = 4.76) items in the week.

Examining the interrelationships between the measured variables indicated a number of interesting findings (see Table 1). In particular, the implicit measures did not correlate significantly with the explicit measure, nor did the implicit measures correlate with each other, the latter perhaps being the more surprising result (but see De Houwer, 2006). In addition, the explicit attitudes

measure was significantly positively correlated with the SRHI (r = .26, p < .01), while NFC was significantly negatively correlated with the IAT scores (r = -.19, p < .05). DSC was significantly correlated with the EAST (r = .18, p < .05), explicit attitude (r = .22, p < .05) and SRHI (r = .39, p < .01).

[INSERT TABLE 1 ABOUT HERE]

To examine the implicit and explicit measures of attitudes as predictors of behavior (DSC), we performed hierarchical regressions. Separate regressions were performed for the two implicit measures (IAT, EAST) in order to aid comparisons with previous research. Independent variables and moderators were centered before calculating the interaction terms. In the regressions, we entered the two measures of attitudes (IAT and explicit attitudes; or EAST and explicit attitudes) at step 1, then added the two moderator variables (SRHI, NFC) at step 2, and finally at step 3 we entered the hypothesized interaction terms between each measure of attitude and each moderator (IAT x SRHI, IAT x NFC, Explicit x SRHI, Explicit x NFC; or EAST x SRHI, EAST x NFC, Explicit x SRHI, Explicit x NFC). The results of the regression analyses are reported in Table 2 (using the IAT as the implicit measure in left-hand columns and EAST as implicit measure in right-hand columns). The results for the two implicit measures were somewhat different and so are described separately. When using the IAT as the implicit measure of attitude, at step 1, only the explicit measure of attitude was found to be a significant predictor of DSC, explaining a marginally significant portion of variance in DSC, $F(2,117) = 2.98$, $p = .055$. At step 2, when we added the individual difference variables to the regression, we found that the SRHI was the only significant predictor and the explicit measure of attitude ceased to be significant. The individual difference variables significantly added to predictions of DSC, $Fchange(2,115) = 8.34$, $p < .001$. At step 3, we entered the interaction terms which significantly added to the predictions of DSC, $Fchange(4,111) = 2.52$, $p < .05$. One interaction term was significant at this step (Explicit Attitude x NFC, $p < .01$) along with the SRHI measure. Together these variables explained a total of 23.8% of the variance in DSC.

When using the EAST as the implicit measure of attitude, at step 1, both the EAST and the explicit measure of attitude were found to be significant predictors of DSC, explaining a significant portion of variance in DSC, $F(2,117) = 5.31$, $p < .01$. At step 2, when we added the individual difference variables to the regression, we found that the SRHI was a significant predictor along with the EAST, and the explicit measure of attitude ceased to be significant. The individual difference variables significantly added to predictions of DSC, $Fchange(2,115) = 9.18$, $p < .001$. At step 3, we entered the interaction terms which significantly added to the predictions of DSC, $Fchange(4,111) = 4.53$, $p < .01$. Two interaction terms were significant at this step (EAST x SRHI, $p < .01$; Explicit Attitude x NFC, $p < .05$) along with the EAST and SRHI measures. Together these variables explained a total of 32.0% of the variance in DSC.

We next probed the nature of these interaction effects using simple slopes analyses (Aiken & West, 1991) to examine the effects of the attitude measure on behavior (DSC) at the mean, low (1 SD below mean) and high (1 SD above the mean) levels of the moderator. Simple slope analyses demonstrated that the EAST was more strongly related to behavior at high levels of habit ($B = 34.82$, $p < .001$), than when habit was moderate or low ($B = 12.72$, $p < .05$; $B = -9.38$, ns; for moderate and low levels of SRHI respectively). Thus, as predicted, the power of the EAST to predict behavior became stronger as habit strength increased. Simple slope analyses also demonstrated that the moderating effect of NFC on the relationship between explicit measures of attitude and behavior was similar when controlling for IAT and its interactions (Table 2, left-hand columns) as when controlling for EAST and its interactions (Table 2, right-hand columns). The explicit measure of attitude was only significantly related to behavior at high levels of NFC ($B = 2.03$, $p < .005$ when controlling for IAT; $B = 1.74$, $p < .005$ when controlling for EAST) and unrelated to behavior when NFC was moderate ($B = .853$, ns; $B = .747$, ns; when controlling for IAT and EAST respectively) or low ($B = -.322$, ns; $B = -.249$, ns; when controlling for IAT and EAST respectively). Thus, as predicted, the power of an explicit measure of attitude to predict behavior became stronger as NFC increased. This represents a clear pattern of a double-dissociation of moderators. For people who are high in

deliberative thinking (high NFC), explicit attitudes better predicted sweets consumption (DSC), while for people for whom sweets consumption is highly habitual (high SRHI), the EAST better predicted sweets consumption (DSC), and the converse did not apply[4].

[INSERT TABLE 2 ABOUT HERE]

The pattern of results in Study 1 broadly fitted our predictions. SRHI moderated the relationship between EAST and behavior and NFC moderated the relationship between the explicit measure of attitude and behavior. However, we did not observe the expected moderating effect of SRHI on the relationship between IAT and behavior or between the explicit measure and behavior (although the latter was marginally significant in both tests reported in Table 2, $p < .10$). A further criticism of Study 1 was that we only employed a self-report measure of behavior. Replication of the implicit measure of attitude by habit interaction using a more valid IAT measure than that used in Study 1 and replication of the explicit measure of attitude by NFC interaction both on a similar behavior measure and a more objective measure would add to our confidence in the generalizability of these findings. Study 2 was designed as such a replication that also tested the possibility that it was the use of a neutral comparison category in our IAT that accounted for the failure to find effects for the IAT in Study 1.

Variants of the IAT focus on testing the concept of interest against a neutral category or a contrasting category. However, IAT studies using a neutral comparison category such as shapes as used in Study 1 may provide weaker measures of implicit attitudes compared to those using a true contrast category (Perugini, 2005). Penke, Eichstaedt, and Asendorf (2006) have argued that the use of a neutral category introduces systematic error variance that reduces the validity of the implicit measure. The possibility that this reduced validity explains the findings for the IAT was explored in Study 2 by replacing the neutral category IAT with an IAT with a true contrast category. In Study 1 we were interested in the selection of chocolates/sweets and the neutral comparison category seemed the most appropriate one to use. However, in Study 2 we decided to look at the choice between chocolates/sweets and fruit which represents a common choice particularly in relation to snack foods

(Conner, Fitter, & Fletcher, 1999; Grogan, Bell, & Conner, 1997; O'Connor, Jones, Conner, McMillan, & Ferguson, in press). This allowed us to employ an IAT that contrasts chocolates/sweets with fruit. It also allowed us to examine a more objective behavior measure (a choice between chocolate/sweets and fruit) in addition to our self-report diary measure.

Study 2

Study 2 was designed as a partial replication and extension of Study 1. We used an IAT that contrasted a preference for chocolate/sweets with one for fruit. In order to ensure maximum correspondence among measures we also made changes to a number of other measures. For the explicit measure of attitudes, we assessed evaluations in relation to both chocolate/sweets and fruit and used the difference between the two as the measure of explicit attitudes. For the self-report diary measure of behavior we assessed both chocolate/sweets consumption and fruit consumption and calculated the proportion that were chocolate/sweets. Finally, we added an unobtrusive choice task where respondents made a choice between chocolate/sweets and fruit on their way out of the experimental session. This represents a more objective measure of behavior.

Method

Participants

A total of 104 participants (20 males, 84 females, mean age=23.2, SD = 4.90) were recruited on campus at a university in northern England, following poster advertisements. Participants were paid £5 (approximately $9.50) for participating.

Materials

Explicit Attitudes Measures

The target behavior in this study was eating chocolate ('I think that for me to EAT chocolate is…') versus eating fruit ('I think that for me to EAT fruit is…') and the measure incorporated the same seven bipolar scales used in study 1, scored 1 to 7 with higher scores indicating more positive attitudes to chocolate (α = .85) or fruit (α = .74). The final attitude score was taken as the difference between the attitude towards chocolate and the attitude towards fruit (i.e., positive scores indicate a

preference for chocolate over fruit).

Implicit Association Test

The IAT was identical to that used in study 1 with the following exceptions. The target concept was chocolate (Snickers, Crunchie, Twix, Maltesers, KitKat) and the contrast category was fruit (bananas, apples, oranges, strawberries, mango). The attribute categories were pleasant (love, gift, joy, pleasure, and rainbow) and unpleasant (evil, cancer, vomit, death, and agony). There were 20 practice trials and responses were recorded via keyboard. As in study 1 the IAT score was computed using the D algorithm (Greenwald et al., 2003) with a positive score reflecting preference for chocolate over fruit.

Behavior measures

Two measures of behavior were obtained. One index was a food choice measure, in which, following the completion of all of the measures in the laboratory session, participants were presented with two boxes. One contained various fruits and the other various chocolate bars. A large number of items were placed in each box to prevent participants guessing that their choice would be recorded. Participants were told that they could take one item as a thank-you for their taking part and did so in a separate room to the experimenter. After participants left the laboratory, the experimenter noted their selection by counting the number of items in each box (coded 1 = chocolate, -1 = fruit). This is similar to measures used in other studies (e.g., Perugini, 2005, study 2). Also similar to Study 1, a second index of behavior was a diary-based measure assessing the numbers of chocolates/sweets and fruit consumed on each day during the seven days following the study. This followed the same structure as the DSC measure in Study 1. However, this was scored as the proportion of chocolates/sweets consumed (out of the total number of chocolates/sweets and fruits consumed) and labelled Diary Proportion Sweets Consumption (DPSC). A positive score would indicate that more than half the choices were for chocolate/sweets.

Moderator variables

The same two moderator variables were assessed: SRHI and the NFC ($\alpha = .79$). For the

habit measure respondents completed questions in relation to chocolate (α = .92) such that higher scores indicated more habitual consumption of chocolate[5].

Procedure

For the laboratory session, participants were led to the testing booth, where they were given a brief overview of the study, instructed on the use of the computer and then requested to attend carefully to the instructions. Participants then completed all of the direct measures which appeared in a fixed order (SRHI, NFC, explicit attitudes), followed by the indirect measures (IAT, counterbalanced across participants), or vice-versa. After all measures had been completed in the laboratory, participants were thanked and given a seven-day food diary with the instruction to begin completing it the following day and return it one week later. Following this, participants were presented with the food choice task.

Results and Discussion

A total of 11 participants were dropped (2 males, 9 females) from the analysis due to missing data on one or more measures (and the excluded participants did not differ from those retained on any measured variable, *p*s > .20). For the remaining participants, the explicit attitude (*M* = -2.10, *SD* = 1.02) indicated a preference for fruit over chocolate, although the IAT shows a more positive attitude towards chocolate than fruit (*M* = .45, *SD* = .34). Selection in the food choice task slightly favored fruit over chocolate (*M* = -.01, *SD* = 1.01), while the ratio of chocolate to chocolate and fruit based on the diary measure (DPSC) suggests more chocolate was selected (*M* = .28, *SD* = .26).

Examining the correlation between the measured variables (see Table 3) indicated that the IAT did not correlate significantly with the explicit measure. In addition, the explicit attitudes measure was marginally significantly positively correlated with the SRHI (*r* = .20, *p* = .054). Food choice was significantly predicted by the IAT (*r* = .33, *p* < .01), while the diary measure (DPSC) was significantly predicted by the IAT (*r* = .24, *p* < .05), and SRHI (*r* = .23, *p* < .05). Finally, the two behavior measures were significantly correlated (*r* = .25, *p* < .05).

[INSERT TABLE 3 ABOUT HERE]

To examine the measures of attitude as predictors of behavior, we again performed hierarchical regressions. Independent variables and moderators were centered before calculating the interaction terms. In the regressions, we entered the two measures of attitude (IAT, explicit) at step 1, then added the two moderator variables (SRHI, NFC) at step 2, and finally at step 3 we entered the hypothesized interaction terms between each attitude measure and each moderator (IAT x SRHI, IAT x NFC, Explicit x SRHI, Explicit x NFC).

We first examined participants' food choice. Here a logistic regression procedure was employed due to the binary nature of the dependent variable. At step 1, the overall equation correctly classified a significant proportion of individuals, Chi-squared(2) = 10.61, $p < .01$. At this step only the IAT measure was significant (see Table 4, left-hand panel). At step 2, the addition of SRHI and NFC did not significantly increase the proportion of individuals correctly classified, Chi-squared change(2) = 1.93, ns. At this step neither SRHI nor NFC were significant. Finally, at step 3, when the four interactions were added, this marginally increased the proportion of individuals correctly classified, Chi-squared change(4) = 6.49, $p < .20$. A total of 69.9% of the participants were correctly classified in the final equation (Nagelkerke $R^2 = .247$). At this step, IAT and the interaction between IAT and SRHI were significant. It is worth noting that the addition of the IAT by SRHI interaction on its own at step 3 significantly increased the proportion of individuals correctly classified, chi-squared change(1) = 4.52, $p < .05$. No other variables approached statistical significance.

[INSERT TABLE 4 ABOUT HERE]

We next probed the nature of the significant interaction effect by plotting the predicted probabilities of choosing a chocolate bar as a function of IAT scores at low (1 SD below mean) and high (1 SD above the mean) levels of the moderator (SRHI) (Jaccard, 2001). These plots (Figure 1) demonstrated that the IAT was more strongly related to choice at high compared to low SRHI, as evidenced by the steeper slope. Thus, as predicted, the power of the IAT to predict behavior became

stronger as habit strength increased.

[INSERT FIGURE 1 ABOUT HERE]

The regression of DPSC on to the attitudes measures (see Table 4, right-hand panel) revealed a different pattern of results. At step 1, the IAT was the only predictor of DPSC, accounting for a significant portion of variance in DPSC, $F(2,90) = 3.57$, $p < .05$. At step 2, when the individual difference variables were added to the regression, we found that both IAT and SRHI were significant predictors although this only marginally significantly increased the variance explained in DPSC, $Fchange(2,88) = 2.61$, $p < .10$. At step 3, when we entered the interaction terms, this significantly increased the proportion of variance explained in DPSC, $Fchange(4,84) = 2.96$, $p < .05$. Two interaction terms were significant at this step (IAT x SRHI; Explicit Attitude x NFC; both $p < .05$) and together the predictors explained a total of 23.3% of the variance in DPSC. Examination of the interactions again revealed a clear pattern of a double-dissociation of moderators. For people who were high in deliberative thinking (high NFC), explicit attitudes better predicted proportion of chocolate/sweets consumed (DPSC), while for people for whom chocolate/sweets consumption was more habitual (high SRHI), the IAT better predicted sweets consumption (DPSC), and the converse did not apply.

We next probed the nature of these interaction effects using simple slopes analyses (Aiken & West, 1991) to examine the effects of the attitude measures on behavior (DPSC) at the mean, low (1 SD below mean) and high (1 SD above the mean) levels of the moderator. Simple slope analyses demonstrated that the IAT was strongly related to behavior at high levels of habit ($B = .217$, $p < .001$), but unrelated to behavior when habit was moderate or low ($B = .108$, ns; $B = -.001$, ns; for moderate and low levels of SRHI respectively). Thus, as predicted, the power of the IAT to predict behavior became stronger as habit strength increased. In addition, simple slope analyses demonstrated that explicit attitude was only significantly related to behavior at high levels of NFC ($B = .076$, $p < .05$) and unrelated to behavior when NFC was moderate or low ($B = .058$, ns; $B = .040$, ns; for moderate and low levels of NFC respectively). Thus, as predicted, the power of explicit measures of attitude to

predict behavior became stronger as NFC increased.

The findings for Study 2 replicated those of Study 1 in showing that for a self-report measure of behavior (DPSC) the relationship between an implicit measure of attitude and behavior was moderated by level of SRHI, while the relationship between an explicit measure of attitude and behavior was moderated by level of NFC. However, for an objective measure of behavior (choice) only the IAT by SRHI interaction was significant. In addition, consistent with Study 1, no explicit measure of attitude by SRHI interaction was observed in regressions using either measure of behavior in Study 2.

General Discussion

The present research reports two moderating effects in relation to the correlation between implicit and explicit measures of attitudes and measures of behavior that were consistent with our predictions. Across the two studies we consistently observed that the power of an implicit measure of attitude to predict behavior was moderated by the habitualness of the behavior, although the implicit measure varied across studies (Study 1: EAST x SRHI significant; Study 2: IAT x SRHI significant). Importantly, in Study 2 this interaction was significant for both a self-report (DPSC) and a more objective (choice) measure of behavior. We also consistently observed that the correlation between an explicit measure of attitude and behavior was moderated by need for cognition. However, in both studies SRHI did not moderate the correlation between explicit measures of attitude and behavior and NFC did not moderate the correlation between implicit attitudes and behavior. This data provides support for a double dissociation of implicit and explicit measures of attitudes in their correlation with behavior. Not only do implicit and explicit measures of attitude independently predict behavior but different moderators change their individual relationships with behavior.

These findings support the view that implicit and explicit measures of attitudes predict behavior through different processes (Strack & Deutsch, 2004; Wilson et al., 2000) and these processes are altered by distinct individual differences. Our data would suggest that as behaviors

become more habitual (higher SRHI) for an individual they come to be more predicted by implicit measures of attitudes. In contrast, for explicit measures of attitudes these become more influential in determining behavior for individuals who have a tendency to engage in thinking (High NFC). More broadly our research suggests that it might be fruitful to examine individual difference variables and how these influence the relationship between implicit and explicit measures of attitudes and measures of behavior. Such research might further inform understanding of the processes by which implicit and explicit measures of attitude predict behavior (Richetin, Perugini, Adjali, & Hurling, 2007).

The moderating role of habit on the implicit measures of attitude-behavior relationship was consistent with a double dissociation model that has received support using paradigms where spontaneous and deliberative behaviors are measured separately (Hofmann et al., 2005). As predicted, where the behavior was reported to be more habitual (high SRHI) implicit measures of attitudes (Study 1: EAST; Study 2: IAT) were significantly more predictive of behavior. Interestingly, it was only when habit was low (SRHI: Mean - 1 SD) that implicit measures of attitude did not predict behavior suggesting that this is a behavior which is mainly spontaneous. Importantly this effect also emerged with a more objectively assessed measure of behavior (Study 2).

It is also worth noting that the pattern of moderation for our habit measure was not symmetrical across the implicit and explicit measures. Our measure of habit (SRHI) significantly positively moderated the relationship between our implicit measure of attitude and behavior, but did not produce the significant negative moderation for the relationship between the explicit measure of attitude and behavior (Study 1: $\underline{\beta}$ = -.16 and -.13, $\underline{p}$s < .10; Study 2: $\underline{B}$ = .05, $\underline{p}$ =.45 for choice measure; Study 2: $\underline{\beta}$ = -.11, $\underline{p}$ =.59 for DPSC measure). It is possible that this is because this behavior is generally more spontaneous than deliberative. A key factor may be the stability of the context in which the behavior is performed (Wood et al., 2002). If we only tapped the behavior as performed in stable contexts we might expect only the implicit measure of attitude to be predictive,

while if we only tapped the behavior in unstable contexts we might expect only the explicit measure of attitude to be predictive. However, such speculation clearly needs to be specifically tested in further research.

In contrast to the effects for SRHI, for the need for cognition (NFC) measure we predicted an asymmetric pattern of moderation with NFC moderating the explicit measure of attitude-behavior relationship and not moderating the implicit measure of attitude-behavior relationship. The findings supported this view across the two studies for the self-report diary measures of behavior: high NFC was associated with a preference for more deliberative processing where one might expect explicit measures of attitude to be more predictive of behavior. This replicates the findings of Cacioppo et al. (1986) and shows this effect is present even when controlling for implicit measures of attitude. However, we did not observe a moderating effect of NFC on the relationship between explicit measures of attitude and the objectively assessed food choice measure in Study 2. We suspect that this may be attributable to the choice task being a more spontaneous behavior where one might expect implicit as opposed to explicit measure of attitude to be more predictive (Hoffman et al., 2005) and that this was the case even for those high in NFC.

Our findings are also relevant to discussions of the incremental validity of implicit measures of attitudes over and above explicit measures of attitudes. In a recent meta-analysis of over 100 studies using the IAT, Poehlman, Uhlmann, Greenwald, and Banaji (2007) reported a significant association between the IAT and relevant behavioral criteria, such as judgments, choices, and behaviors (frequency weighted mean correlation: $\underline{r}_+ = .27$). In the same set of studies, explicit measures ($\underline{r}_+ = .35$) slightly outperformed the IAT. Similarly, Hofmann et al. (2005) reported a correlation between the IAT and self-reported behaviors of $\underline{r}_+ = .26$. Importantly, Poehlman et al. (2007) also reported that their results suggested that the IAT had incremental validity over explicit measures of attitude and reported a value of $\underline{r}_+ = .14$. The current findings would appear to support the incremental validity of implicit measures of attitudes over and above explicit measures of attitudes, although this is partly dependent on individual differences. An additive implicit/explicit

model was obtained in Study 1, although additional incremental validity was achieved when the moderators were added. In study 2, incremental validity (implicit and explicit measures of attitudes explaining significant unique variance in behavior) was only obtained via moderated pathways. These findings suggest the value of considering individual difference variables in relation to the question of the incremental validity of implicit measures of attitudes over and above explicit measures of attitudes when predicting behavior.

The variation in effect for our different implicit measures of attitude are worthy of comment. We attribute the failure of the IAT to predict behavior in Study 1 to the use of a neutral comparison category weakening its validity as an implicit measure of attitudes. It may be that, in relation to the IAT, the use of the comparison category of shapes weakens the measure compared to using a less neutral category (e.g., fruit; see also Penke et al., 2006). The difference in findings between Study 1 and Study 2 supports this view. In addition, Richetin, Perugini, Prestwich, and O'Gorman (2007) used a snacks versus fruit IAT in a combined sample of 399 participants and found it to predict behavior. In hindsight, a single-category IAT (Karpinski & Steinman, 2006) that does not need a contrast category might have been a more suited paradigm for Study 1. A similar argument cannot be made for the EAST which does not use a comparison category and did show predictive validity in Study 1.

In summary the present research adds to the growing body of research exploring the relationship between implicit and explicit measures of attitude and measures of behavior in a number of ways. First, it provides additional evidence of an additive model of the relationship between implicit and explicit measures of attitude and measures of behavior. Second, and most importantly, it uses individual difference variables to provide novel support for a double dissociation of moderation for implicit and explicit measures of attitudes in their relationship with measures of behavior. The additive effect of implicit measures of attitude was moderated by habit (SRHI), while the additive effect of explicit attitude was moderated by need for cognition. We would argue that this elucidation of theoretically justified factors that moderate the relationship of

implicit and explicit measures of attitudes with behavior offers a useful route to furthering our understanding of the way these two influences predict behavior. Further research might usefully assess these effects across a range of behaviors and test a broader range of individual difference variables.

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Footnotes

1. A measure of faith in intuition from Epstein's (1990) Cognitive-Experiential Self-Theory was included in both studies reported here; however, as no main effects or moderation effects were observed in either study this measure is not further considered here.

2. There were 5.1% of errors for the positive responses and 7.1% for negative responses. An error-based EAST score was calculated but it was not related significantly to any variable, an indication that the valid variance was mostly contained in the reaction times of the correct answers. Therefore, the error-based EAST score was not considered further.

3. The deleted item was 'Thinking hard and for a long time about something gives me little satisfaction'. Results with all five NFC items were marginally weaker: for example, the interaction between 5-item NFC x explicit attitudes was a marginally non-significant predictor of DSC ($\underline{\beta}$ = .174, $\underline{p}$ = .054) while the 4-item NFC x explicit attitudes interaction was a significant predictor ($\underline{\beta}$ = .225, $\underline{p} < .05$).

4. It is also worth noting that similar results were obtained when using both implicit measures in the same analyses. In addition, in those analyses there was no evidence of an interaction between implicit (IAT or EAST) and explicit measures of attitudes in predicting behavior (as has been reported by Perugini, 2005, study 1).

5. We also took a habit measure in relation to fruit (α = .86). Using this habit measure or a combined habit measure as the difference between the two (i.e., positive scores indicate greater habit for chocolate compared to fruit) produced substantively similar results in relation to the interaction between IAT and SRHI for both behavior measures.

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Table 1: Descriptives and Pearson correlations between measured variables in Study 1 (N = 120).

	IAT	EAST	Explicit attitudes	SRHI	NFC	DSC
IAT	1					
EAST	-.03	1				
Explicit attitudes	.08	-.02	1			
SRHI	.04	-.02	.26**	1		
NFC	-.19*	-.14	.12	-.02	1	
DSC	.04	.18*	.22*	.39**	.06	1
Mean	.54	-.02	4.09	3.39	3.81	5.46
SD	.34	.07	.83	1.32	.77	4.76

Note: IAT = Implicit Association Test; EAST = Extrinsic Affective Simon Task; SRHI = Self-Reported Habit Index; NFC = Need for Cognition; DSC = Diary Sweets Consumption.

* $p < .05$, ** $p < .01$ (2-tailed).

Table 2: Hierarchical regressions of diary sweets consumption (DSC) on implicit measure of attitude (left-hand columns using IAT; right-hand columns using EAST), explicit measure of attitude, moderators, and interactions for Study 1 (N = 120).

	Diary Sweets Consumption (DSC)					
	Unstandardized Beta Coefficient (B)	Standard Error of Beta (SE)	β	Unstandardized Beta Coefficient (B)	Standard Error of Beta (SE)	β
Step 1						
IAT	.343	1.256	.025	-	-	-
EAST	-	-	-	12.951	6.101	.188*
Explicit attitude	1.248	.521	.217*	1.278	.510	.222*
Change in R^2			.048*			.083**
Step 2						
IAT	.426	1.209	.031	-	-	-
EAST	-	-	-	14.140	5.771	.205*
Explicit attitude	.674	.514	.117	.685	.498	.119
SRHI	1.767	.436	.357***	1.794	.425	.362***
NFC	.372	.542	.060	.510	.523	.082
Change in R^2			.120***			.126***
Step 3						
IAT	.486	1.188	.035	-	-	-
EAST	-	-	-	12.716	5.679	.185*
Explicit Attitude	.853	.509	.148	.747	.482	.130
SRHI	1.640	.446	.331***	2.077	.420	.420***
NFC	.324	.530	.052	.436	.495	.070
IAT x SRHI	.288	1.343	.019	-	-	-
IAT x NFC	-.582	1.493	-.033	-	-	-
EAST x SRHI	-	-	-	16.740	5.466	.251**
EAST x NFC	-	-	-	-.807	.481	.065
Explicit Attitude x SRHI	-.959	.523	-.157	5.457	6.838	-.132
Explicit Attitude x NFC	1.526	.572	.228**	1.294	.537	.193*
Change in R^2			.069*			.111**

Note: IAT = Implicit Association Test; EAST = Extrinsic Affective Simon Task; SRHI = Self-Reported Habit Index; NFC = Need for Cognition.

* $p < .05$, ** $p < .01$ (2-tailed).

Table 3: Descriptives and Pearson correlations between measured variables in Study 2 (N = 93).

	IAT	Explicit attitudes	SRHI	NFC	Choice	DPSC
IAT	1					
Explicit attitudes	.07	1				
SRHI	.05	.20	1			
NFC	-.10	.18	.05	1		
Choice	.33**	.05	.16	-.04	1	
DPSC	.24*	.14	.23*	-.10	.25*	1
Mean	.45	-2.10	-3.25	5.02	-.01	.28
SD	.34	1.02	1.98	1.04	1.01	.26

Note: IAT = Implicit Association Test; SRHI = Self-Reported Habit Index; NFC = Need for Cognition; Choice = Choice of chocolate or fruit; DPSC = Diary Proportion Sweets Consumption.

* $p < .05$, ** $p < .01$ (2-tailed).

Table 4: Hierarchical linear regressions of food choice and diary proportion sweets consumption (DPSC) on implicit attitudes measure, explicit attitudes measure, moderators and interactions for Study 2 (N = 93).

	Dependent Variable					
	Choice of chocolate or fruit			Diary Proportion Sweets Consumption (DPSC)		
	Unstandardized Beta Coefficient (B)	Standard Error of Beta (SE)	Wald	Unstandardized Beta Coefficient (B)	Standard Error of Beta (SE)	β
Step 1						
IAT	2.133	.715	8.891**	.176	.076	.234*
Explicit attitude	-.045	.216	.044	-.031	.026	-.122
Change in R^2			.144**			.073*
Step 2						
IAT	2.100	.719	8.526**	.160	.076	.213*
Explicit attitude	.009	.229	.001	-.026	.026	-.101
SRHI	.159	.117	1.857	.027	.013	.207*
NFC	-.039	.219	.031	-.027	.025	-.110
Change in R^2			.024			.052
Step 3						
IAT	2.413	.803	9.042**	.108	.076	.144
Explicit Attitude	-.024	.531	.002	.058	.056	.227
SRHI	.274	.275	.987	.004	.027	.031
NFC	-.081	.261	.096	.016	.029	.063
IAT x SRHI	.557	.285	3.836*	.055	.025	.236*
IAT x NFC	.809	.774	1.094	-.028	.079	-.035
Explicit Attitude x SRHI	.049	.064	.584	-.003	.006	-.111
Explicit Attitude x NFC	-.047	.073	.421	.017	.008	.416*
Change in R^2			.079			.108*

Note: IAT = Implicit Association Test; SRHI = Self-Reported Habit Index; NFC = Need for Cognition.

* $p < .05$, ** $p < .01$ (2-tailed).

Figure 1. Plot of logistic regression slopes of choice measure in Study 2 onto intentions for low and high levels of the self-reported habit index.