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The IAT as a predictor of food choice: The case of fruits versus snacks

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Abstract

One of the issues concerning the application of implicit measures like the IAT is whether they can be successfully applied to consumer choices. Four studies (N=399) tested the predictive and incremental validity of an IAT of attitudes towards fruits versus snacks on the choice of a fruit or a snack at the end of the experimental session. Specifically, additive and interactive patterns to predict behavioral preference towards snacks or fruits were tested. The results showed that the IAT has both predictive and incremental validity and supported the additive pattern (i.e., both implicit and explicit measures independently predicted the behavioral preference for fruits versus snacks).

Since its introduction by Greenwald, McGhee and Schwartz (1998), the Implicit Association Test has been the most frequently used measure for assessing implicit attitudes. The IAT is a computerized paradigm that measures indirectly the strength of the association between pairs of concepts (e.g., two target categories: fruits and snacks; two attribute categories: positive and negative) via a classification task. The IAT score is computed by subtracting the average response time of the two versions of the combined classification task (i.e., two pairings of target-attribute: fruits-positive and fruits-negative) in which stimuli from all categories are randomly presented. The assumption underlying the IAT is that if two concepts are highly associated (e.g., fruits and positive), the classification task will be easier (and the participants quicker to respond) when the associated concepts share the same response key than when they require a different response key (for a more detailed description, see Greenwald et al., 1998). Theoretically based on an associative network conceptualization of a Social Knowledge Structure in memory (see Greenwald, Banaji, Rudman, Farnham, Nosek, & Mellot, 2002) and on the conceptualization of an attitude as the association between an attitude-object and a valence concept (Fazio, 1995), the IAT is assumed to reflect the relative strength of automatic associations between concepts. The IAT has been used as an implicit measure of attitudes, self-concepts, and stereotypes (for reviews, see Greenwald & Nosek, 2001; Hofmann, Gawronski, Gschwender, Lee, & Schmitt, 2005; Poehlman, Uhlmann, Greenwald, & Banaji, 2006). Numerous studies have shown the reliability of the IAT in various domains, with values generally hovering around .80 for the internal consistency and .60 for test-retest stability (e.g., Dasgupta & Greenwald, 2001; Greenwald & Farnham, 2000; Greenwald & Nosek, 2001; Perugini, 2005a).

Predictive validity.

One of the key issues concerning the IAT is its ability to predict relevant behaviors. In fact, one could argue that, both on practical and theoretical grounds, an acid test for a measure such as the IAT is whether it shows evidence of predictive validity (Perugini, 2005b; Perugini, O'Gorman, & Prestwich, 2006). Poehlman et al.'s (2006) meta-analysis indicated significant relations of the IAT with several types of behaviors (e.g., self-reported, judgments, choices), thus demonstrating its ability to predict different criteria (e.g., nonverbal behaviors, impression formation, shyness, anxiety, consumer choices, voting). However, whereas the predictive validity of the IAT has been one of the main focuses in several papers, its incremental validity has not been studied as thoroughly. In other words, relatively few studies (e.g., Egloff & Schmukle, 2002; Schnabel, Banse, & Asendorpf, in press) have tested whether there is some unique contribution from the IAT in the prediction of behavior, over and above the contribution provided by explicit measures. Indeed, in their meta-analysis reviewing 61 studies using the IAT, Poehlman et al. (2006) mentioned the possibility that the IAT has incremental validity but they did not test it statistically because of the lack of appropriate parameters in most of the studies reviewed.

Perugini (2005a) reviewed the different patterns describing the role of implicit and explicit processes: additive, interactive and double dissociation patterns. In the *additive* pattern, both explicit and implicit attitudes provide a unique prediction of behavior. Thus, low correlations between the measures should not be taken as evidence of the existence of two independent systems but rather of the discriminant validity between two different types of measures (Perugini, 2005a). In predictive terms, this pattern would imply that an IAT measure should provide evidence of incremental validity for most types of behaviors. In the *interactive* pattern, implicit and explicit attitudes interact synergistically to predict behavior. In this view, the correlation between implicit and explicit measures is in some sense irrelevant: implicit and explicit measures may therefore complement each other in predicting behavior (Perugini, 2005a, Study 1; Brunel, Tietje & Greenwald, 2004; Maison, Greenwald, & Bruin, 2004). Empirically, this should typically be reflected in a significant interaction term between an implicit and explicit attitudinal measure over and above the unique individual contributions of either. Finally, in the *double dissociation* pattern, implicit attitude predicts independently spontaneous/automatic behaviors and explicit attitudes predict solely deliberative/planned behaviors. This pattern has received some empirical support in a number of studies (e.g., Asendorpf, Banse, & Mucke, 2002; Dovidio, Kawakami, & Gardner, 2002; Perugini, 2005a, Study 2).

In a more general perspective, these three patterns can be linked to theoretical work devoted to understand how reflective/deliberative and impulsive/automatic processes underlie the execution of behavior. Dual-processes models theorizing the role of implicit and explicit processes (e.g., Fazio, 1990; Strack & Deutsch, 2004; Wilson, Lindsey, & Schooler, 2000) all assume the importance of both processes as basic determinants of behaviors. However, besides several similarities, these models differ in how implicit and explicit factors contribute in predicting behavior. All three patterns are compatible with Strack and Deutsch's (2004) model postulating the interaction between a reflective and an impulsive system that activate the same behavioral schemata and usually operate in parallel. These two systems can interact in a synergistic or antagonistic fashion to determine behavior and lead to additive, interactive, and dissociative patterns of behavior prediction. Fazio instead suggests that there is a single attitudinal system representation that can be measured in different ways (cf. Fazio & Olson, 2003). In other words, the measures can be thought of as direct (i.e., explicit) or indirect (i.e., implicit) ways to tap into the same attitude. This view is mainly compatible with an additive pattern of behavior prediction. Finally, Wilson, Lindsey, and Schooler's (2000) model of dual attitudes postulates the independent co-existence of different evaluations, one implicit and one explicit, of the same attitude object. This model therefore is particularly compatible with a double dissociation pattern.

Food choice.

The potentiality of a measure like the IAT can be exploited for predicting consumer choice (Brunel, Collins, Greenwald, & Tietje, 1999; Brunel, Tietje, & Greenwald, 2004) and, more specifically, food choice. However, the empirical evidence so far has been mixed, both at the level of eating habits and of specific behavioral food choices. For example, Maison, Greenwald and Bruin (2001) used an IAT high vs. low calorie foods to successfully predict eating behavior that, however, was measured via self-report. In contrast, Roefs and Jansen (2002), using an IAT high vs. low fat, found that obese people had significantly more negative implicit attitudes towards high fat food compared to normal weight people, therefore implying a negative relation between IAT and eating behavior. At a more specific level of behavioral choices, a study by Karpinski and Hilton (2001, Study 2) showed that an IAT did not predict the choice between a candy bar and an apple whereas an explicit attitudinal measure did predict it. In principle, such a choice could be driven by relatively spontaneous processing and henceforth predicted by the implicit measure. In support of this logic, Perugini (2005a, Study 2) showed that the IAT significantly predicted a choice between snacks and fruits whereas the explicit attitudinal measure did not. The difference between the results could be due to a number of factors. First, there are some procedural differences. In fact, Perugini (2005a) considered attitudes toward the more general categories of snacks and fruits whereas Karpinski and Hilton (2001) considered candy bars and apples. Moreover, in Perugini's (2005a) study, the behavioral choice was between different types of snacks and fruits, whereas Karpinski and Hilton's (2001) behavioral choice was between one type of candy bar (Snickers) and a Red Delicious apple. Second, it might be that the relatively small sample sizes of the studies (113 and 85 participants, respectively) are a reason why contrasting findings have been obtained.

Aim of the contribution

This contribution is focused on the capability of the IAT to predict a behavioral choice between fruits and snacks using a large sample and considering also separate explicit attitudinal measures. Four similar studies were performed at different points in time and analyzed as a single sample. Specifically, we tested whether both implicit and explicit attitudes towards snacks and fruits predict independently (additive pattern) or interactively (interactive pattern) the behavioral choice between snacks and fruits. Given that a single dependent variable was considered, the double dissociation pattern could not be tested.

Method

Participants

The sample consisted of 406 participants recruited on campus, 226 women and 180 men (age, M =24.24, SD =7.03) in the period from June 2002 to July 2005, divided in four studies. The first (n=114, 62 women, M age=25.1) and the fourth (n=74, 38 women, age M =26.6) studies were run in the summer, whereas the second (n=120, 57 women, age M =20.76) and the third (n=98, 69 women, M age=26.01) during winter. The data from seven participants were discarded for different reasons, leaving a total of 399 (223 women, age M =24.24, SD =7.03). Across these four studies, two participants were discarded due to computer failure, four because of excessive errors (above 25% of the trials), and one participant because he did not perform the food choice task.

Materials and procedure

The four studies consisted of first an IAT then a questionnaire (explicit attitudes) and a final behavioral choice[1]. The order of the tasks was constant in all studies.

Participants were individually contacted in campus and invited to participate in an experimental session. Each participant was seated in a cubicle at a table with a desktop computer. The computerized categorization task was the IAT. The target concept was fruits and its contrast was snacks, whereas the attribute categories were pleasant and unpleasant. For each category, six (Study 1) or five stimuli (Studies 2, 3 & 4) were used (see Appendix 1). All practice blocks consisted of 20 trials and each critical block consisted of 41 trials for Study 1 and 62 trials for Studies 2, 3 and 4. The order of step 3 (Fruits + Positive) and step 5 (Snacks + Positive) was counterbalanced. The questionnaire contained questions concerning attitudes towards both eating snacks and eating fruits. Attitudes were assessed with six bipolar scales (bad-good, unpleasant-pleasant, negative-positive, unenjoyable-enjoyable, unhealthy-healthy, unattractive-attractive) for Studies 1 and 3, and seven bipolar scales (foolish-wise added) for Studies 2 and 4 on a 7-step answer scale ranging from –3 to +3.

The behavior measurement consisted in a behavioral choice (BC, coded as 1= fruit and 0= snack). At the end of the session, participants were asked to exit the cubicle, pointed towards two bowls on a nearby table containing a selection of fruits and snacks, asked to choose a free snack or fruit, and debriefed afterwards (cf. Karpinski & Hilton, 2001, Study 2; further details on the procedure are contained in Perugini, 2005a, Study 2). In Study 3 the behavioral choice was slightly different. The study was divided in two sessions. The first session consisted of the IAT and the explicit attitudinal measure. In addition, participants were asked to express their choice of what they would have liked to receive the following week (fruit vs. snack). Then, a week after, participants were asked to actually choose a snack or a fruit[2].

Results

The first trial for Study 1 and the first two trials of each critical block for the other studies were removed due to typically longer reaction times. The IAT scores of each study were calculated by taking the difference in reaction time between phase three and five and transforming it (D algorithm developed by Greenwald, Nosek, & Banaji, 2003), reflecting a preference for fruits relative to snacks. The reliabilities of the IAT scores were good (Study 1: α□= .86, Study 2: α□= .88, Study 3: α□= .80, Study 4: α□= .81).

Three different explicit attitude scores were considered. First, an explicit attitude score toward snacks (EAS) was calculated by aggregating the scores for each item. The reliabilities of this measure were good (Study 1: α= .77, study 2: α= .80, Study 3: α= .66, Study 4: α= .82). A similar calculation was made to obtain an explicit attitude score toward fruits (EAF) (Study 1: α= .83, Study 2: α= .81, Study 3: α= .73, Study 4: α= .73). Finally, a general explicit attitude score of preference for fruits over snacks (EASF) was obtained by subtracting the sum of the scores for snacks from those for fruits. The reliabilities of these composite scores were good (study 1: α= .80, study 2: α= .80, study 3: α= .70, study 4: α= .78).

Overall, participants had a preference for fruits over snacks at the implicit (IAT: M=.32, SD=.50) and explicit levels (EASF: M=1.88, SD=1.14). This pattern was present in each study (cf. Table 1). Nevertheless, this preference was not confirmed by the behavioral choice (overall 49.1% of participants chose a fruit). More specifically, participants from Studies 2 and 3 (during winter) chose a fruit less frequently than a snack (30.8% and 32% of participants chose a fruit, respectively) whereas in Studies 1 and 4 (during summer) participants chose a fruit more frequently than a snack (53.6% and 55.6% chose a fruit, respectively).

[Insert Table 1 about here]

Predictive validity.

The correlation between the implicit measure and the behavioral choice showed only a tendency towards significance, whereas all the three explicit measures were correlated with the behavioral choice (cf. Table 2). Although the IAT showed a significant correlation in Study 1 (r=.22, p=.02) and a tendency toward significance in Study 4 (r=.20, p=.09) (both of them were ran during summer), no significant correlation was found in the two other studies ran during winter (r=.11 and r=-.02 for Study 2 and 3, respectively). Implicit and explicit measures were not correlated with each other. Interestingly, the explicit attitude toward fruits was not negatively correlated with the explicit attitude toward snacks.

[Insert Table 2 about here]

As originally ascertained by Greenwald et al. (1998), there is a procedural effect concerning the order of the combined tasks in the IAT. Although this effect is usually accommodated by counterbalancing, counterbalancing per se does not guarantee an unbiased score. However, it does allow the estimation of biases arising from order effects and to partly correct for them. Perugini and Gallucci (2006) have developed a framework (Order Analysis) to deal with order effects. Briefly, there are two possible order biases, *offset* and *attenuation*. An offset bias implies an asymmetry in the relation between the IAT and the criterion variable, whereas an attenuation bias implies an under-estimation of the true relation between IAT and criterion (i.e., the relation that would be obtained if there were no order effects). Preliminary analyses showed that there was no significant offset bias. Therefore, the effects of a potential attenuation bias were partialled out by including the order of presentation as an independent variable in the regressions.

Similarly, because the four studies were ran in summer and winter with both female and male participants, and because season and gender can be potential factors influencing food choice (e.g., Cash & Brown, 1989 for gender effect, and Tomlinson, 1998 for season effect), their potential effects were partialled out by including them in the regressions[3].

In order to test the predictive validity of the IAT, a binary logistic regression investigated the contributions of implicit attitude, order, gender and season in the choice for snack or fruit. Moreover, potential moderation effects were also inspected by constructing the appropriate multiplicative terms. Variables were centered before analysis to reduce multicollinearity. The final model explained 12.7% of variance. The IAT (B=.39, SE=.12, p=.001), Order (B=.50, SE=.23, p=.03), Season (B=-1.05, SE=.21, p<.001) were significant predictors whereas gender was not (B=.22, SE=.21, p=.31). None of the two- or three-way interactions were significant. Therefore, participants who had an implicit preference for fruits chose more frequently a fruit. Participants who performed the IAT with the association Fruits and positive first chose more frequently a fruit than those who performed the IAT with the association Snacks and positive first. Finally, those who participated in the study during summer were more likely to choose a fruit rather than a snack.

To test the incremental validity of the IAT, a series of binary logistic regressions were performed. At the first step, the IAT, order, season and gender were entered as predictors of choosing a fruit or a snack (which we have already discussed above). At the second step, the explicit attitude score was entered to see whether the IAT score remained a significant predictor of the behavioral choice alongside explicit attitudes. When the explicit attitude toward fruits and snacks (EASF) was entered, the full model explained 17% of variance. Although the EASF was a significant predictor (B = .51, SE = .12, p < .001), the IAT remained significant (B = .36, SE = .12, p = .003). The same pattern was found when considering in turn the explicit attitude toward snacks (EAS) or the explicit attitude toward fruits (EAF) or both. The full models explained 17.1%, 11.8% and 18.1% of variance, respectively. The EAS was a significant predictor both when considered alone (B = -.49, SE = .12, p < .001) and when considered together with EAF (B = -.55, SE = .12, p < .001). On the contrary the EAF was not significant in both cases (B = .15, SE = .11, p =.171; B = .22, SE = .12, p =.059). The IAT score was still a significant predictor after the introduction of the EAS (B = .37, SE = .12, p = .002), the EAF (B = .38, SE = .12, p = .002) and both (B = .43, SE = .12, p = .001).

In order to investigate the presence of an interactive model, the three interactions terms between IAT and each explicit attitude were added to the models reported above. The introduction of the respective interaction terms IAT x EASF, IAT x EAS and IAT x EAF did not improve the overall prediction (Nagelkerke R^2 =.172, Nagelkerke R^2 =.176 and Nagelkerke R^2 =.119, respectively) and none of the interaction effects was significant (B = .08, SE = .11, p =.447, B = -.16, SE = .11, p =.165 and B = -.06, SE = .11, p =.566, respectively). All the results therefore converged to support an additive rather than an interactive model.

Discussion

These data provide some fresh empirical evidence for both predictive and incremental validity of the IAT for behavioral food choice. Moreover, the results show that the additive rather than the interactive pattern explains the role of implicit and explicit attitudes in predicting these choices.

The contradictory results obtained by Karpinski and Hilton (2001, Study 2) and Perugini (2005a, Study 2) did not allow any clear conclusion about the predictive validity of the IAT for behavioral preferences for fruits versus snacks. Like many others in different domains, our results contribute to demonstrate the predictive validity of the IAT. More specifically, the results obtained in 4 studies with in total 399 participants show that, unlike the second study of Karpinski and Hilton (2001), the IAT predicts the behavioral preference for snacks versus fruits. The effect is significant but small, and it has been detected mainly because of the relatively big power. This can explain why previously contradictory results have been obtained. Furthermore, it has to be noticed that the IAT became a significant predictor only after having removed the effects due to the counterbalanced order of its critical steps. Given that most of the studies with the IAT as a predictor use a counterbalanced order, as recommended by Greenwald (e.g., Greenwald & Nosek, 2001), without any statistical correction, the results obtained here would suggest that the predictive validity of the IAT may be generally underestimated, because of the presence of an attenuation bias. Another interesting and perhaps unexpected result was the main effect of order of presentation, suggesting that the way in which the measure is presented predicts the behavior. In other words, asking participants to associate first fruits with positive apparently affected their subsequent choice in the same direction. One could speculate that this is an instance of a subtle effect of priming directly on behavior. This issue, which may be somehow problematic for the internal validity of the IAT as a measure, deserves further investigation.

But the most interesting results concerning the validity of the IAT are those suggesting the presence of incremental validity. Specifically, the IAT was still a significant predictor when the general attitude towards fruits and snacks or each of the specific attitude (i.e., towards fruits or towards snacks) was introduced as an additional predictor.

The procedure used in the four studies allowed only a test of the additive and interactive models of prediction. The results showed no interaction effects between implicit and explicit attitudinal measures in the prediction of the behavioral preference for fruits or snacks but supported the additive model, with unique predictive contributions from both implicit and explicit measures. This would seem to support the idea that there is a single attitude representation about fruits and snacks that is assessed by two different measures.

Although this contribution mainly focused on the results concerning the IAT and its validity, there were some interesting findings concerning explicit attitudes. First, they were able to significantly predict behavioral choice. Second, an interesting asymmetry was present. Only the Explicit Attitude toward Snacks predicted behavioral choice whereas the Explicit Attitude toward Fruits did not, suggesting that the former plays a more important role in affecting choice. This result indirectly highlights some limitations of the standard IAT. A standard IAT requires both a target category and a contrast category and therefore one cannot determine whether it measures the implicit attitude towards snacks or towards fruits. This suggests that different paradigms such as the unipolar concept IAT (SA-IAT, Penke, Eichstaedt, & Asendorpf, in press; ST-IAT, Wigboldus, Holland, & van Knippenberg, 2005), that does not need a contrast target category, could be useful, at least in the domain of food choices. Given the finding that the Explicit Attitude toward Snacks is the only one that predicts the behavioral choice, it might be worth testing whether this asymmetric predictive validity occurs also at the implicit level. Future research using two versions of ST-IAT for snacks and for fruits could test this hypothesis.

In conclusion, these studies have shown a significant effect of the IAT in terms of predicting behavioral food choices. This effect is unique to the IAT and therefore provides evidence of its incremental validity. The effect is relatively small but robust because it emerged by considering a relatively large sample of nearly 400 participants. In practical terms, a change of one unit in the IAT D score implies an increase of 43% in the likelihood of choosing a snack rather than a fruit. Future research should seek to replicate such additive patterns within different domains to further substantiate the findings reported here and the general issue concerning the predictive validity of the IAT.

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Footnotes

[1] The four studies included some additional measures that will not be considered because they were not available for all studies.

[2] There was no substantial difference between the analyses performed considering as a dependent variable the prospective choice on the spot or the behavioral choice after one week. For the sake of uniformity, in the following section we will consider only the behavioral choice.

[3] Preliminary analyses showed that the participants' age did not have any effect on the variables and therefore it was not considered further.

Table 1. Means and standard deviations for the implicit and explicit measures for each study.

	IAT		EASF		EAS		EAF	
	M	SD	M	SD	M	SD	M	SD
Study 1	.10	.57	2.04	1.08	4.10	.84	6.13	.70
Study 2	.38	.43	1.85	1.20	4.22	.90	6.07	.70
Study 3	.39	.48	1.69	1.14	4.22	.81	5.91	.71
Study 4	.46	.44	1.96	1.08	4.26	1.00	6.22	.66
	.32	.50	1.88	1.14	4.19	.88	6.07	.70

Note: IAT = Implicit Association Test (D score); EASF = Explicit Attitude toward Snacks and Fruits; EAS = Explicit Attitude toward Snacks; EAF = Explicit Attitude toward Fruits.

Table 2. Correlations between implicit and explicit measures across all four studies

	IAT	EASF	EAS	EAF	BC
IAT	1				
EASF	.08	1			
EAS	.07	-.79***	1		
EAF	-.04	.63***	-.02	1	
BC	-.09^{+} -	.23***	-.22***	.10*	1

Note: IAT = Implicit Association Test (D score); EASF = Explicit Attitude toward Snacks and Fruits; EAS = Explicit Attitude toward Snack; EAF = Explicit Attitude toward Fruits; BC = Behavioral Choice.

$^{+}$ = $p < .10$

* = $p < .05$

*** = $p < .001$

Appendix

Implicit Association Test stimuli for the 4 studies

IAT categories	Study 1	Study 2	Study 3	Study 4
Pleasant	rainbow, happy, smile, joy, peace, pleasure	idem Study 1 except pleasure	idem Study 2	idem Study2
Unpleasant	pain, death, poison, agony, sickness, vomit	idem Study 1 except vomit	idem Study 2	idem Study 2
Snacks	chocolate, cookie, cake, snacks, pastry, candy	idem Study 1 except candy	idem Study 2	chocolate, biscuits, cake, snacks, crisps
Fruits	fruits, apple, banana, grapes, kiwi, pears	fruits, apple, banana, grapes, orange	idem Study 2	fruits, apple, banana, grapes, pear