Project Implicit Technical Note 2008-01

Comparative model fitting of relations among IAT versions, attitudes, and cultural knowledge

Supplement to Nosek and Hansen (2008a, 2008b)

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Abstract

Nosek and Hansen (2008a) tested the contribution of attitudes and cultural knowledge to the Implicit Association Test and found that cultural knowledge had little or no relation to the IAT after accounting for their shared relationship with explicit attitudes. Nosek and Hansen (2008b) compared the original and personalized versions of the IAT and concluded that the personalized version encouraged explicit evaluation of target concepts, and that influence may account for the increased correlation between self-reported attitudes and the personalized IAT compared to the original IAT procedure. This supplement summarizes comparative model fitting testing whether the personalized and original tasks have distinct relations with cultural knowledge. This elaborates on the analyses reported in Nosek and Hansen (2008b) and shows that personalizing does not alter the (non) relationship between the IAT and cultural knowledge.

This supplement assumes that the reader is familiar with at least one of Nosek and Hansen (2008a) or Nosek and Hansen (2008b). We recommend reviewing those articles to extract as much useful information from this report as possible.

Hypothesis Testing Through Comparisons of Nested Structural Equation Models

Comparing results of nested structural equation models allows us systematically to test specific hypotheses about the structure of relations between variables (McArdle, Johnson, Hishinuma, Miyamoto, & Andrade, 2001). For example, we can test whether the original and personalized IATs differ in their relation to evaluative knowledge by comparing the fits of two differently constrained models of the interrelationships among knowledge, explicit attitudes, and the IAT. The models are identical except that one constrains the functional relation between knowledge and each of the IAT versions to be equal, while the other model allows those relations to vary freely for the modified and original IATs. If the latter model demonstrates a significant improvement in overall model fit, then we can conclude that relations between the two versions of the IAT and knowledge are significantly different. This enables a direct test of the conceptual question without isolating that comparison from the interrelationships with other variables (as would be the case with a significance test of the difference in correlation coefficients).

All models share a common structure in which explicit attitudes and evaluative knowledge are factors predicting the IAT. In the first two studies summarized, original and personalized IATs were collected within-subjects and are represented as two endogenous variables in a single model. In the last three studies summarized, original and personalized IATs were measured between-subjects and so we conducted two-group (original or modified) structural equation modeling with a single endogenous IAT variable (McArdle & Hamagami, 1996).

Assessment of model fit was based on the *root-mean-square error of approximation* index (RMSEA or ε_a; Browne & Cudeck, 1993; Steiger & Lind, 1980). This index weighs absolute fit, which declines whenever a parameter is removed from the model, against model complexity, such that the benefits of parsimony are considered along with fit (Steiger, 2000). Models fitting with $\varepsilon_a < .05$ are usually considered "close" fits, .05 to .08 as "fair" fits, .08 to .10 as "mediocre," and above .10 as "poor" (MacCallum, Browne, & Sugawara, 1996). Change in model fit from one proposed model to another was assessed by $\Delta\chi^2/\Delta df$

and by the 95% confidence interval (CI) of ε_a generated by this change.

Study 1: Nosek and Hansen (2008a), Study 6: Nosek and Hansen (2008b) – Racial Attitudes

Method

This study measured racial attitudes and included explicit attitude, cultural knowledge, and both original and personalized IATs. See Nosek and Hansen (2008a) for a description of the methods, and Nosek and Hansen (2008b) for a description of the original versus personalized procedures. Note that Nosek and Hansen (2008a) provides the most complete description of study methods for all studies reported here, but none of the personalized IAT data was included in that report.

Results and Discussion

Relations between the IAT and explicit attitudes and evaluative knowledge

The primary hypotheses concerning the relations between attitudes, knowledge and the IAT were tested through a comparison of nested structural equation models. We began with an unconstrained model in which all parameters were freely estimated and proceeded to add constraints in accord with specific hypotheses, testing whether the constraints resulted in significant losses in overall model fit. The final model is presented in Figure 1, and results of the sequence of nested models are presented in the top panel of Table 1.

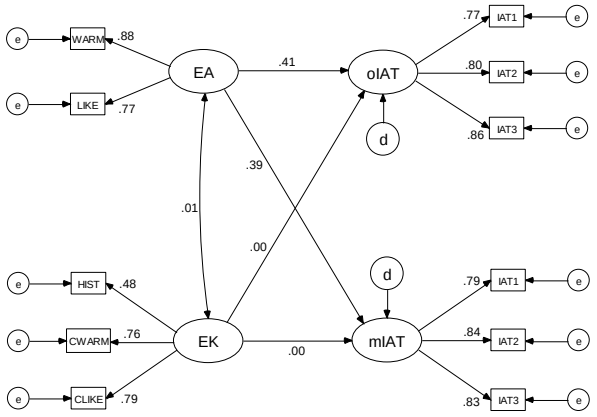
Table 1. Hypothesis Tests Relating Explicit Attitudes, Evaluative Knowledge, and the IAT Presented in a Series of Structural Model Fit Comparisons.

Model	χ^2	df	$\Delta\chi^2$/df	ε_a	95% CI ε_a of Δ
Study 1 - Racial Attitudes					
0) All parameters free	62	39		.065	
1) EK->mIAT, EK->oIAT constrained equal	62	40	.2 / 1	.063	.000, .199
2) EK->mIAT, EK->oIAT fixed to 0	62	41	.1 / 1	.061	.000, .183
3) M2 + EA->mIAT, EA->oIAT constrained equal	62	42	0 / 1	.061	.000, .000
4) M3 + EA->IAT fixed to 0	94	43	31.6 / 1	.092	.308, .638
Study 2 - Food Attitudes					
0) All parameters free	72	39		.061	
1) EK->mIAT, EK->oIAT constrained equal	72	40	0 / 1	.059	.000, .000
2) EK->mIAT, EK->oIAT fixed to 0	73	41	.8 / 1	.058	.000, .188
3) M2 + EA->mIAT, EA->oIAT constrained equal	73	42	0 / 1	.056	.000, .000
4) M3 + EA->IAT fixed to 0	189	43	115.6 / 1	.121	.578, .836

Note: All comparisons were to prior model. EA=Explicit Attitude; EK=Evaluative Knowledge (numbered if represented as multiple correlated factors); IAT = Implicit Association Test; εa = root mean square error of approximation; CI = confidence interval; mIAT = personalized (modified) IAT; oIAT = original IAT.

Question 1: Is knowledge differentially predictive of original and personalized IATs (comparison of Models 0 and 1)? We hypothesized that procedural modifications to the IAT would not affect the relationship between the IAT and evaluative knowledge. If that is true, then constraining equal the paths between knowledge and the two IAT versions should have little impact on overall model fit. Adding such a constraint (Model 1) resulted in little change in χ^2 ($\Delta\chi^2(1) = 0.2$, $p = .65$), and overall model fit is actually slightly improved ($\varepsilon_a = .063$ from $\varepsilon_a = .065$). The 95% confidence interval around the *RMSEA of the change* in fit (95% CI ε_a of Δ) between these models includes .05, a further indicator that the model fits are very close to one another.

Figure 1. Structural equation model of explicit racial attitudes (EA) and evaluative knowledge (EK) predicting original (oIAT) and personalized (mIAT) IATs (Study 1, Model 3 from Table 1).



Question 2: Is evaluative knowledge related to the IAT at all (comparison of Models 1 and 2)? We also predicted that evaluative knowledge would be unrelated to IAT scores, and tested this question by comparing Model 1 with a model in which the relationship between evaluative knowledge and the IAT was fixed to zero (Model 2). If constraining this relationship to zero resulted in significant loss of model fit, then we would have evidence that such a relationship does exist and cannot be ignored. However, adding the constraint did not significantly increase model misfit, $p = .75$, suggesting that there was no meaningful relation between knowledge and the IAT.

Question 3: Are explicit attitudes differentially predictive of original and personalized IATs (comparison of Models 2 and 3)? In Model 3, we tested whether explicit attitudes were more strongly related to the personalized than original IAT by

constraining the relationship between the paths between IATs and explicit attitudes to be equal. This resulted in no change in model fit $\Delta\chi^2(1) = 0.1$, $p = .75$, and suggests that procedural modifications did not strengthen the attitude-IAT relationship for racial attitudes.

Question 4: Are explicit attitudes related to the IAT at all (comparison of Models 3 and 4)? Our final hypothesis was that there would be a significant and positive relationship between attitude and the IAT. To test this question, we constrained in Model 4 the IAT-attitude relationship to be zero. Compared to the fit of Model 3 that did not impose such a constraint, Model 4's misfit is substantially greater ($\Delta\chi^2(1) = 31.6$, $p < .001$), *RMSEA* has increased from .06 to .09, and the 95% CI ε_a of Δ does not include .05 (.31-.64). Thus, Model 3, which allows relations between explicit attitude and IATs, is superior to Model 4, and we can conclude that there is a meaningful relationship between explicit attitudes and the IAT.

In summary, four questions were examined with progressive tests of comparative model fit that represented our hypotheses. The data was best fit by Model 3 and a path diagram is presented in Figure 1 as a summary account.[1] For evaluations of Black Americans relative to White Americans, the IAT was unrelated to evaluative knowledge, and was positively related to self-reported attitudes. Those relations did not differ between original and personalized IATs. We found no evidence to support the contention that evaluative knowledge is predictive of IAT scores, or that the proposed procedural modifications reduce such an influence.

Study 2: Nosek and Hansen (2008a); Study 7: Nosek and Hansen (2008b) – Food Attitudes

Method

This Study included 235 participants and measured implicit and explicit attitudes and cultural knowledge toward peanuts versus shellfish. See the original sources for more information about the methods. Like the previous study, personalized and original IATs were administered within subjects.

Results and Discussion

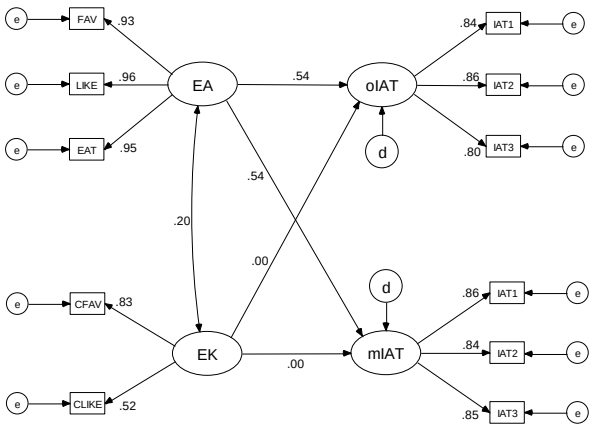
[1] Note that equality constraints from the models concern unstandardized coefficients and all Figures present standardized coefficients for interpretability. Also, in all studies there was no difference in results if questions 3 and 4 were evaluated before questions 1 and 2.

Relations between the IAT and Self-Reported Attitudes and Evaluative Knowledge

We examined the strength of the relationship between evaluative knowledge and the two versions of the IAT. If the original IAT was influenced by knowledge about others' evaluations of these foods, then these factors should correlate positively. Also, if the personalized IAT reduces or removes the influence of extra-personal knowledge, then it should show significantly weaker correspondence with the knowledge items.

We followed the hypothesis testing approach outlined in the previous study to evaluate the relations between the IAT, explicit attitudes, and evaluative knowledge. As before, a sequence of hypotheses were evaluated by comparing model fit statistics that directly examined specific hypotheses in the context of a full model of relations. The sequence of models is identical to the previous study and is summarized briefly (full model fit information is available in Table 1).

Figure 2. Structural equation model of explicit food attitudes (EA) and evaluative knowledge (EK) predicting original (oIAT) and personalized (mIAT) IATs (Study 2, Model 3 from Table 1).



The initial model allowing all parameters to vary freely fit the data reasonably well ($\varepsilon_a = .061$). Evaluative knowledge was not differentially related to original and modified versions of the IAT, $\Delta\chi^2(1) = 0$, $p = .99$ (comparing Models 0 and 1), suggesting that the procedural modifications had no effect on the relations between knowledge and the IAT. Further, fixing the relationship between evaluative knowledge and the IAT to zero had minimal impact on model fit, indicating that evaluative knowledge was unrelated to IAT scores, $\Delta\chi^2(1) = 0.8$, $p = .37$ (comparing Models 1 and 2). The IAT-attitude relationship did not vary between IAT versions, $\Delta\chi^2(1) = 0$, $p = .99$ (comparing Models 2 and 3). Finally, the relationship between

explicit attitudes and the IAT was positive and significant; fixing that relationship to zero significantly increased model misfit, $\Delta\chi^2(1) = 115.6$, $p < .0001$ (comparing Models 3 and 4).

In summary, these progressive model tests replicated prior observations in the domain of food attitudes. Figure 2 shows Model 3, representing the best fitting model. Again, the IAT was not related to evaluative knowledge and was positively related to self-reported attitudes. The procedural modifications to the IAT did not moderate either of these relations. We found no evidence for an extra-personal knowledge confound in the IAT, and no evidence to support the contention that the proposed IAT procedural modifications help to reduce that influence.

Study 3: Nosek and Hansen (2008a); Study 2: Nosek and Hansen (2008b) – Political Attitudes

Method

This Study (*N*=1124) administered the personalized, hybrid, and original IATs measuring attitudes toward John Kerry and George Bush between subjects. Only data from the personalized and original IATs are used for these analyses. See the original reports for more details on the method.

Results and Discussion

Relations between the IAT, Explicit Attitudes and Evaluative Knowledge

We examined our hypotheses concerning the relations between attitudes, knowledge and the IAT following the comparative model fitting approach used in the previous studies. However, since the IAT version was manipulated between-subjects, rather than within subjects, a multiple-group (two) structural modeling approach was used. Model fit results are presented in the first panel of Table 2.

Question 0.1: Can factorial invariance be assumed for measurement models across groups? A confident comparison of latent factors between groups (original and personalized IATs) requires that the underlying measurement models show factorial invariance (Horn & McArdle, 1992; Meredith, 1964; Thurstone, 1947), that is, that the pattern of factor loadings is similarly across groups. Factorial invariance was examined by constraining the factor loadings equal across groups and comparing the fit with a model in which all loadings varied freely. Adding the loading constraint resulted in a non-significant change, $\Delta\chi^2(9) = 16.5$, $p = .06$ and a slight improvement in overall model fit (95% CI ε_a of Δ= .000, .063), demonstrating that the assumption of invariance across groups is justified.

Table 2. Hypothesis Tests Relating Explicit Attitudes, Evaluative Knowledge and the IAT Presented in a Series of Structural Model Fit Comparisons.

Model	χ2	df	$\Delta\chi^2$/df	ε_a	95% CI ε_a of Δ
Study 3 - Political Attitudes					
0) All parameters free	368	118		.054	
0.5) EA<->EK1, EA<->EK2 constrained equal across groups	371	121	3.1 / 3	.053	.000, .070
1) M0.5 + EK1->IAT, EK2->IAT equal across groups	378	123	6.8 / 2	.053	.000, .116
2) M1 + EK1->IAT, EK2->IAT fixed to 0	382	125	4.3 / 2	.053	.000, .101
3) M2 + EA->IAT equal across groups	391	126	9.2 / 1	.054	.039, .184
4o) M2 + EA->IAT fixed to 0 for original IAT only	547	126	165.2 / 1[a]	.068	.403, .548[a]
4m) M2 + EA->IAT fixed to 0 for modified IAT only	642	126	259.9 / 1[a]	.075	.524, .669[a]
Study 4 - Racial Attitudes					
0) All parameters free	95	68		.030	
0.1) Factor loadings equal across groups	98	74	3.2 / 6	.027	.000, .050
0.2) M0.1 EA<->EK1, EA<->EK2, EA<->EK3 equal across groups	101	80	2.8 / 6	.025	.000, .044
1) M0.2 + EK1->IAT, EK2->IAT, EK3->IAT equal across groups	102	83	1.7 / 3	.023	.000, .076
2) M1 + EK1->IAT, EK2->IAT, EK3->IAT fixed to 0	108	86	6.1 / 3	.025	.000, .115
3) M2 + EA->IAT equal across groups	109	87	.3 / 1	.024	.000, .120
4) M3 + EA->IAT fixed to 0	158	88	49 / 1	.043	.244, .434
Study 5 - Food Attitudes					
0) All parameters free	259	76		.056	
0.1) Factor loadings equal across groups	261	83	.9 / 7	.053	.000, .000
0.2) EA<->EK1, EA<->EK2, EK1<->EK2 equal across groups	263	86	1.9 / 3	.052	.000, .059
1) M0.2 + EK1->IAT, EK2->IAT equal across groups	264	88	1.3 / 2	.051	.000, .072
2) M1 + EK1->IAT, EK2->IAT, fixed to 0	266	90	1.7 / 2	.051	.000, .077
3) M2 + EA->IAT equal across groups	270	91	4.5 / 1	.051	.000, .148
4o) M2 + EA->IAT fixed to 0 for Original IAT only	309	91	43.3 / 1[a]	.056	.168, .310
4m) M2 + EA->IAT fixed to 0 for Modified IAT only	346	91	80.5 / 1[a]	.061	.255, .397

Note: [a] compared to Model 1 in top two panels and to Model 2 in bottom panel, otherwise all comparisons were to prior model. EA=Explicit Attitude; EK=Evaluative Knowledge (numbered if represented as multiple correlated factors); IAT = Implicit Association Test; ε_a = root mean square error of approximation; CI = confidence interval.

Question 0.2: Is the relationship between explicit attitudes and evaluative knowledge different across conditions (comparison of Models 0.1 and 0.2)? Whether participants completed the original or personalized IAT should have no impact on the relationship between evaluative knowledge and explicit attitudes. This preliminary prediction was tested by constraining the attitude-knowledge relationship equal between groups. Consistent with our hypothesis, this resulted in minimal loss of model fit compared to the unconstrained model, $p = .53$.

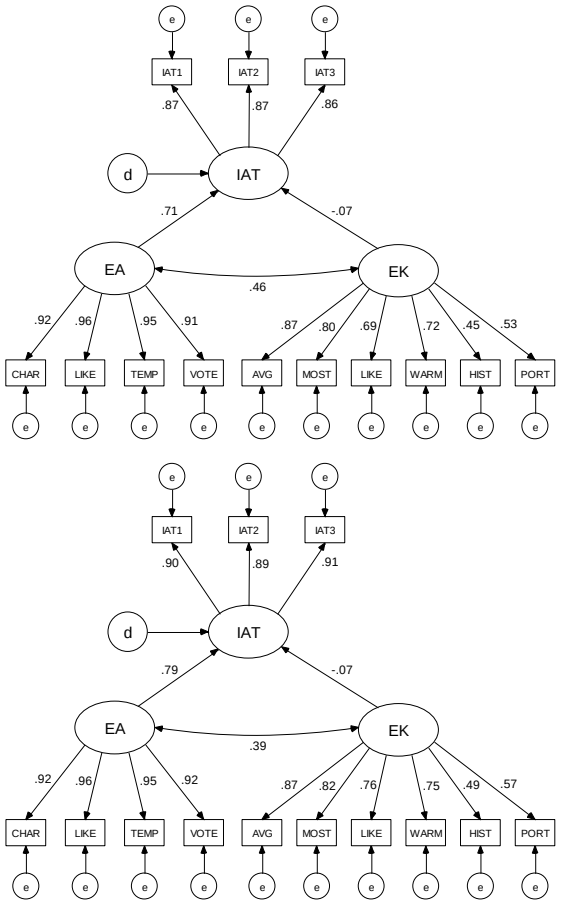
Question 1: Is knowledge differentially predictive of original and personalized IATs (comparison of Models 0.2 and 1)? We hypothesized that procedural modifications to the IAT would not affect the relationship between the IAT and evaluative knowledge. If that is true, then constraining the knowledge-IAT relations to be equal across IAT conditions should have little impact in overall model fit. Adding such a constraint (Model 1) resulted in a trivial change in χ^2 relative to Model 0.2, $\Delta\chi^2(1) = 0.5$, $p = .48$. This suggests that the procedural modifications had no effect on the IAT's relation with evaluative knowledge.

Question 2: Is evaluative knowledge related to the IAT at all (comparison of Models 1 and 2)? We predicted that evaluative knowledge would have no meaningful relationship to IAT scores. This question was tested by fixing for both groups the relationship between evaluative knowledge and the IAT to zero. If constraining this relationship to be zero (Model 2) results in a meaningful decrement in model fit, then we would have evidence that such a relationship does exist and should not be ignored. The difference in χ^2 between Models 2 and 1 is statistically significant ($\Delta\chi^2(1) = 3.9$, $p = .05$), but trivial in the context of the models' complexity and sample size. This assertion is supported by observing that the *RMSEA* for Model 2 was unchanged ($\varepsilon_a = .060$), and the 95% CI for the *RMSEA of the change* includes .05 (.00-.15). This indicates that the fits of these models are not substantively different and that the gain in parsimony from the added constraint compensated for the minor loss of fit. Further, the relationship between knowledge and the IAT was actually in the opposite direction predicted by prior theories (Karpinski & Hilton, 2001; Olson & Fazio, 2004). That is, people who believed that others had a greater preference for Bush relative to Kerry actually showed slightly greater preference for Kerry relative to Bush on the IAT ($\beta = -.07$; see Figure 3). Despite the minimal change in fit, the small magnitude of effect, and the opposite direction from prediction, this is an inkling of there being even a slight relationship between knowledge and the IAT. So, to give the hypothesis that knowledge and the IAT are related every chance to persist, we did not retain the zero-constraint on the IAT-knowledge relationship.

Question 3: Are explicit attitudes differentially predictive of original and personalized IATs (comparison of Models 1 and 3)? In Model 3, we constrained the relationship between the IAT and explicit attitude to be equal across IAT conditions and again observed, despite the small, but statistically significant change in χ^2 compared to the less constrained Model 2 ($\Delta\chi^2(1) = 7.5$, $p = .01$) that these models are not substantially different ($\varepsilon_a = .061$ for Model 3, .060 for Model 1; and 95% CI ε_a of Δ includes .05. However, because the difference in correlation strength between explicit attitudes and the IAT versions is critical to the hypothesis proposed by Olson and Fazio (2004), we retained the less constrained Model 2. The procedural modifications did affect the relationship between the IAT and explicit attitude for these political attitudes, and the IAT-attitude relationship was stronger for the personalized IAT than for the original IAT (see Figure 3).

Question 4: Are explicit attitudes related to the IAT at all (comparison of Models 1 and 4o and 4m)? Because the original and personalized IATs exhibited different relations with self-reported attitudes, testing the magnitude of the relationship between attitudes and the IAT were conducted separately for each IAT version. Model 4o fixed the relationship between explicit attitudes and the original IAT to zero and was compared to Model 1 to test whether defining a null attitude-original IAT relationship resulted in an important loss of fit. Model 4m allowed for the same comparison but with the explicit attitude-personalized IAT relationship fixed to zero.

Figure 3. Two-group (original IAT top and personalized IAT bottom) structural equation model of explicit political attitudes (EA) and evaluative knowledge (EK) predicting IAT scores (Study 3, Model 1 from Table 2).



The results presented in Table 2 make clear that in both cases, fixing the IAT-attitude relationship to zero had substantial deleterious effects on the quality of model fit (original: $\Delta\chi^2(1) = 165$, $p < .0001$; modified: $\Delta\chi^2(1) = 260$, $p < .0001$). The ε_a was likewise negatively affected by adding these constraints and the 95% CIs

for *RMSEAs of the changes* no longer include .05. We can thus conclude that there is a meaningful relationship between explicit attitudes and the IAT, both in its original and personalized form.

Model 1 is presented in Figure 3 as the summary account of the results. For evaluations of George Bush relative to John Kerry, the IAT was weakly but negatively related to evaluative knowledge, and was strongly and positively related to self-reported attitudes. Also, replicating earlier work, the procedural modifications resulted in somewhat stronger positive correspondence with self-reported attitudes (β for original IAT = .71, personalized IAT = .79). Consistent with the prior studies, we found no evidence to support the contention that the proposed procedural modifications reduce a confounding influence of evaluative knowledge, even in this case where a weak knowledge-IAT relationship was observed.

Study 4: Nosek and Hansen (2008a); Study 3: Nosek and Hansen (2008b) – Racial Attitudes

Method

This Study (*N*=735) administered the personalized, hybrid, and original IATs measuring attitudes toward Black Americans versus White Americans between subjects. Only data from the personalized and original IATs are used for these analyses. See the original reports for more details on the method.

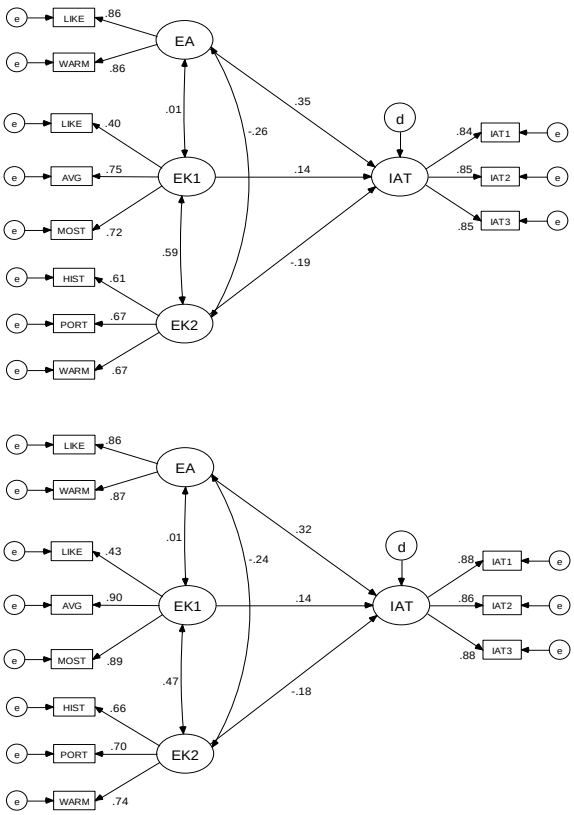
Results and Discussion

Analysis followed the approach described in the previous study, and results are presented briefly to conserve space. An exploratory factor analysis of the knowledge items revealed two eigenvalues ≥ 1.0 (2.8, 1.2), leading to a correlated, two-factor model (Factor 1: liking and preferences of average and most people; Factor 2: warmth and historical and social portrayals) of evaluative knowledge. As before, analyses with the individual manifest knowledge items were consistent with the reported effects unless otherwise noted.[2]

Relations between the IAT, explicit attitudes, and evaluative knowledge

To examine the relations between the IAT, explicit attitudes, and evaluative knowledge, this study followed the same series of hypothesis tests described in the previous study. The results are summarized in Table 2.

Figure 4. **Two-group (original IAT top and personalized IAT bottom) structural equation model of explicit racial attitudes (EA) and evaluative knowledge (EK) predicting IAT scores (Study 4, Model 3 from Table 2).**



The initial model allowing all parameters to vary freely was a good fit to the data (ε_a = .036) and comparison to Model 0.1 supports an assumption of factorial invariance, $\Delta\chi^2(7) = 6.8$, $p = .45$. Further constraining the relationship between explicit attitudes and evaluative knowledge to be equal across IAT conditions had no effect on overall model fit, $p = .64$ (comparing Models 0.1 and 0.2).

Concerning the substantive hypotheses, evaluative knowledge was not differentially related to original and modified versions of the IAT, $\Delta\chi^2(2) = 1.1$, $p = .58$ (comparing Models 0.2 and 1), suggesting that the procedural modifications had no effect on the relations between knowledge and the IAT. Fixing the relationship between evaluative knowledge and the

[2] Typically, using exploratory factor analysis is considered a liability because it can increase the incidence of Type I error, and a priori factor identification is much preferred. However, this approach maximizes the potential to show that a knowledge-IAT relation may exist. Note that the exploratory factor identification was only conducted for knowledge. For explicit attitudes, a single a priori defined factor was used in all models.

IAT to zero had a small but significant impact on model fit indicating that evaluative knowledge was related to IAT scores, $\Delta\chi^2(2) = 6.0$, $p = .05$ (comparing Models 1 and 2). As before, despite the significant change in χ^2, the change in ε_a was minimal and the 95% confidence interval included .05 (see Table 2), again suggesting that statistical significance was a consequence of large sample size. Examination of beta weights revealed that one relation was positive and the other negative. Further, follow-up tests on the individual knowledge items showed that only one (historical portrayals) was significantly related to the IAT ($p = .051$) and in the wrong direction ($\beta = -.14$). Even so, the relation was retained to promote the best opportunity for a knowledge-IAT relation to persist.

Replicating the observation for racial attitudes in Study 2, the IAT-attitude relationship did not vary between IAT versions, $\Delta\chi^2(1) = .4$, $p = .53$ (comparing Models 1 and 3). Finally, the relationship between explicit attitudes and the IAT was positive and significant and fixing that relationship to zero significantly increased model misfit ($\Delta\chi^2(1) = 30.6$, $p < .0001$), the change in *RMSEA* was substantial and its 95% confidence interval did not include .05 (comparing Models 3 and 4).

The summary model is represented in Figure 4. For evaluations of Blacks relative to Whites, the IAT was positively related to self-reported attitudes and showed slight positive and negative relations with evaluative knowledge. The procedural modifications to the IAT did not moderate either of these relations. While showing a significant IAT-knowledge relation, these data were not very reassuring for the knowledge confound hypothesis. The knowledge relation was in the opposite direction from prediction for one factor, and the effect was so small that model fit indices suggested that it was meaningless. The lack of adjustment to the significance level in the context of the large sample sizes may be the culprit.

Study 5: Nosek and Hansen (2008a); Study 4: Nosek and Hansen (2008b) – Food Attitudes

Method

This Study (*N*=1197) administered the personalized, hybrid, and original IATs measuring attitudes toward candy bars versus apples between subjects. Only data from the personalized and original IATs are used for these analyses. See the original reports for more details on the method.

Results and Discussion

The knowledge items were positively correlated with one another (*r*s = .05 - .68, median $r = .17$), and preliminary analysis indicated some heterogeneity such that the best latent model of evaluative knowledge involved two correlated factors (eigenvalues ≥ 1.0: 2.3, 1.6; Factor 1: liking and warmth of society and estimates of average and most people's preferences; Factor 2: historical and social portrayal). A two-factor representation of evaluative knowledge was used for the subsequent analyses. The same analyses conducted on each of the individual manifest knowledge items were consistent with the reported results.

Relations between the IAT, Explicit Attitudes, and Evaluative Knowledge

In this study the target concepts of interest were evaluations of food (Candy Bars versus Apples). The results are summarized in the third panel of Table 2. Again, the initial model allowing all parameters to vary freely fit the data reasonably well ($\varepsilon_a = .056$) and constraining the factor loading equal across groups resulted in minimal loss of fit, $\Delta\chi^2(7) = .9$, $p = .99$ (comparing Models 0 and 0.1). Also, constraining the relationship between explicit attitudes and evaluative knowledge to be equal across IAT conditions had no effect on overall model fit, $\Delta\chi^2(3) = 1.9$, $p = .59$ (comparing Models 0.1 and 0.2).

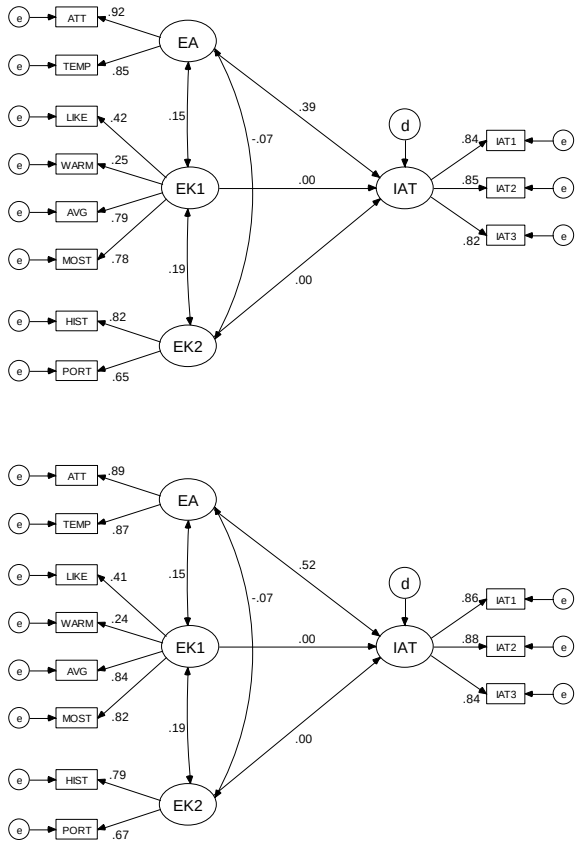
More critically, evaluative knowledge was not differentially related to original and personalized versions of the IAT, $\Delta\chi^2(2) = 1.3$, $p = .52$ (comparing Models 0.2 and 1) suggesting that the procedural modifications had no effect on the relations between knowledge and the IAT. Fixing the relationship between evaluative knowledge and the IAT to zero had no impact on model fit, $\Delta\chi^2(2) = 1.7$, $p = .43$ (comparing Models 1 and 2).

Previous studies demonstrated inconsistency in whether the IAT modifications would elicit stronger correspondence with explicit attitudes. Constraining the attitude-IAT relationship to be equal across IAT versions for Candy Bar-Apple attitudes resulted in a significant change in χ^2, $\Delta\chi^2(1) = 4.5$, $p = .03$ (comparing Models 2 and 3). However, there was no change in overall model fit ($\varepsilon_a = .051$). Even so, because this difference is central to the hypothesis that the IAT modifications reduce the influence of confounding variance, we did not force this equality constraint.

Because the attitude-IAT relationship was not constrained equal across groups, two separate models tested setting the attitude-IAT relationship to zero for the original and personalized IATs. In both cases,

constraining the attitude-IAT relationship to zero resulted in a substantial increase in model misfit (Original IAT only: $\Delta\chi^2(1) = 43.3$, $p < .0001$; Personalized IAT only: $\Delta\chi^2(1) = 80.5$, $p < .0001$; comparing Model 2 with 4o and 4m), and the 95% confidence interval of the ε_a of change clearly shows a decline in fit that does not justify adding this constraint. This indicates that both versions of the IAT were related to self-reported attitudes.

Figure 5. Two-group (original IAT top and personalized IAT bottom) structural equation model of explicit food attitudes (EA) and evaluative knowledge (EK) predicting IAT scores (Study 5, Model 2 from Table 2).



These effects are summarized graphically by Model 2 in Figure 5. For evaluations of Candy Bars relative to Apples, the IAT was not related to evaluative knowledge and was related to self-reported attitudes. The procedural modifications to the IAT altered the attitude-IAT relationship such that the personalized IAT showed somewhat stronger relations to self-reported attitudes. Despite high power and a heterogeneous array of evaluative knowledge assessments, we found no evidence for an evaluative knowledge confound in the IAT, and no evidence to support the contention that the proposed procedural modifications to the IAT help to reduce such a confounding influence.

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