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Unresolved problems with the "I", the "A", and the "T": A logical and psychometric critique of the Implicit Association Test (IAT)

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The Implicit Association Test (IAT) had already gained the status of a prominent assessment procedure before its psychometric properties and underlying task structure were understood. The present critique addresses five major problems that arise when the IAT is used for diagnostic inferences: (1) the asymmetry of causal and diagnostic inferences; (2) the viability of the underlying association model; (3) the lack of a testable model underlying IAT-based inferences; (4) the difficulties of interpreting difference scores; and (5) the susceptibility of the IAT to deliberate faking and strategic processing. Based on a theoretical reflection of these issues, and a comprehensive survey of published IAT studies, it is concluded that a number of uncontrolled factors can produce (or reduce) significant IAT scores independently of the personality attribute that is supposed to be captured by the IAT procedure.

The present critique of the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998) pertains to *diagnostic inferences* from IAT

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scores (conceived as a personality test) to underlying person attributes, as distinguished from *causal analyses* of the impact of experimentally controlled factors on IAT performance (conceived as a research tool). In experimental research, a causal factor is manipulated between randomised groups (e.g., a negative attitude to a face brought about by conditioning), and the causal question is whether some dependent measure (e.g., the IAT) reflects the experimentally controlled factor. If it does, any difference observed in the dependent measure can only reflect the experimental manipulation. The only causal factor is established firmly, randomised groups cancel out extraneous variance and the data are aggregated at group level, and there is no need to predict individual data. In contrast, when an individual's test score is used diagnostically, the causal factor to be inferred is not under the experimenter's command, the data analyses do not aggregate across many individuals, and no randomisation is involved so that an unknown number of uncontrolled factors may have influenced the individual's test performance. As a consequence, diagnostic inferences can be assumed to involve more risk and uncertainty than causal or experimental inferences.

Is the IAT actually used as a diagnostic inference tool, so that psychometric criteria must be applied? Or is it just an ordinary dependent measure for experimental research, like a "recognition test" or an informal "speed test", as proponents of the IAT have recently asserted in response to psychometric critique?[1] To be sure, in science it matters little what proponents and authors declare; what is relevant is what function the IAT is playing in scientific reality. In this regard, it would hardly be justified to negate the diagnostic role attributed to the IAT. The IAT is abundantly used, and was originally meant (Greenwald et al., 1998), as a tool for measuring individual differences. Psychometric criteria, like validity and reliability, are explicitly reported (cf. Bosson, Swann, & Pennebaker, 2000; Cunningham, Preacher, & Banaji, 2001; Egloff, Schwerdtfeger, & Schmukle, 2005; Greenwald & Farnham, 2000; Nosek, Greenwald, & Banaji, in press; Schmukle & Egloff, 2004), often treating *the* IAT as a unitary category, like a standardised diagnostic procedure. In many published studies, when IAT scores are given, their meaning and interpretation are open to be inferred. The most chosen research focus is on the IAT as a diagnostic end in itself and only rarely on tests of IAT-independent cognitive or affective hypotheses (for notable exceptions see Devine, Plant, Amodio, Harmon-Jones, & Vance, 2002; Wittenbrink, Judd, & Park, 2001), rendering it quite different from simple research tools, such as a recognition test or a priming

[1]For example, the argument, presented by a prominent IAT proponent in a review of a former version of this chapter, that "the IAT is not a diagnostic instrument but a tool for measuring individual differences", reflects a misunderstanding of the term "diagnostic".

measure. IAT scores are given surplus meaning, supposed to reflect some hidden attribute that is "not dependent on introspection" (Nosek et al., in press; e.g., an automatic ingredient to prejudice) and that often evades other measurement procedures. And some of the most prominent IAT applications, even in journals as highly cited as *Nature* (Gray, MacCulloch, Smith, Morris, & Snowden, 2003), clearly emphasise the diagnostic function of individual IAT scores: "... this test may become an important tool for distinguishing psychopaths who are likely to commit extremely violent offences from those who are not" (Gray et al., 2003, p. 497). Egloff and Schmukle (2002) refer to the "predictive validity of an implicit association test for assessing anxiety", and Asendorpf, Banse, and Mücke (2002, p. 392) concluded: "Just as free associations in psychoanalytic settings provide a window to the unconscious, implicit association tests provide another, probably more reliable window."

It would thus appear to be fair and appropriate to treat the IAT with the same scrutiny and scientific rigour as other diagnostic procedures, such as intelligence tests (Binet, Simon, & Town, 1913; Raven, 1941), survey measures of attitudes (Schwarz & Sudman, 1996), polygraph tests (Fiedler, Schmid, & Stahl, 2002), or projective tests (Lilienfeld, Wood, & Garp, 2000). Indeed, our critique of the IAT was motivated by the fact that in social cognition, the IAT's home discipline, the legal use of polygraph testing is often considered a prime example of scientifically questionable practice. Asking analogous questions as in the polygraph-test debate should thus not harm the IAT: Could IAT results reflect false alarms (e.g., high test scores in the absence of prejudice) or always hits (cf. Fiedler et al., 2002)? Can IAT results be simulated or dissimulated (cf. Honts, Hodes, & Raskin, 1985)? Can the IAT be considered a standardised procedure at all? What cognitive or sensori-motor model can account for the performance on an IAT task? The highest degree of scrutiny and scientific rigour are called for as pertinent scientific results intrude into societal and legal systems (Kang & Banaji, in press).

Any problems along these lines should be of interest to students of the IAT, especially those not tackled in the "Top ten list of things wrong with the IAT" (Greenwald, 2004). To anticipate the conclusion of our IAT critique, some problems may be circumvented in the future, but some appear to be hard to overcome. Although our critique relies on common knowledge and methodological principles, and although a number of recent articles have tackled one or two issues (Brendl, Markman, & Messner, 2001; Fazio & Olson, 2003; Mierke & Klauer, 2001, 2003; Rothermund & Wentura, 2004; Steffens & Plewe, 2001), we believe our analysis is unique in integrating the critique, going beyond the issues already raised by Plessner and Banse (2001).

The following brief sketch of how the IAT works can be skipped by readers who are familiar with the procedure. We shall then first provide an

overview of five major problems. The remainder of this chapter will be devoted to a more elaborate review and critique of those five problems, which all somehow relate to the letters "I", "A", "T".

A BRIEF SKETCH OF THE IAT

The IAT constitutes an attempt to measure person attributes that are assumed to rely on implicit associations,[2] including attitudes, stereotypes, self esteem, and self-conceptions (Greenwald, Banaji, Rudman, Farnham, Nosek, & Mellott, 2002a; Greenwald et al., 1998). These attributes are defined as implicit associations between an object and an evaluation (attitude), an object and an attribute (stereotype), the self and an evaluation (self-esteem), or the self and an attribute (self-conception). We confine ourselves to attitudes, but analogous arguments apply to the other three attribute types.

The IAT is designed to measure the strength of such associations, using small sets of stimuli selected to represent those constituents (e.g., a set of Turkish names and evaluative terms when measuring the attitudinal association between Turks and valence). The example of an IAT used to assess Germans' attitudes towards Turks will be used throughout this chapter. An attitude IAT assesses speed on a computerised two-fold sorting task involving two response keys on the keyboard. The stimuli to be sorted represent (a) two attribute concepts of opposite valence (e.g., positive vs negative words) and (b) two target categories (e.g., German and Turkish names). The test score is the difference in sorting time required for sorting the stimuli into two response categories under two conditions. In the *compatible* condition (assuming a pro-German/anti-Turkish attitude), the instruction is to use the same response key for positive stimuli and names of Germans, but another key for negative stimuli and names of Turks. In the *incompatible* condition, positive stimuli and Turkish names are mapped onto one key and negative stimuli and German names on the other. A negative implicit attitude against Turks would be evident in faster responding in the former than in the latter condition.

Anyone who has participated in an IAT will have experienced how hard it is to counteract the slowdown on incompatible trials. Among German students, the proportion that takes longer to sort Turks and positive valence together than to map Germans and positive valence onto the same response key can be estimated to be more than 75% ($N = 144$; Fiedler & Bluemke, 2005; Exps. 1–3), suggesting almost consensual implicit prejudice, although

[2]It is unclear whether the term implicit in the IAT refers to implicitly learned attitudes or associations, to implicitly assessed attitudes or associations, or to a construct of implicit associations, which would presuppose the existence of explicit associations by complement.

the vast majority from this population would verbally assert themselves not to be prejudiced at all, and many of them would actually be in contact with Turkish friends. Likewise 25 of 26 White psychology students taking part in the seminal study (Greenwald et al., 1998, Exp. 3) received a Black–White IAT score in favour of Whites, which—according to the authors—indicated "the pervasiveness of unconscious forms of prejudice" (p. 1475). Olson and Fazio (2003) found a prejudice prevalence of 79% among White undergraduates ($N = 100$), according to the IAT. With respect to the discrepancy of IAT scores and self-reports, the IAT's declared purpose is to capture implicit associative structures revealing latent ethnic attitudes that may not be accessible in explicit measures, such as interviews and questionnaires, which are typically biased towards social desirability or political correctness (Pettigrew & Meertens, 1995), or depend on depth of information processing (Florack, Scarabis, & Bless, 2001; Wilson, Lindsay, & Schooler, 2000). However, alternatively, rather than reflecting a prejudice prevalence which is actually that high, it may be possible that other, uncontrolled factors are responsible for the high rate of significant IAT scores.

Status of the IAT

Within a few years, the IAT has gained the status of a major research topic. Today, hardly any lab in social or personality psychology can be found that is not somehow concerned with this favourite tool. No other recent innovation in testing has reached a comparable degree of popularity in both basic and applied research. This outstanding prominence of the IAT reflects several factors, such as unrestricted availability on the Internet, affinity to the modern notion of implicit cognition (Greenwald & Banaji, 1995; Roediger, 1990; Schacter, 1987), and the strong and significant results almost guaranteed in IAT studies (cf. Greenwald & Nosek, 2001).

However, we believe the main reason for the importance ascribed to the IAT derives from its status as a test. As a test that promises to measure prejudice (against females, Black people, and minorities), and introspectively unidentified or voluntarily hidden affective attitude components (related to sensitive, intimate, and potentially illegal attitude objects), the IAT appears to fulfil a basic need, namely to reveal people's ultimate internal motives, desires, and unconscious tendencies. Those who have taken part in an IAT and experienced a seemingly irresistible slowdown on incompatible trials will understand why researchers believe they have found a fascinating instrument. This phenomenological experience raises the surplus meaning of a test that discloses the ultimate, uncontrollable, hard-to-fake tendencies residing in the mind. It is but one step further to assume that, at least in some cases (cf. Nosek, Greenwald, & Banaji, 2005), these automatic tendencies are closer to the "true" attitudes than explicit self-reports. Thus, the IAT

is assumed to avoid the pitfalls of traditional attitude measurement. The IAT is assumed to "be necessary to examine socially sensitive attitudes" (Dasgupta, McGhee, Greenwald, & Banaji, 2000, p. 326) or to assess a distinct aspect of two coexisting attitude components, "... both obese and normal-weight controls have an implicit as well as an explicit negative attitude towards high-fat foods" (Roefs & Jansen, 2002, p. 520). Some IAT proponents advocate that society as a whole suffers from "pervasive implicit biases"—based on IAT studies to a large degree—and request that societal action take these considerations into account (Kang & Banaji, in press).

Among IAT users, it is generally taken for granted that high IAT scores (i.e., high latency differences for incompatible minus compatible trials in speeded classification) can be interpreted as, or even equated with, attitudinal associations. Little attention is given to such questions as: Is the prevalence of implicit anti-Black attitudes among American students really as high as 96% (Greenwald et al., 1998, Exp. 3)? Or could this prevalence be (partly) due to alternative causes that are independent of attitudes? Could the summed latency on a speeded classification task measure something different from attitudinal associations? To what degree are latency measures influenced by sensori-motor skills and general processing speed? To what extent does the summed latency measure tap into something about the stimuli used for the IAT as opposed to the test person's attitude?

FIVE MAJOR PROBLEMS OF THE IAT

In this chapter, we shall address five serious but mostly ignored problems of the IAT, drawing on a survey of all peer-reviewed IAT studies that were available in the PsycINFO database in October 2005 (listed in the Appendix):

1. The asymmetry of causal and diagnostic inferences; that is, between the conditional probability $p(\mathrm{A} \mid \mathrm{IAT}+)$ that an attitude A can be inferred from an elevated test score IAT+ and the reverse, causal probability, $p(\mathrm{IAT}+ \mid \mathrm{A})$, which can differ greatly.
2. The viability of the underlying association model.
3. The lack of a cognitive-process model and a psychometric model.
4. The long-known problems that complicate difference scores, and the differential susceptibility of the two latency components to uncontrolled factors.
5. The susceptibility of the IAT to deliberate faking and strategic processing.

These five major problems can be classified as speaking to the issue of *implicitness* of measurement (Problem 5 referring to the letter "I"), the

psychology of *association* (Problem 2 referring to the letter "A"), and psychometric issues relevant to *tests* (Problems 1, 3, and 4 referring to the letter "T").

Problem 1: Asymmetry of causal and diagnostic inference

A major source of misunderstandings in diagnostic assessment, and a challenging topic of research, is that the likelihood of diagnostic inferences can be radically different from the likelihood of the reverse causal inferences (Fiedler, Brinkmann, Betsch & Wild, 2000; Gigerenzer & Hoffrage, 1995; Swets, Dawes & Monahan, 2000). To illustrate this Bayesian issue, the (causal) probability of a positive mammogram, given that the test person actually has breast cancer, is much higher than the reverse (diagnostic) probability that a (randomly selected) person has breast cancer, given a positive mammogram.[3] Bayesian calculus shows that this happens when the base rate of the diagnostic sign, or positive test result, exceeds the base rate of the attribute to be diagnosed. From $p(\text{test}+) > p(\text{breast cancer})$, it follows that the causal inference $p(\text{test}+ \mid \text{breast cancer})$ is more likely than the diagnostic inference $p(\text{breast cancer} \mid \text{test}+)$. For pragmatic reasons (e.g., liability; unequal cost of false positives and false negatives), the sensitivity of the test should be high, but this gives rise to false diagnostic inferences (false alarms, false positives).

There are good reasons to expect, or at least to consider seriously, that the same basic asymmetry of conditional probabilities applies to IAT outcomes, although attitude measurement is fundamentally different from cancer diagnosis. As already mentioned, the base rate of significant IAT scores can be very high: 77% for Germans' attitude against Turks; 96% for White American students' prejudice against Blacks. Such a high consensus is often taken for granted as evidence that an implicit "racial bias" is very common (Richeson et al., 2003). However, rather than adopting such an overly pessimistic view, which is hardly justified on a priori grounds, an alternative assumption is that IAT+ scores are just more prevalent than the attitude (A) to be diagnosed, $p(\text{IAT}+) > p(\text{A})$. If this is the case, because IAT effects may reflect other causes than genuine attitudes, Bayes' theorem implies that the diagnostic probability $p(\text{A} \mid \text{IAT}+)$ is lower than the causal probability $p(\text{IAT}+ \mid \text{A})$. Thus, while the probability for causal inferences of IAT effects (IAT+) from experimentally induced attitudes (A) may be high, the reverse probability for diagnostic inferences from IAT+ to A may be quite low. As the mammography example suggests, this asymmetry can be extreme. Likewise, the inequality of $p(\text{IAT}+) > p(\text{A})$ can be severe (see Figure 1), depending on whether IAT+ scores can originate in other causes than A—an issue central to later sections.

[3]The two conditionals actually differ by the factor 10 (cf. Gigerenzer & Hoffrage, 1995).

Unfortunately, the correlation coefficients commonly reported as measures of validity are not sensitive to such asymmetries. Even when $p(\mathrm{A} \mid \mathrm{IAT}+)$ is low, as most A cases constitute but a small subset of IAT+ cases (Figure 1), the resulting validity coefficient can indicate a significant relationship $r_{\mathrm{IAT} \bullet \mathrm{A}}$, simply because subsets usually correlate with supersets. This problem is widely ignored in validity studies in general and in IAT research in particular. Table 1 shows the correlations that can be expected between the occurrence of the attribute A (subset) and the diagnostic index IAT+ (superset) for various assumptions about the diagnostic conditional,

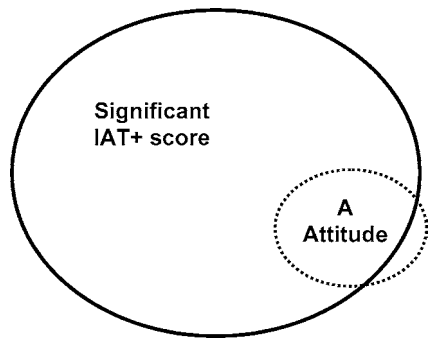

Figure 1. To the extent that attitudes constitute but a subset of the entire set of significant IAT+ scores, inferences from IAT+ effects to attitudes A are asymmetrically weaker than inferences from A to IAT+ effects.

TABLE 1
Subset and superset

	p(A | IAT+)				
p(IAT+) Base rate	*.10*	*.20*	*.30*	*.40*	*.50*
.10	0.30	0.43	0.53	0.61	0.69
.20	0.29	0.41	0.51	0.59	0.67
.30	0.27	0.39	0.48	0.56	0.64
.40	0.25	0.36	0.45	0.53	0.61
.50	0.23	0.33	0.42	0.50	0.58
.60	0.21	0.30	0.38	0.46	0.53
.70	0.18	0.26	0.34	0.41	0.48
.80	0.15	0.22	0.28	0.34	0.41

Correlations between attitude (subset) and the occurrence of a high IAT score (superset) as a function of the base rate of high IAT scores and the proportion of high IAT scores reflecting an implicit attitude.

$p(A \mid IAT+)$, and the base rate, $p(IAT+)$.[4] For example, the entry in the second row and the second column indicates a substantial correlation of .41 when the IAT+ base rate is .20 and the diagnostic probability is as low as $p(A \mid IAT+) = .20$—that is, when only one out of five people with a conspicuous IAT score possesses the critical attitude. Apparently, correlation-based validity may grossly overestimate the certainty of diagnostic inferences, and the neglect of this phenomenon may have influenced conclusions in the IAT literature to a considerable extent (Campbell & Fiske, 1959).

As the asymmetry problem is virtually never considered, and no attempt is made to separate the two reverse conditionals, there is no direct evidence for the notion that implicit attitudes may be but a subset of IAT+ cases. However, a good deal of indirect evidence seems to support this conjecture. First, the excessively high base rates of $p(IAT+)$ in the population appear to be unrealistic if interpreted in terms of unconscious prejudice or latent dispositions based on the association structure. Second, a growing number of studies show that high IAT+ scores can reflect unwanted intrusions of extraneous factors independent of a pre-existing attitude A (McFarland & Crouch, 2002; Mierke & Klauer, 2001, 2003; C. J. Mitchell, 2004; Rothermund & Wentura, 2001, 2004). In particular, recent evidence suggests that IAT+ scores may merely reflect knowledge of what stereotypical attitudes are common, as opposed to the test persons' own attitudes (Fazio & Olsson, 2003; Karpinski & Hilton, 2001). Third, the set inclusion assumption is also consistent with the observation that the causal probability $p(IAT+ \mid A)$ turns out to be quite high in some studies that manipulate A experimentally (Baccus, Baldwin, & Packer, 2004; C. J. Mitchell, Anderson, & Lovibond, 2003; Olson & Fazio, 2001, 2002, 2003). And finally, regardless of variables that potentially moderate the implicit–explicit correlation (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005; Hofmann, Gschwendner, & Schmitt, 2005), the asymmetry assumption is also consistent with studies showing that other correlates of A (e.g., explicit or other implicit measures of A) often do not correlate with IAT+ (e.g., Asendorpf et al., 2002; Baccus et al., 2004; Bosson et al., 2000; Marsh, Johnson, & Scott-Sheldon, 2001; Olson & Fazio, 2003; Sherman, Rose, Koch, Presson, & Chassin, 2003). When they do correlate, even uncorrected for attenuation (e.g., Banse, Seise, & Zerbes, 2001; Maison, Greenwald, & Bruin, 2001; McConnell & Leibold, 2001), this may reflect situations where the base rate $p(A)$ is relatively high (e.g., strong attitudes towards presidential candidates; Nosek, Banaji, & Greenwald, 2002a), thus reducing asymmetry.

[4]Table 1 includes ϕ correlations, for all combinations of $p(IAT+)$ and $p(A \mid IAT+)$, calculated from cell frequencies $a = p(IAT+) \cdot p(A \mid IAT+)$; $b = p(IAT-) \cdot p(A \mid IAT-)$; $c = 1 - a$; and $d = 1 - b$. It was assumed that $b = 0$, because A should never occur in the absence of IAT+.

Let us only note in passing, before we turn to the second major problem, that the over-estimation of $p(A \mid IAT+)$ can be amplified when correlational studies are based on the comparison of average IAT scores in two groups supposed to differ in A ("known-groups studies", e.g., Japanese and Korean ethnic groups; Greenwald et al., 1998)—a practice that is quite common in the IAT literature. That strong differences at group or cultural level need not imply differences at individual level is well known as the problem of ecological correlations (Hammond, 1973; Robinson, 1950),[5] which highlights the need to analyse individual differences, and is a warning against the use of group data in test psychology.

Problem 2: Viability of the underlying association model

That $p(IAT+)$ may exceed $p(A)$, due to extra-attitudinal IAT effects, is related to the question of what the IAT task measures. Granting the definition of an attitude as an evaluation (e.g., negative valence) associated with an attitude object (e.g., Turks), the purpose of the IAT is to assess the strength or degree of association between these two constituents (e.g., Turks and negative valence). This equation of an attitude with an association (adopted from Fazio, Chen, McDonel, & Sherman, 1982; see also Fazio, 1986), however, is not unproblematic as it implies that any association entails an attitude. There are good reasons to distinguish between valence that is negative for the attitude object (the suffering of a victim) and valence that is negative for the attitude holder (the hostility of a victim; cf. Peeters, 1983). Unlike feelings of anger and disappointment, *negative* feelings of pity and remorse towards a person (attitude object) associated with suffering (negative valence) might constitute the basis for a *positive* attitude, helping, and heroic behaviour (Cialdini & Kenrick, 1976). Indeed, Rothermund, Wentura, and Bak (2000) found that implicit responses to negative traits are due to stimuli that have negative implications for the respondent (dangerous), rather than the person holding the trait (lonely). More generally, equating attitudes and evaluative associations is by definition problematic because the attitude construct is then one-dimensional (referring to approach vs avoidance tendencies), whereas the laws of association can be multi-dimensional, as we shall see next.

The function relating attitude sign and strength to closeness of association may be non-monotonic. Associations may connect synonyms

[5]For example, the correlation between race and education may be strong across districts but negligible at individual level. The reason is that the two levels, districts and individuals, are subject to completely different influences (e.g., base rates of socio-economic level affecting districts; learning motivation affecting individuals). Boundary conditions for relying on group data are developed in Hammond (1973).

(comrade – friend) or antonyms (friend – enemy), may cause assimilation (love → lenient evaluation) or contrast effects (love → strict evaluation). Associations can be highly asymmetric and lead to different spreading activation [p(cheddar → cheese) > p(cheese → cheddar)], they can reflect grammatical constraints (e.g., a syntagmatic association rule, linking an adjective to a noun, as opposed to paradigmatic associations between members of the same word class; cf. Jarman, 1980; Peeters, 1989), and they are strongly influenced by superficial factors such as word frequency, rhyme, or graphical appearance, which are independent of the semantic closeness and similarity. Many associations reveal more about the lexicon or the symbol system, or knowledge of cultural consensus, than about the attitudinal structure of individual persons. Because of these and other complicating factors, the universal assumption that attitude strength can be inferred unambiguously from the closeness of associations would appear to be hard to defend. Nevertheless, this assumption is crucial for the way the IAT is constructed and applied, and it is corroborated in a theoretical article by Greenwald et al. (2002a; cf. Blanton & Jaccard, 2006).

To be sure, if it turns out that tight associations may not reflect congruent attitudes, this might explain the asymmetrically higher prevalence of IAT+ and A. Part of the IAT+ scores may reflect non-attitudinal or counter-attitudinal associations (cf. Arkes & Tetlock, 2004). For example, an environmentalist with a strongly pro-environmental attitude may nevertheless strongly associate environmental objects with negatively valued meanings such as pollution, danger, and threat (cf. Schultz, Shriver, Tabanico, & Khazian, 2004). Her positive attitude may reflect a contrast reaction to the associative link between the attitude object (environment) and the evaluative tone (negative, pessimistic). Likewise, a strong association between children and sexuality need not be rooted in a paedophilic tendency but may an experience of being sexually abused as a child, or one's attempts to conceive a baby (cf. Gray, Brown, MacCulloch, Smith, & Snowden, 2005). Or a soccer fan with a wholeheartedly positive attitude towards his club may build up a strong association with the negative valence of a recently lost dramatic match (i.e., the experience of loss, shame, frustration).

One might contend, post hoc, that what this association "really" measures is not a negative attitude towards the club but a negative emotional experience resulting from a negative event affecting a positively valued club. However, the very possibility of re-interpreting an association that way only confirms the crucial point that an association between object and negative valence is not sufficient evidence for an attitude. Although the cause of the soccer fan's negative association may not be an attitude, a diagnostic inference that relies on the formula "negative association = attitude" will erroneously infer an attitudinal cause. Alternatively, it is only consequential to discard or to qualify the universal assumption that all object – valence

associations reflect attitudes. This assumption is hardly warranted on a priori grounds. With respect to its empirical status, it has to be noted that empirical tests of non-linear rules of associations (Carr & Dagenbach, 1990) can be hardly found in IAT research.

Problem 3: Lack of a testable process model that transforms latencies into attitude measures

Up to this point, it has been silently assumed that what the IAT measures is the dyadic association between an attitude object (e.g., Turks) and an evaluation (e.g., negative)—regardless of whether this association reflects an attitude or not. This most basic of all assumptions is rarely contested, although what the IAT task measures may be quite different from dyadic associations. At surface level, the task never calls for the formation of an association between the attitude object (Turks) and the evaluation (negative). Rather, participants have to engage in a two-fold speeded-classification task, on which they have to sort two subsets of stimuli onto the same two response keys, stimuli referring to the attitude objects (e.g., EINSTEIN for Germans, ATATÜRK for Turks) and stimuli denoting positive and negative evaluation (e.g., LOVE, WAR). Hence, the IAT constitutes an *indirect* measurement procedure of associations, which therefore has to rest on a testable model that constitutes the basis of indirect measurement (De Houwer, 2003a, 2006).

Attitudinal interpretation of indirect measurement. One question to start with is what kind of association this indirect measurement procedure is to capture: between the attitude object and the evaluative concept, between the target stimuli and the evaluative stimuli, or between the target stimuli and the evaluative concept; between the attitude object and an established response tendency, the attitude object and the response keys charged with valence, or between the attitude object and the response keys charged with content idiosyncratically by the evaluative stimuli; or other triadic and even longer association chains?

A good deal of evidence suggests that IAT effects depend crucially on the specific stimuli used for the sorting task, holding the chief constituents (i.e., attitude object and evaluation) constant. Bluemke and Friese (2006) showed that the size and even the sign of West Germans' IAT score towards East Germans changes dramatically when the specific target-related stimuli (e.g., positive West-related stimuli such as DEMOCRACY and negative East-related stimuli such as COMMUNISM) are replaced by stimuli with a reversed similarity structure (e.g., negative West-related target stimuli such as RAF [TERRORIST RED ARMY FACTION] and positive East-related stimuli such as KARL MARX). Changes in IAT effects also occur when

the cross-category associations of evaluative trait stimuli are modified, such that the typically positive stimuli referring to West Germans (FLEXIBLE) and negative stimuli referring to East Germans (ENVIOUS) are replaced by positive stimuli relating to East Germans (SOCIABLE) and negative stimuli relating to West Germans (IMPERSONAL). Conceptually similar findings were obtained by Steffens and Plewe (2001), Govan and Williams (2004), and J. P. Mitchell, Nosek, and Banaji (2003).

This raises the question of whether the IAT assesses the person's attitude towards the concept of East Germans, the meaning of the stimuli (WEST-BERLIN, JENA, BALTIC SEA, NORTH SEA; see also Kühnen, Schießl, Bauer, Paulig, Pöhlmann, & Schmidthals, 2001), the specific Germans chosen to represent the attitude objects (BORIS BECKER, CHRISTA WOLF; see also Rudman, Greenwald, Mellott, & Schwartz, 1999, Exp. 3; J. P. Mitchell et al., 2003, Exp. 2), or the surnames and forenames as generic stimuli (JULIA, THOMAS, MANDY, RONNY; Steffens & Plewe, 2001; see also Greenwald et al., 1998; Richeson & Ambady, 2001; Rudman et al., 1999, Exps. 1, 2)—all of which are in principle distinct from the general concept.

More generally, the crucial question is whether the IAT involves person scaling or stimulus scaling. Stated differently, does the IAT measure an attitude (or prejudice, stereotype, self-concept, self-esteem) that the participant carried into the experiment, residing in her associative long-term memory as an implicit attitude formed from "traces of past experience" (Greenwald & Banaji, 1995, p. 4)? Or may it measure an ad-hoc representation created within the experimental session, as an attempt to deal with the sorting task at hand?

Strategic processing. Ad-hoc representations might either refer to the evaluation of specific experimental stimuli or, quite differently, to the availability of task strategies. Thus, what a German/Turk IAT measures may not be an attitude towards the target object, but the cognitive flexibility to invent a strategy to facilitate the sorting of attitude targets (Turkish and German stimuli) and valence terms (positive and negative) onto the same response keys. What has not been spelled out clearly before is that the IAT task is different from typical priming measures in at least one crucial aspect: it infers associative strength from the *active sorting process* of both target and evaluative stimuli instead of capturing quasi-automatic associations between the components themselves. It is this feature that renders the IAT specifically vulnerable to strategic processing. (It should be kept in mind that the present definition of "strategic" clearly refers to strategies of dealing with the IAT sorting task; the term does not imply voluntary or conscious instrumental behaviour.)

One such facilitative strategy may be to *focus only on valence*, rather than permanently switching between two different discrimination tasks

(cf. Mierke & Klauer, 2001, 2003). Such a sorting strategy would indeed be sensitive to whether the connotations of Turkish stimuli are positive or negative. An alternative strategy could be to classify stimuli according to self-reference as "like me" versus "unlike me". From the standpoint of German participants, German stimuli are "like me" and Turkish stimuli are "unlike me", just as positive stimuli are "like me" and negative stimuli are "unlike me". Such a *self-reference strategy* is in principle independent of valence and attitudes; it can be used even if pretests of target stimuli prevent item sets from being confounded with valence; it could even be used by a German woman who is married to a Turkish man and has plenty of contact with her husband's lovely family stemming from a different cultural background.

Rothermund and Wentura (2001, 2004) have provided strong evidence for another strategy called *figure–ground*.[6] Accordingly, unfamiliar and negative stimuli (AYRAN, WAR to stick with the German–Turk example) tend to be mentally represented as figures, whereas familiar and positive stimuli (BEER, PEACE) tend to be represented as ground. Rothermund and Wentura demonstrated that the two-fold IAT task is facilitated when all figure stimuli have to be sorted to one response key whereas all the ground stimuli have to be mapped onto the other key. By contrast, mixed sorting of figure and ground stimuli onto the same response key is difficult and causes interference. Compatible blocks (that assign the same response key to all figure stimuli and ground stimuli) should thus allow for faster sorting than incompatible trial blocks (calling for mixed sorting), simply as a consequence of strategic processing, in the absence of a pre-existing implicit attitude. Even in the absence of clear-cut figure–ground dichotomies, the sorting task itself is partly responsible for latency differences between blocks ("mere acceptance effect"; C. J. Mitchell, 2004). Instead of elaborating on why participants take sides without a reason in the IAT in the absence of pre-existing attitudes ("implicit partisanship"; Greenwald, Pickrell, & Farnham, 2002b), we call on researchers to reflect on alternative instead of attitudinal interpretations of IAT effects. When controlling for figure–ground effects and similar factors, IAT effects can be strongly reduced or eliminated.

Impressive as such figure–ground effects may appear, they reflect but one of several possible strategies that could help or hinder the IAT task. The self-reference strategy noted above affords another universally applicable strategy. Another ad hoc strategy that might help a German to obtain a reversed (i.e., outgroup-friendly) IAT score would be to think of their last summer holiday in Turkey and all the episodes of hospitality and good

[6]Even when Rothermund and Wentura did not call their principle "strategic", their findings clearly fit the present definition of strategic influences.

mood; the stimuli could then be sorted as fitting that experience versus not fitting it. There is growing evidence showing that *mental reframing* of this kind can indeed reduce or even reverse the IAT score (Blair, Ma, & Lenton, 2001; Dasgupta & Greenwald, 2001; Glen & Banse, 2004; Lowery, Hardin, & Sinclair, 2001). Rather than assuming that such a treatment changes attitudes or prejudice within a few minutes, one might simply interpret the reversals or voluntary influences on the IAT as strategic effects, quite distinct from long-term memory associations between attitude objects and valence (cf. Rudman, Ashmore, & Gary, 2001).

In a later section we shall see that strategic processing is particularly relevant to faking and the possibility of influencing one's IAT score voluntarily. For the moment, we further pursue the neglect of a cognitive-process model. If IAT performance is sensitive to ad-hoc generated sorting strategies in working memory, as opposed to fixed associations between attitude objects and evaluations in the individual's long-term memory, then we have to ask whether these two theoretically distinct aspects can be assumed to correlate empirically. Could the cognitive ability to find a clever strategy for IAT responding correlate with the attitude it is to measure? Are there reasons to suggest that people who are prejudiced against Turks (or Blacks, females, homosexuals etc.) are less successful at inventing strategies than unprejudiced people? To our knowledge, direct evidence on this crucial question does not exist, but incidentally the evidence on strategic IAT effects does not suggest such a restriction. In all relevant studies listed in the Appendix, the allocation of participants to the voluntary-strategy condition was random and independent of the level of prejudice. Given that strategic reduction of IAT effects was successful in many studies, in spite of a high p(IAT+) rate in the baseline condition, strategic effects cannot be confined to those (unprejudiced) people who have low or reversed IAT scores.

However, it is highly likely that strategy invention correlates with several other personality factors such as flexibility, interference inclination (Baeumler, 1965), creativity, need for cognition (Cacioppo & Petty, 1982), general processing speed (Blanton, Jaccard, Gonzales, & Christie, 2006), or sensorimotor coordination, which in turn depend on age, fatigue, working memory capacity, and other unspecific factors that are unrelated to attitudes. Note that the impact of such factors on strategy selection is logically distinct from their influence on the latency measure itself. Recent attempts by IAT users to reduce such extraneous influences on response latency through revised scoring procedures (Greenwald, Nosek, & Banaji, 2003) cannot therefore be expected to control for strategic influences. If a cognitively alert person finds an efficient strategy, the sorting task no longer involves Turkish and evaluative stimuli, but newly generated aspects like figure versus ground, reminiscent of Turkish holidays or not, self-referent or not, and so on. This case is categorically different from the case when

a prejudiced person tries to compensate for the difficulty of using the same response key for Turks and positive stimuli non-strategically. When cognitive effort alone enhances sorting speed in the absence of a strategic trick, this may be partially corrected through individually standardised scoring rules or similar monotonic transformations. However, when strategic flexibility turns the alleged IAT into a qualitatively different task, no transformation of response speed can correct for such a qualitative shift.

In the end, whether facilitative strategies are possible will depend not only on the person, but also on the meaning, format, and nature of the IAT stimulus material. When sorting pictures, graphical strategies may be used; when sorting words, semantic strategies should be more likely (cf. De Houwer, Geldof, & De Bruycker, 2005). Depending on experience with the attitude object, a biographical strategy may be applied (e.g., thinking of a gay acquaintance in a homosexual IAT). When stimulus sets are small, strategies may rely on extensionally represented sets in working memory. Although strategic influences on the IAT have not been investigated systematically, the few empirical proofs that exist have shown strategic influences to be remarkably easy to demonstrate (see the Appendix).

Cross-category associations. Even when participants stick to the instruction and do not replace the attitude-relevant distinctions (e.g., Germans vs Turks and positive vs negative) by other aspects (e.g., figure vs ground), processing speed may be subject to systematic, attitude-independent biases. This is particularly the case when the stimuli selected to represent the target objects on the one hand and positive versus negative valence on the other are confounded in associative space—a problem denoted cross-category associations (Steffens & Plewe, 2001). When the focus is on negative attitudes towards Turks, researchers may inadvertently select more negative stimuli for Turks than for Germans, and the negative valence terms may be closer in meaning to Turks than the positive valence terms. If this occurs, the stimulus materials alone may produce an artificial IAT effect, as already illustrated with reference to Bluemke and Friese (2006), who were able to reduce and even to invert West and East Germans' IAT scores towards each other by manipulating the valence of target stimuli and the target-reference of valence stimuli. Similar results have been obtained by other researchers (De Houwer, 2001, Fn. 4; Govan & Williams, 2004; J. P. Mitchell et al., 2003; Steffens & Plewe, 2001; Steffens et al., 2004).

Does it matter, pragmatically, whether the IAT is sensitive to the latent concepts (Turks and negative valence) or to the stimuli used to represent these concepts? We contend that this difference is indeed as fundamental as the question of whether the test measures the attitude in the participant's mind or the valence of the stimuli provided by the researcher. That

stereotypically associated items like BELLY DANCING and TORTURE have clear positive and negative connotations, respectively, is a well-known semantic fact, shared by all language users. It does not reveal much about a respondent's attitude towards Turks. To assess individual attitudes, one would have to study what stimuli respondents associate *spontaneously* with the attitude objects. However, when stimuli are pre-selected by the test constructor, as in the IAT, controlling for stimulus associations would appear to be indispensable if an elevated IAT score is to reflect a person attribute rather than a stimulus selection effect.

Although specific rules for the construction of viable IATs have not been formulated or even standardised, there seems to be consensus that stimuli should be representative of the category (e.g., Turkish stimuli should be prototypical for Turks) and specific (e.g., the Turkish stimuli should not at the same time be related to other concepts, like Germans, Iraqis), and not confounded with valence. Thus, neutral stimuli like ISTANBUL, ANATOLIA, and KEBAB should be appropriate, whereas depreciating stimuli such as WOG, CUMIN EATER, and TORTURE are not. However, creating representativeness is not that simple. The latter, depreciating terms may not be representative for the experimenter's notion of Turks, but they may be representative for the associative structure of a prejudiced person who does spontaneously associate such negative concepts when thinking of Turks. Stimuli that are representative for someone with a neutral attitude may not be representative for the associative structure of a highly prejudiced person, just as the derogatory stimuli are unrepresentative for someone with a neutral attitude. Thus, selecting neutral stimuli may conceal negative attitudes just as selecting negative stimuli may serve to reverse neutral attitudes. In any case, there is hardly one ideal set of stimuli that can be considered representative of all attitudinal positions. In reality, the double claim that IAT stimuli be both diagnostic and specific for a category (Greenwald & Nosek, 2001; Nosek et al., 2005, in press) is rarely tested strictly. Based on an inspection of published IAT papers (as available in the PsycINFO database in October 2005),[7] the Appendix reveals what standards, if any, have been applied for selecting IAT stimuli. Many studies report some pilot testing to secure

[7]We searched in the PsycINFO database for peer-reviewed articles, scanning keywords, titles, and abstracts for "IAT", "implicit association", "implicit attitude", "implicit stereotype", "implicit evaluation", "implicit measure", "automatic association", "automatic attitude", and "automatic stereotype". After omitting false alarms (e.g., IAT related to "Intervention Assistance Teams" or "intracarotid amobarbital test"), we identified 200 IAT-related, peer-reviewed articles in October 2005, published in the English language, from 1998 up to 2005). Of these, 34 articles were concerned with IAT derivates like the Extrinsic Affective Simon Task (EAST) or merely discussed the IAT in a review, editorial, comment, or essay, leaving 166 empirical articles comprising 331 studies that dealt with 495 separate IAT applications (cf. Appendix and see References marked with an asterisk).

the familiarity of stimuli, or the valence of valence stimuli, or the target reference of target stimuli—the implicit assumption being that appropriate stimuli have to be pronounced and clear-cut on the respective dimension. But even this modest criterion of stimulus control is rarely ever met for both stimulus subsets. At a more enhanced criterion level, only two exceptional studies controlled the scale values of both stimulus subsets on the other dimension (Jelenec & Steffens, 2002; Steffens & Buchner, 2003). Some more studies included such a pretest for only one subset (six articles coded "a", "b", or "c" for target stimuli plus five articles for attribute stimuli).[8] In general, this important aspect (for precursors of the stimulus-connotation problem, see Devine, 1989; Lepore & Brown, 1997) was primarily considered in methodological studies that were deliberately concerned with methodological issues such as cross-category associations, task-switching, strategic recoding, or label vs stimulus influence (articles coded "d"; Govan & Williams, 2004; Klauer & Mierke, 2005; Mierke & Klauer, 2001, 2003; J. P. Mitchell et al., 2003; Rothermund & Wentura, 2004; Rudman et al., 2001a; Steffens & Plewe, 2001).

What many studies try to maximise, however, is that target stimuli be strongly related to the target category and that valence stimuli be markedly positive or negative, respectively. The underlying implicit assumption here is that target and valence stimuli will afford a better measure of an attitude (conceived as a target–valence link) when the stimulus reference to its belonging category is strong rather than weak. Although plausible, this premise may not be correct. Just as questionnaire items of medium difficulty may discriminate better than items of very low or high difficulty, it is quite possible that moderate and ambiguous IAT items are better suited for discriminating between individuals than the most clear-cut items. (One can compare this to the fact that attitudes can direct behaviour only in weak or ambiguous situations, while strong situational cues may override a person-driven interpretation of situations and counteract the expression of attitudes.) To date, it is an open empirical question whether extreme IAT stimuli accentuate or reduce the difference between people high and low on an attitude. Again, there is no systematic evidence relating the strength of IAT effects to the extremity or unambiguousness of stimuli, consistent with the overall paucity of interest in tests of psychometric model assumptions (Blanton et al., 2006). In the absence of a comprehensive performance model, which decomposes IAT scores into its various latency components,

[8]In IAT studies using the individual "self" and "others" as categories, a pretest for both target and attribute stimuli on cross-category associations does not make sense (cf. "self" in the Appendix). Note also that, depending on a researcher's focus, "self" can sometimes be used as a target category or as an attribute category.

we know very little about the relative contribution of memory access times, motor responses, task-switch costs, stimulus effects and response-label effects, strategic versus naïve processing, central (memory) versus peripheral (motor) factors.

Popperian view on indirect measurement. Linking IAT research to a testable model is not only essential to distinguish stimulus variance from person variance, or pre-experimentally existing attitudes from experimentally induced, emergent effects. It is also at the heart of the Popperian insight that scientific assumptions are empty unless they can be falsified. A falsifiable model is particularly needed in indirect, as opposed to direct, personality assessment or scaling. Direct measurement procedures, like intelligence tests or explicit ratings, can rely on *content validity*. Observations from intelligence test items or explicit attitude questions are immediate reflections of the construct to be assessed. In contrast, indirect procedures assess something different from the construct to be inferred (e.g., latencies to infer attitudes). The transition from latencies to an attitude cannot be guaranteed by definition, by simply stating that an attitude results from every object–valence association and that the IAT exactly taps into this association. However large the consensus on this assumption seems to be at the moment, in order to be non-empty it has to be tested in the context of a falsifiable argument. Much as a Thurstonian attitude model (1927)—the classical example of indirect attitude measurement—can be falsified empirically, so IAT research ought to be entertained in a fashion that renders its assumptions testable. As virtually no IAT research up to now has been concerned with falsifiable aspects of the (psychometric) IAT model, or with tests of cognitive association models, the Appendix need not contain extra column for these aspects.

In contrast to this Popperian view, IAT proponents continue to show no interest in testing falsifiable implications. Instead, there is a widely shared consensus in treating the IAT in a friendly way and generously, pointing out that (a) only the IAT's correlations with behavioural criteria count; (b) that successful findings of such correlations can be generalised by default; (c) that uncontrolled factors and confounds may at best affect absolute latencies but can be assumed to conserve the ordering of respondents; and (d) that most measurement problems can be controlled through appropriate transformations of latency data. However, the present critique points out that (a) correlations obtained in some studies are at best equivocal; (b) generality has to be proven rather than presupposed; (c) many confounds can be assumed to have a differential impact on different individuals' IAT scores, so that the order of individuals may not be conserved and, consequently, (d) monotonic transformations cannot solve these problems.

Problem 4: Drawbacks of the latency difference model

In spite of the lack of overt model constraints, an embedded model is inevitably entailed in the computational definition of the IAT score. The difference measure, IAT effect = $L_I - L_C$ (latency on incompatible trials minus latency on compatible trials), implies that being fast on compatible trials counts as much as being slow on incompatible trials. All trial subsets—being fast on the response keys for German + positive and for Turkish + negative, and being slow in sorting German + negative and Turkish + positive trials—receive the same weight (Blanton et al., 2006). This entails very strong assumptions, namely that the attitude target object (Turks) and the comparison target object (Germans) have the same impact on attitude measurement, that evaluative stimuli as well as target stimuli contribute the same, and that systematic and unsystematic error affects L_I and L_C to the same degree. To the extent that errors influence L_I and L_C differentially, the resulting IAT difference score will reflect unwanted error variance. Using structural equation methods, Blanton et al. (2006) have recently demonstrated that when these overly strong restrictions are given up and the different components of L_I and L_C are allowed to take different weights, the component contributions (e.g., devaluing Turks and valuing Germans) can differ to a great extent.

Similarly, in a gender IAT used by Fiedler and Zogmaister (2002), the ingroup response key (i.e., the response key onto which female participants have to sort female names) made a significantly stronger contribution to the total IAT score than the outgroup key, suggesting that impairment on incompatible trials was mainly due to a slowdown in sorting ingroup stimuli together with negative valence, rather than sorting outgroup stimuli together with positive valence. Such differences and asymmetries are levelled off by the computational model inherently adopted in IAT research. Differences between latency components are rarely analysed (with very few, notable exceptions; e.g., De Jong, Pasman, Kindt, & van den Hout, 2001; Gemar, Segal, Sagrati, & Kennedy, 2001). If it were done routinely, and granting systematic item subset differences were found (as in Blanton et al., 2006, or in Wigboldus, Holland, & van Knippenberg's, 2004, recent work on Single-Target IATs), the question that suggests itself immediately is whether they reflect the strength of attitudes (i.e., the ingroup-positive as compared with the outgroup-negative association) or uncontrolled extraneous influences.

Apart from such inherent and untested symmetry and equality assumptions, perhaps the most serious problem lies in the very ambiguity of difference scores—a well-known problem that was vividly explained by Cronbach and Furby (1970). In general, when a difference measure, a – b, is related to a criterion (e.g., in the course of a validity study), the results are

contaminated and flawed if the criterion correlates with either a or b, or if the criterion correlates differentially with the two constituents. In the IAT case, this serious problem arises when the two latency components, L_I and L_C, are differentially affected by other variables (cf. Figure 2), reflecting systematic and unsystematic error. For example, a very plausible assumption is that incompatible trials are more taxing than compatible trials, due to resource limitations and task-switch costs (Brendl et al., 2001; McFarland & Crouch, 2002; Mierke & Klauer, 2001, 2003). As a consequence, processing resources may be depleted on incompatible trials so that additional impairment—resulting from fatigue (cf. order effects of compatible vs incompatible block first, Nosek et al., 2005), age (Hummert, Garstka, O'Brien, Greenwald, & Mellot, 2002), stress (Frantz, Cuddy, Burnett, Ray, & Hart, 2004; Gehring, Karpinski, & Hilton, 2003), and other factors that reduce general processing speed—should have a stronger effect on L_I than on L_C. To the extent that this occurs, the difference L_I, – L_C is inflated due to those extraneous factors.

Many other factors may differentially affect L_C more than L_I (Figure 2). Strategic attempts to reduce response latencies, in particular, may be more

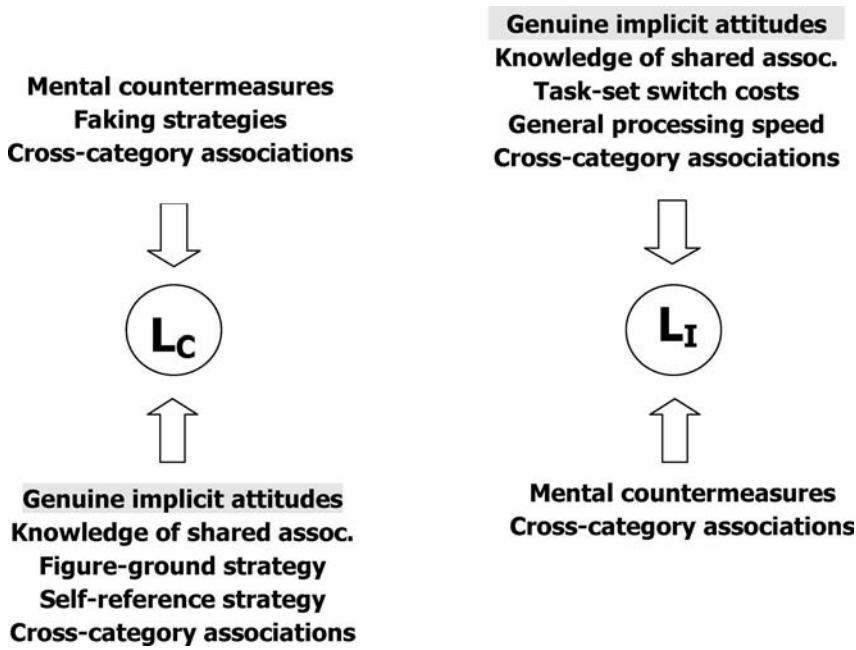

Figure 2. Variety of facilitative (upward arrow) and inhibitory factors (downward arrow) that can have a different impact on the two latency components, L_C and L_I, thus creating artificial IAT effects.

successful on compatible than incompatible trials, as we shall see in the final section on faking. Whatever the direction of the inequality, however, the challenging theoretical and empirical question is whether and to what extent one can assume that the impact of extraneous variance on L_I and L_C is the same. Although the general problem of difference scores is occasionally recognised in the IAT literature, a comprehensive theoretical and empirical analysis of this crucial validity problem is missing.

Extraneous influences on IAT scores. Direct evidence for extraneous influences on $L_I - L_C$ comes from a recent series of experiments conducted by Mierke and Klauer (2003). Using attitude-independent, geometric materials, associations between target stimuli (blue vs red) and attribute stimuli (large vs small) were created by experimental contingencies. Individual differences on an IAT designed to measure these arbitrary geometric associations were substantially correlated with individual differences on a flower–insect IAT. Similar effects were replicated in a whole series of studies, suggesting a general personality factor that influences all kinds of speeded-classification tasks, regardless of the stimulus contents. Evidence for such a personality attribute is as old as Baeumler's (1965) notion of "interference inclination", referring to performance on Stroop-like tasks that involve a comparison of compatible and incompatible trials (Stroop, 1935/1992). Individual differences in this personal factor may reflect differences in mental flexibility, fluid intelligence, and general sensori-motor speed rather than attitudes or associations. Respondents who score high on interference inclination can be assumed to choke on incompatible trials and hence to get an inflated IAT score.

Inhibitory versus facilitative influences. Figure 2 gives an overview of diverse confounds or extraneous factors that may affect L_I and L_C differentially. In this overview, two distinctions are introduced, between inhibitory (relative slow-down) and facilitative (relative speed-up) influences, and whether an influence mainly operates on incompatible or on compatible trials. As already mentioned, the relevant variable that the IAT intends to capture, attitude-related associations, is assumed to exert an equally strong inhibitory influence on the incompatible and a facilitative influence on the compatible block. *Impaired processing speed* (due to age, alcohol, fatigue, stress, distraction, overload etc.) can be classified as exerting an inhibitory influence that should mainly affect L_I. *Interference inclination* is also defined as an impairment manifested in L_I. *Practice and training* of double-classification or task switch can be expected to mostly benefit the low performance on incompatible trials, causing a speed-up in L_I. By contrast, attitude-congruent *cross-category associations* could have a facilitative impact on L_C, as a single dimension (i.e., valence) is sufficient to

classify both target and valence stimuli, whereas an inhibitory impact should emerge on incompatible trials because the attitude-congruent cross-category associations do interfere with the association of concepts. A reverse influence could be expected in the case of incongruent cross-category associations. A particularly effective *faking or countermeasure strategy* is to slow down voluntarily in L_C rather than trying to speed up in L_I.

Within the integrative framework of possible influences on speeded-classification task performance (cf. Figure 2), one particularly interesting class of attitude-independent factors is due to strategic influences on L_I and L_C. Strategies can operate on both latency components. Whereas effective faking consists in slowing down on L_C, mental reframing (e.g., of Turks in Turkish holiday settings) may serve to reduce L_I. Rothermund and Wentura's (2001, 2004) figure–ground strategy means not switching between target and valence classification from trial to trial, but instead utilising another constant cue, namely the distinction of figure (unfamiliar and negative stimuli) and ground (familiar and positive stimuli). By increasing L_I and decreasing L_C, this strategy mimics an attitude effect in many ingroup–outgroup IATs because, say, Turks and negative stimuli are figures and Germans and positive stimuli are the ground.

On more unusual IATs, such as Brendl et al.'s (2001) comparison of insects and nonwords, the figure–ground strategy may explain why it is easier to sort negative stimuli together with nonwords than with insects. Presumably, unusual nonwords are more likely to be represented as figures than ordinary insects, thus sharing the figure status of negative stimuli. Brendl et al.'s (2001) assumption that different response criteria are applied to compatible and incompatible trials also implies a differential strategic influence on L_I and L_C.

Similarly, Mierke and Klauer's (2001, 2003) major point is that task-switch costs inhibit performance on incompatible trials more than on compatible trials. If attitude-congruent cross-category associations of the target stimuli are strong enough (e.g., Turkish stimuli carry sufficient negative valence), the valence cue provides a simplified criterion for sorting all stimuli (target and valence stimuli) on compatible trials. By contrast, higher task-switch costs will arise in incompatible blocks, thus leading to higher L_I than L_C.

A self-reference strategy (i.e., classifying both targets and valence on a "like-me" vs "unlike-me" dimension) can mimic attitudes on many IATs (i.e., both Turk and negative is "unlike me"). The participant's attitude may be masked when he/she in fact has a positive attitude towards Turks, but nevertheless classifies both Turks and negative valence as "unlike-me". Or, when the respondent is not a member of any target category, a self-referent strategy may produce all kinds of outcomes. For instance, when an IAT involves typically male and female crimes along with positive and negative

stimuli, male respondents with a self-referent sorting strategy may find it easy to sort male crimes and positive valence together, as if crimes had positive valence for this subject. Similarly, from the standpoint of female heterosexuals, both positive valence and photographs of females are "like-me", whereas male photographs and negative valence are "unlike-me", as if their attitudes were homosexual (i.e., more positive towards female than male photographs; cf. Rudman & Goodwin, 2004; Rudman, Greenwald, & McGhee, 2001b).

Those authors who point out the impact of stimulus associations across categories as a potential source of error also presuppose that the influence of the stimuli selected by the experimenter (as distinguished from the attitude in the participant) should affect L_I and L_C in different ways, facilitating responses on compatible trials but inhibiting responses on incompatible trials (Bluemke & Friese, 2006; Steffens & Plewe, 2001).

The impact of knowledge about cultural associations, which Fazio and Olson (2003) as well as Karpinski and Hilton (2001) have distinguished from genuine attitudes, reflects *observed* associations that facilitate responding on compatible trials more than on incompatible trials. Of course, the genuine attitudes intended to be assessed by the IAT, reflecting the object–valence associations *actually held* by the participants, is also explicitly assumed to be evident in a difference between L_I and L_C.

To summarise, both intended IAT effects as well as unintended intrusions can exert a differential effect on the two latency components. The purpose of Figure 2 is not only to illustrate how many confounds exist that can affect the latencies in compatible and incompatible blocks to different degrees, but also to highlight that the case of a precisely equal net influence of all factors of speeded classification performance on L_I and L_C would be highly unlikely to be an empirical outcome. If, however, these factors affect L_I and L_C differentially, the IAT score will be biased. Therefore, the fundamental critique of difference scores (cf. Cronbach & Furby, 1970) is pertinent to all IAT studies listed in the Appendix.

It is important to note that the difference-score problem cannot be solved in a single-target IAT (Wigboldus et al., 2004). Regardless of the symmetry of responses (left key vs right key) and the number of attitude targets involved (single or double), the resulting measure is always a difference between two blocks of trials, which differ in associative structure, but also in difficulty, strategy proneness, and an open class of other factors. The basic problem of difference scores in particular cannot really be solved through standardisation like individual z-transformations or rescaling procedures, such as Greenwald et al.'s (2003) suggestion to divide individual raw differences by the individual pooled standard deviation of all latencies across compatible and incompatible blocks. Theoretically and mathematically, it is easy to show that biases can impact the difference $L_I - L_C$ without increasing

the latency variance across trials. Strategic biases may come along with a decrease in inter-trial variance, so that the problem may be amplified through division by a small denominator. Thus, even when rescaling happened to reduce biases in some studies (Cai, Sriram, Greenwald, & McFarland, 2004; Greenwald et al., 2003; Mierke & Klauer, 2003), this cannot be expected to hold in general, on theoretical or formal grounds. The improved D measure may often reduce biases due to general processing speed. But many other strategic factors affecting L_I and L_C differentially cannot be assumed to be controlled by the improved algorithm. Moreover, by normalising IAT scores in relation to the respondent's general processing speed, one may not only reduce error variance but also sacrifice part of the genuine attitude variance whenever the attitude is correlated with aspects of processing speed (cf. Blanton et al., 2006).

Problem 5: Susceptibility of the IAT to deliberate faking and voluntary processing

There are three sensible answers to the question of what is implicit in the IAT, related to the letter "I": the association to be assessed, the learning history of the attitude, or the measurement procedure. Let us exclude the first answer, because there is no cognitive-psychological basis for a distinction between implicit and explicit associations. We may also exclude the second option, for the genesis of the attitudes to be measured is unknown in most IAT studies, and there are many examples of IATs applied to explicitly acquired attitudes. Apparently, then, what many researchers really have in mind when they call the IAT "implicit" is the measurement procedure (cf. De Houwer, 2006). At the heart of the IAT is the claim that social desirability, political correctness, and self-presentation concerns that obscure explicit attitude measurement can be ruled out through implicit measures. The stronger interpretation of implicit measurement is lack of awareness; the weaker interpretation allows for awareness but maintains lack of voluntary control. In any case, the implicitness attribute is at least debatable.

Although respondents are not asked to evaluate attitude targets explicitly, they nevertheless recognise, vividly, that the entire task and the difficulty experienced during sorting is caused by meaningful stimuli, denoting target objects (e.g., Black and White people) and valence cues (pleasant vs unpleasant). Thus, the purpose of testing is not concealed at all. Given this high awareness of the IAT theme, the weaker criterion, lack of voluntary control, would appear to be crucial. However, a recent review (Blair, 2002) suggests that performance on the IAT may be more amenable to voluntary influence than expected. To influence one's IAT score intentionally, it is sufficient to think of admired or disliked individuals

(Dasgupta & Greenwald, 2001), or to engage in counter-stereotypical imagery (Blair et al., 2001). In applied contexts, making the test purpose obvious increases the likelihood of faking—simulation or dissimulation—which is detrimental to any test's validity and usefulness. Note that, from a theoretical point of view, faking is but a special case of a larger class of strategic influences, such as imagining targets (e.g., Turks) in specific affective contexts (e.g., a summer vacation in Antalya), reframing stimuli on a figure–ground dimension, or empathising with the perspective of an outgroup member.

Is faking on the IAT possible at all? Even though it may be hard to speed up responses on incompatible trial blocks (e.g., sorting Turks and positive together), respondents who understand the rationale of the test may well succeed in slowing down their responses on compatible trial blocks (e.g., sorting Turks and negative together). Verifying this claim empirically was much easier than expected in a recent study (Fiedler & Bluemke, 2005). Using a German–Turk IAT, German participants who were instructed to fake slowed down on compatible trials, even when they were not instructed to apply this strategy. Moreover, they did this in a manner that made it impossible for IAT testers to identify faked data sets among authentic data sets. As noted by Steffens (2004, p. 176), "faking cannot be easily detected" due to large individual differences in response speed. It even turned out that faking instructions also produced a significant latency decrease on incompatible trials. Although successful faking could not be demonstrated by other researchers (Asendorpf et al., 2002, Study 2; Banse et al., 2001; Egloff & Schmukle, 2002; Foroni & Mayr, 2005; Kim, 2003a; Steffens, 2004, Study 1), the instructions they gave to participants may have been too weak and ineffective. Thus, rather than concluding that strong instructions are required to induce successful faking, it seems more appropriate to conclude that failure to find faking has only been shown using weak or even unclear instructions. Logically, null or weak findings in some studies cannot undo a strong existence proof that faking or voluntary influence is principally possible, that it can actually be quite easy, and that it becomes more likely with increasing IAT experience (Blair, 2002; Fiedler & Bluemke, 2005; Schnabel, Banse, & Asendorpf, 2006; Steffens, 2004, Study 2).

Incidentally, applying Greenwald et al.'s (2003) rescaling procedure (i.e., dividing latencies by a reduced denominator) would have increased the success of faking in the Fiedler and Bluemke (2005) study, because faking reversed the $L_I - L_C$ latency difference while the standard deviation of latencies across all trials was often reduced. Under what specific conditions faking can be detected is an open empirical question. To summarise, the fifth problem with the IAT, related to its implicitness, must also be considered open and unresolved, as only very few published studies have investigated the full potential of strategic influences (see the Appendix).

CONCLUSIONS

In this critical appraisal of the IAT as a diagnostic instrument, we have tried to articulate several problems related to the letters "I", "A", and "T". With regard to the distinction of causal and diagnostic inferences, the IAT may be subject to the same strong asymmetry that complicates other diagnostic inferences. Even when an IAT effect may be quite likely when an attitude is actually present, the reverse, diagnostic inference from an observed IAT effect to an underlying attitude may be quite unlikely, just because many other factors, besides genuine attitudes, can produce IAT effects. Even when IAT scores do reflect actually existing associations, these need not constitute an attitude. There are good reasons to question the assumed equivalence of an object–valence association and an attitude. The lack of a testable model of IAT performance has prevented comprehensive causal analyses of the genesis of IAT effects, particularly to what extent the IAT measures an attitude in the test person as distinct from the semantics of the test stimuli. Perhaps the most severe problem lies in the well-known vicissitudes of difference scores. As uncontrolled factors and confounds cannot be assumed to affect the two latency components equally, the difference score tends to be biased, especially when self-generated strategies replace the original IAT task. One particular class of strategies, those used for faking and voluntary simulation, call the implicitness into question, and the extent to which implicit attitude measurement using the IAT really evades the problem of self-presentation, social desirability, and (dis)simulation of test results.

The status of these five major problems is far from being solved. From the evidence summarised in the Appendix, based on publications until 2005, it can be concluded, first, that the IAT's reliance on a difference score poses a major problem neglected in most published research. To overcome this problem, it is necessary to start isolating and assessing wanted and unwanted influences on L_I and L_C separately. This would also allow us to test the unwarranted implicit model assumption that slow L_I and fast L_C reflect precisely the same latent attribute.

With regard to the more general need to formulate and test falsifiable model constraints, the Appendix reveals that only a very small portion of IAT research is concerned with the possibility of strategic redefinition of the double-classification task. It is generally taken for granted that test persons do what researchers want them to do, namely trying to classify target stimuli by target categories on some trials and then switch to sorting valence stimuli by valence on other trials. That they could—voluntarily or involuntarily—tackle the task with a different strategy is rarely the focus of empirical tests. Even when participants may not completely replace the IAT task dimensions by such sorting strategies as self-reference, figure–ground

relations, or some faking strategy (e.g., slow down, elaborate, or rehearse on congruent trials), they may at least partially utilise such strategic cues in addition to the cues focused in the task instructions.

The paucity of research on testable aspects of a cognitive or psychometric IAT model is evident in the lack of explicit standards for the construction and selection of test stimuli. The Appendix shows that hardly any studies sufficiently controlled for the possibility of cross-category associations of both target and attribute stimuli. Controlling for the influence of stimuli is essential to the question of whether IAT effects reflect the attitude of respondents rather than the semantics of stimuli. This tricky issue cannot be solved by reaching a consensus that stimuli should be representative, or even diagnostic (for a category) and specific (only for that category) at the same time. What stimuli are representative for an associative structure may vary strongly with the individuals' attitudes, so there may be no optimal stimulus set suitable to capture the associative structure of all attitude holders. Using neutral target stimuli may correctly reveal a neutral attitude, whereas valence-laden target stimuli may be needed to represent the attitude structure of a prejudiced person. Calling for representativeness does not provide a solution to this difficult problem. If neutral stimuli shift the distribution of all IAT scores towards smaller values, whereas stereotypical and value-laden stimuli cause an upward shift towards large values (cf. Bluemke & Friese, 2006), this must be attributed to the stimuli rather than the respondents.

Controlling for the impact of stimuli is highly relevant to the implicit association theory adopted widely in IAT research. At the very moment when a stimulus item is assigned to one of the two response keys, the psychological algorithm could be either

Stimulus ISTANBUL → Response key "*Turk*", or
Stimulus ISTANBUL → Category *Turk* → Response key "*Turk*".

If the response is immediately driven by the stimulus, without activating the superordinate category, then the performance can at best reflect the attitude towards Istanbul (or the average attitude of all stimulus items) but not the attitude towards the target category, Turks. For the IAT to reflect the attitude towards the target category, it is essential to demonstrate the involvement of categorical inferences. Just assuming that the IAT will tap into the intended category anyway is equally as unsatisfactory as the uncritical adoption of the assumption that each and every association between a category and an evaluation must constitute an attitude.

Concerning the remaining issue, the asymmetry between causal and diagnostic inference, we can assert in general that virtually all validity

studies rely on correlation coefficients, whereas no attempt was made to distinguish between $p(\text{IAT}+ \mid \text{A})$ and $p(\text{A} \mid \text{IAT}+)$. It should be added quickly that this is common practice in test construction and personality research, in spite of strong warnings (cf. Swets et al., 2000). However, if this problem of the IAT is shared with other diagnostic tools, this does not mean that erroneous diagnostic IAT inferences are less erroneous or have less severe consequences. In a scientific discipline, mistakes cannot be justified by other mistakes. On the contrary, problems and deficits encountered in one area should alert researchers to pursue similar problems that may hold in other areas.

Interestingly, the distinction of causal and diagnostic uses of the IAT also suggests contexts in which IAT measures ought to be valid and free of ambiguity. This should be the case whenever a purely attitudinal influence is guaranteed experimentally. When randomised experimental groups undergo differential treatments so that one group differs from the other only in attitudes (i.e., conditioned evaluation, cf. Baccus et al., 2004; Olson & Fazio, 2001, 2002; C. J. Mitchell et al., 2003) but no other systematic factor (as recently in Wänke, De Houwer, Plessner, Richter, & Gärtner, 2002), then a difference in a subsequent IAT can be unambiguously attributed to the experimental factor. In this case, the ambiguity of IAT effects is eliminated by allowing for just one source of influence. However, notably, here the research focus has changed from *diagnostic* to *causal* inferences.

Throughout this chapter we have refrained from evaluating the published evidence on the IAT's predictive validity. This reflects in part the fact that the reported correlation coefficients are insensitive to the asymmetry of causal versus diagnostic inferences emphasised in the present chapter. However, correlation-based validities are not worthless. One notable implication of the framework depicted in Figure 1 is that correlations between IAT+ and a validity criterion of A should increase with an increasing base rate, $p(\text{A})$. That is, when the base rate asymmetry of $p(\text{IAT}+)$ and $p(\text{A})$ is reduced so that the prevalence of the attribute to be assessed (prejudice, stereotype etc.) in the sample is large enough, the correlation and the predictive value may become substantial. This may actually characterise those studies that report the most impressive predictive validities (cf. Greenwald & Nosek, 2001; Nosek et al., in press). Unfortunately, the failure to control for $p(\text{IAT}+)$ and $p(\text{A})$ prevents us from testing this account systematically. However, for the reasons delineated above, the promising results of these successful validity studies cannot be generalised to other diagnostic uses of the IAT when the prevalence of the criterion, $p(\text{A})$, is either very low or unknown.

We believe that progress in the various unresolved problems of the IAT can only be attained when the problems are tackled openly, rather than

downplaying them as irrelevant or comparable to other tests in psychology. Serious topics like the lack of standardisation of stimulus selection, the appropriateness of the underlying association model, the viability and confound-proneness of the latency difference model, and the role played by self-generated strategies, should not be hidden in small-group conferences or in the confidential peer-reviewing process. Rather, pluralistic research about such problems should take place in the published literature, with reference to clearly spelled out theoretical assumptions that can be tested and—most importantly—falsified empirically.

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APPENDIX
Coding of IAT articles

Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Aberson et al., 2004	Study 1: Black/White-IAT (Ss having African American friends)	d			stimuli: Greenwald et al. (1998)	
	Study 2: Black/White-IAT (Ss having Latino friends)	d			stimuli: Greenwald et al. (1998)	
Aidman & Carroll, 2003	Self-Esteem-IAT; Self-Gender-IAT; Gender-IAT	d	self/self/–		stimuli: Greenwald et al. (1998) and Farnham et al. (1999)	
Arkes & Tetlock, 2004*	Attribution of implicit prejudice, or 'Would Jesse Jackson "fail" the IAT?'	–	–	–	–	–
Asendorpf et al., 2002	Study 1: Self-Shyness-IAT	d	self		attributes: factor-analysis (1998)	
	Study 2: Self-Shyness-IAT	c, d	self		attributes: factor-analysis (1998)	Job application instruction vs. Social perception study
Ashburn-Nardo et al., 2001	Study 1: Black/White-IAT; American/ Surinam-IAT	c			stimuli: (partially) Greenwald et al. (1998)	
	Study 2: Black/White-IAT; American/ Marisat-IAT	c			stimuli: (partially) Greenwald et al. (1998)	
	Study 3: Black/White-IAT; Assigned Minimal Group-IAT	c			stimuli: (partially) Greenwald et al. (1998)	
Baccus et al., 2004	Self-Esteem-IAT	c	self			
Back et al., 2005	Study 1: Task-Switching Ability (TSA)-IAT	d	(d)	(d)		

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 2: TSA-IAT; Self-Anxiety/ Calmness-IAT	d	self			
	Study 3: TSA-IAT; Self-Anxiety/ Calmness-IAT	d	self			
	Study 4: TSA-IAT; Self-Anxiety/ Calmness-IAT	d	self			
Banaji et al., 2004*	Commentaries "No place for nostalgia in science..."	–	–	–	–	–
Banse et al., 2001	Study 1: Homo-/Heterosexuality-IAT; Gender-IAT	d	(c)/(c)		targets: attractiveness; attributes: Ostendorf, 1994; Schwibbe, Räder et al. (1994)	
	Study 2: Homo-/Heterosexuality-IAT	c, d	(c)		targets: attractiveness; attributes: Ostendorf, 1994; Schwibbe, Räder et al. (1994)	fake good instruction
Bassett & Dabbs, 2003	Study 1: Life/Death-Anxiety-IAT; Life/ Death-IAT; Life/Death-Self-IAT	d		–/–/self		
	Study 2: Life/Death-Anxiety-IAT; Life/ Death-IAT; Life/Death-Self-IAT	d		–/–/self		
Bassett et al., 2004	Self-Life/Death-IAT	d	self		stimuli: Bassett & Dabbs (2003)	
Bazermann et al., 2004*	The social psychology of ordinary ethical failures	–	–	–	–	–
Blair, 2002*	Malleability of Social Stereotypes	–	–	–	–	–

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Blair et al., 2001	Study 1: Gender-Strong/Weak-IAT	c			attributes: similar positive evaluative tone	counterstereotypic mental imagery
	Study 2: Gender-Strong/Weak-IAT	c			attributes: similar positive evaluative tone	stereotypic and counterstereotypic mental imagery
	Study 3: Gender-Strong/Weak-IAT	c			attributes: similar positive evaluative tone	stereotypic and counterstereotypic mental imagery
	Study 5: Gender-Strong/Weak-IAT	c			attributes: similar positive evaluative tone	counterstereotypic mental imagery
Boniecki & Jacks, 2002	Study 2: Black/White-IAT (names); Black/White-IAT (faces)	d			stimuli: Greenwald et al. (1998); Cunningham et al. (2001)	
Bosson et al., 2000	Self-Esteem-IAT	d	self		stimuli: Greenwald & Farnham (2000)	
Brendl et al., 2001	Study 1: White Names/Nonwords-IAT	c			targets: Greenwald et al. (1998)	
	Study 2: Insects/Nonwords-IAT	c			targets: Greenwald et al. (1998); attributes: Hager & Hasselhorn (1994) and Fazio et al. (1986)	
	Study 3: Insects/Nonwords-IAT	c			targets: Greenwald et al. (1998); attributes: Hager & Hasselhorn (1994) and Fazio et al. (1986)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Brunel et al., 2004	Study 1: MAC-PC-IAT; Self-MAC-PC-IAT	d		–/self		
	Study 2: Attitude-toward-ads-IAT	d			targets: familiarity	
Brunstein et al., 2004	Self-Achievement-IAT	(c), d	self		attributes: correlations with Nygard & Gjesme's (1973) Achievement Motivation Scale; targets: Nosek et al. (2002)	
Cai et al., 2004	Reanalysis of Study 3 & 4 of McFarland & Crouch (2002)	d			stimuli: McFarland & Crouch (2002)	
	Replication Study: Black/White-IAT; Non/Delicious-Un-/Happiness-IAT	d			stimuli: McFarland & Crouch (2002)	
Chambliss et al., 2004	Fat/Thin-Bad/Good-IAT; Fat/Thin-Lazy/Motivated-IAT	d				
Chassin et al., 2002	Smoking-Pics/Neutral Shapes-IAT	d				
Chee et al., 2000	Flower/Insect-IAT	d			stimuli: presumably Greenwald et al. (1998)	
Chugh, 2004*	Why milliseconds matter	–	–	–	–	–
Crisp & Nicel, 2004*	Intergroup Evaluations: Mentioning of IAT	–	–	–	–	–
Cross et al., 2002	Study 1: Relationship/Individual-IAT	d				
Cunningham et al., 2004	Study 1: Black/White-IAT	d			attributes: Wittenbrink et al. (1997)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 2: Black/White-IAT; Gay/Straight-IAT; Rich/Poor-IAT; Christian/Jewish-IAT; American/Foreign-IAT	d			attributes: Anderson (1968); Greenwald et al. (1998)	
Cunningham et al., 2001	Black/White-IAT	d			attributes: word norms (1986)	
Czopp et al., 2004	Condom/Tree-IAT	d				
Dabbs et al., 2003	Study 1: Flowers/Insects-IAT	d				
	Study 2: Agency/Communion-IAT	d				
	Study 3: Boldness/Friendliness-IAT	d				
Dambrun & Guimond, 2004*	Lexical Decision Task (discussion of IAT)	–	–	–	–	–
Dasgupta, 2004*	Implicit ingroup favoritism, outgroup favoritism, and their behavioral manifestation	–	–	–	–	–
Dasgupta & Greenwald, 2001	Study 1: Black/White-IAT (faces), Flowers/Insects-IAT	c				
	Study 2: Old/Young-IAT (names)	c				
Dasgupta et al., 2003*	Essay	–	–	–	–	–
Dasgupta et al., 2000	Study 1: Black/White-IAT (names); Black/White-IAT (faces)	c			targets: familiarity	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
De Houwer, 2001	British/Foreign-IAT	c	(b)		targets: posttest for cross-category associations	
De Houwer, 2002*	IAT in Psychopathology	–	–	–	–	–
De Houwer, 2003b*	EAST	–	–	–	–	–
De Houwer et al., 2004	Alcoholic/Softdrink-IAT;	d				
	Alcohol/Softdrink-Arousal/Sedation-IAT					
De Jong, 2002	Self-Esteem-IAT	d	self			
De Jong et al., 2001	Neutral/Social Cues-Negative/Positive Outcomes-IAT	d			targets: posttest	
De Jong et al., 2003	Spider/Neutral-IAT	d			attributes: posttest	
DeSteno et al., 2004	Study 2: Ingroup-Outgroup-IAT	c				
Devine, 2001*	Editorial	–	–	–	–	–
Devine et al., 2002	Study 2: Black/White-IAT (names)	d				
	Study 3: Black/White-IAT (faces)	d	(c)		targets: attractiveness; attributes: Greenwald et al. (1998)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Devos & Banaji, 2005	Study 2: White/Asian American-American/Foreign-IAT; White/African American-American/Foreign-IAT; African/Asian American-American/Foreign-IAT (faces)	d		(a)/(a)/(a)	targets: neutral facial expressions	
	Study 3: Black/White Athlete-American/Foreign-IAT (photos)	d				
	Study 4: White/Asian American-American/Foreign-IAT; White European/Asian American-American/Foreign-IAT (names)	c, d		(a)/(a)	targets: celebrity fame	
	Study 5: White/Asian American-American/Foreign-IAT; White/African American-American/Foreign-IAT; African/Asian American-American/Foreign-IAT (faces)	d		(a)/(a)/(a)	targets: neutral facial expressions	
	Study 6: White/Asian American-American/Foreign-IAT; We/They-American/Foreign-IAT; American/Foreign-IAT; We/They-White/Asian American-IAT; White/Asian American-IAT	d	–/(self)/–/(self)/–	(a)/–/–/–/–		
Dijksterhuis, 2004	Study 3: Self-Esteem-IAT	c				

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Dijksterhuis & Smith, 2002*	Study 2: IAT-derived variant for measuring affective habituation	–	–	–	–	–
Egloff & Schmukle, 2002	Study 1: Self-Anxiety/Calmness-IAT	d	self			
	Study 2: Self-Anxiety/Calmness-IAT	c	self			fake good instruction
	Study 3: Self-Anxiety/Calmness-IAT	d	self			
	Study 4: Self-Anxiety/Calmness-IAT	d	self			
Egloff & Schmukle, 2003	Study 1: Self-Anxiety/Calmness-IAT	c	self			
	Study 2: Self-Anxiety/Calmness-IAT	c	self			
Egloff & Schmukle, 2004	Study 1: Self-Anxiety/Calmness-IAT	d	self		stimuli: presumably Egloff & Schmukle (2002)	
Egloff et al., 2005	Study 1: Self-Anxiety/Calmness-IAT	d	self		stimuli: Egloff & Schmukle (2002)	
	Study 2: Self-Anxiety/Calmness-IAT	d	self		stimuli: Egloff & Schmukle (2002)	
	Study 3: Self-Anxiety/Calmness-IAT	d	self		stimuli: Egloff & Schmukle (2002)	
Fazio, 2001*	Automatic Evaluations	–	–	–	–	–
Fazio & Olson, 2003*	Implicit Measures in Social Cognition	–	–	–	–	–

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Field & Lawson, 2003	Animals-IAT	d				
Field et al., 2004	Cannabis-Environment-IAT	d			targets: cannabis-relatedness, word length, frequency	
Florack et al., 2001	German/Turkish-IAT	d				
Foroni & Mayr, 2005	Study 1a: Flower/Insect-IAT	c, d			stimuli: Greenwald et al. (1998)	pro-/counterstereotypic scenario
	Study 1b: Flower/Insect-IAT	c, d			stimuli: Greenwald et al. (1998)	lie-detector scenario/deceive instruction
Frantz et al., 2004	Study 1: Black-White-IAT (Faces)	c			attributes: Greenwald et al. (1998)	
	Study 2: Black-White-IAT (Faces)	c			attributes: Greenwald et al. (1998)	
	Study 3: Black-White-IAT (Faces)	c			attributes: Greenwald et al. (1998)	
Gawronski, 2002	German/Turkish-IAT	d			attributes: Schwibbe, Räder et al., (1994)	
Gawronski, Ehrenberg et al., 2003	Study 1: Gender-Career-IAT	d				
	Study 2: Gender-Career-IAT	d				
Gawronski, Geschke et al., 2003	German/Turkish-IAT (faces)	d			attributes: Schwibbe, Räder et al. (1994)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Gawronski & Strack, 2004	Study 1: Alcoholic/Non-alcoholic beverages-IAT	c, d				
	Study 2: Black/White-IAT	c, d				
Gehring et al., 2003*	Automatic racial attitudes and cognitive control	–	–	–	–	–
Geier et al., 2003	Fat/Thin-Ugly/Beautiful-IAT; Fat/Thin-Lazy/Motivated-IAT; Fat/Thin-Bad/Good-IAT; Fat/Thin-Blameworthy/Blameless-IAT	c				
Gemar et al., 2001	Self-Esteem-IAT	c, (d)	self			
Glen & Banse, 2004	Self-Esteem-IAT	c, d	self		targets: individual pretest of self-associations	
Govan & Williams, 2004	Study 1a: Flower/Insect-IAT	c	d		experimental test of target-CCA influence	
	Study 1b: Black/White-IAT	c	d		experimental test of target-CCA influence	
	Study 2: Animal/Plant-IAT	c	d		experimental test of target-CCA influence	
Gray et al., 2005	Child-Sex-Association-IAT; Flower/Insect-IAT	d			attributes: (partially) Bellezza, Greenwald & Banaji (1986)	
Gray et al., 2003	Violent/Peaceful-IAT	d				

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Greenwald, Banaji et al., 2002	Unified theory (report on data stemming from . . .)					
	- Banaji, Greenwald & Rosier, 1997: Self-Esteem-IAT; Self-Black/White-IAT; Black/White-IAT	d	self/self/–			
	- Farnham & Greenwald, 1999: Self-Esteem-IAT; Self-Gender-IAT; Gender-IAT	d	self/self/–			
	- Mellott & Greenwald, 2000: Self-Esteem-IAT; Self-Age-IAT; Ageism-IAT	d	self/self/–			
	- Nosek, Banaji & Greenwald, 2002: Self-Esteem-IAT; Self-Math-Arts-IAT; Math-Arts-IAT	d	self/self/–			
Greenwald & Farnham, 2000	Study 1: Self-Esteem-IAT (affective words); Self-Esteem-IAT (trait words)	d	self/self			
	Study 2: Self (idiographic)-Gender-IAT; Self (generic)-Gender-IAT	d	self/self			
	Study 3: Self-Esteem-IAT (affective words); Self-Esteem-IAT (trait words)	d	self/self			
Greenwald et al., 1998	Study 1: Flowers/Insects-IAT; Instruments/Weapons-IAT	d				
	Study 2: Japanese/Korean American-IAT	d				
	Study 3: Black/White-IAT	d				

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Greenwald & Nosek, 2001*	Health of IAT at age 3	–	–	–	–	–
Greenwald et al., 2003*	Improved scoring algorithm	–	–	–	–	–
Greenwald, Pickrell et al., 2002	Pretest A: Fictitious Teams-IAT; Fictitious Teams-Self/Other-IAT	c		–/self		
	Pretest B: [Partial-IATs] Fictitious Teams Win/Lose-IAT; Fictitious Teams-Self/Other-IAT	c		–/self		
	Study 1: [Partial-IATs] Fictitious Teams-Win/Lose-IAT; Fictitious Teams-Self/Other-IAT	c		–/self		
	Study 2: [Partial-IATs] Fictitious Teams-Win/Lose-IAT; Fictitious Teams-Self/Other-IAT	c		–/self		
	Study 3: [Partial-IATs] Fictitious Teams-Win/Lose-IAT; Fictitious Teams-Self/Other-IAT	c		–/self		
Gregg, 2003*	Optimal Self-Esteem	–	–	–	–	–
Grover et al, 2003	Light/Heavy-IAT; Light/Heavy-Self-IAT; Gender-IAT; Self-Gender-IAT; Self-Esteem-IAT	d				
Hausmann & Ryan, 2004	Black/White-IAT (faces)	d			stimuli: Web-IAT (implicit.harvard.edu/implicit)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Hofmann et al., 2005	Study 1: East/West German-IAT	d	b		targets: word length, familiarity, and valence	
	Study 2: German/Turks-IAT (names); German/Turks-IAT (faces)	d			targets: names matched in word length; faces taken from Neumann & Seibt (2001)	
Huijding et al., 2005	Study 1: Smoking/Exercise-IAT	d				
	Study 2: Smoking/Writing IAT	d		(a)	attributes: neutral writing stimuli (Hermans & De Houwer, 1994)	
Hummert et al., 2002	Study 1: Old/Young-IAT; Self-Old/Young-IAT; Self-Esteem-IAT	(c)	(c)/self/self		targets: happiness of old/young photos; Greenwald et al. (2002)	
	Study 2: Flowers/Insects-IAT	(c)			stimuli: Greenwald et al. (1998)	
Jajodia & Earleywine, 2003	Alcohol/Mammals-positive/neutral-IAT; Alcohol/Mammals-negative/neutral-IAT	d		(d)/(d)	targets: familiarity, word length; attributes: partially related to drinking outcomes	
Jelenec & Steffens, 2002	Old/Young-IAT	c	c	a	stimuli: word length	
Jellison et al., 2004	Study 1: Sexual Orientation-IAT	d				
	Study 2: Sexual Orientation-IAT	d				

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Jordan et al., 2005	Study 1: Self-Esteem-IAT	d	self		targets: neutral not-self words	
	Study 2: Self-Esteem-IAT	d	self		targets: neutral not-self words	
Jordan et al., 2003	Study 1: Self-Esteem-IAT	d	self		targets: neutral not-self words	
	Study 2: Self-Esteem-IAT	d	self		targets: neutral not-self words	
	Study 3: Self-Esteem-IAT	d	self		targets: neutral not-self words	
Jost et al., 2002	Study 1: Stanford/SJSU-IAT; Stanford/SJSU-Academic/Extracurricular-IAT; Self-Esteem-IAT	d	–/–/self		attributes: evaluative words from Greenwald et al. (1998)	
Kaminska-Feldman, 2004	Polish/Jews-IAT	d				
Karpinski, 2004	Study 1: Self-Esteem-IAT (unspecified other); Self-Esteem-IAT (friend other)	(c), d	self/self		attributes: Greenwald et al. (1998)	
	Study 2: Self-Esteem-IAT (unspecific other); Self-Esteem-IAT (Santa Claus other); Self-Esteem-IAT (Adolf Hitler other)	(c), d	self/self/self		attributes: Greenwald & Farnham (2000)	
Karpinski & Hilton, 2001	Study 1: Flowers/Insects-IAT	d				
	Study 2: Apple/Candy Bar-IAT	c, d				
Karpinski et al., 2005	Study 1: Bush/Gore-IAT	d			attributes: Greenwald et al. (1998)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 2: Coke-Pepsi-IAT	d				
	Study 3: Coke-Pepsi-IAT	c, d				
Kim, 2003a	Study 1: Flowers/Insects-IAT; Instruments/Weapons-IAT	c			stimuli: Greenwald et al. (1998)	fake good instruction
	Study 2: Black/White-IAT (names)	c			stimuli: Greenwald et al. (1998)	fake good instruction
Kim, 2003b	North/South Korea-IAT	d			targets: familiarity	
Kim, 2004	Study 1: Implicit Life Satisfaction (ILS)-IAT (global); ILS-IAT (unique); Self-Esteem-IAT	d	(self)/–/self		attributes: familiarity	
	Study 2: ILS-IAT (global); ILS-IAT (unique); ILS-IAT (emotion)	(c), d	(self)/–/(self)		attributes: familiarity	
	Study 3: ILS-IAT (global); ILS-IAT (unique)	c, d	(self)/–		attributes: familiarity	fake good/bad instruction
Kim & Oh, 2001	Study 1: North/South Korea-IAT	d			targets: familiarity	
	Study 2: Self/Others-North/South Korea-IAT; North/South Korea-IAT	d	self/–		targets: familiarity	
Kitayama & Uchida, 2003	Study 1: Self/Friend-IAT	d	self		stimuli: Greenwald & Farnham (2000)	
	Study 2: Self/Others-IAT	d	self		stimuli: Greenwald & Farnham (2000)	
Klauer & Mierke, 2005	Study 1: Flower/Insect-IAT	c	d	a	stimuli: Mierke & Klauer (2001)	
	Study 2: Flower/Insect-IAT	c	d	a	stimuli: Mierke & Klauer (2001)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Kobayashi & Greenwald, 2003	Study 1: Self/Other-IAT; Best Friend/Other-IAT; Students/Other-IAT (students other)	d	self/–/–		stimuli: (partially) Greenwald et al. (1998) & Greenwald and Farnham (2000)	
	Study 2: Self/Other-IAT; Best Friend/Other-IAT; Students/Other-IAT (students other)	d	self/–/–			
Kühnen et al., 2001	Study 1: East-West-German-IAT	c		a		
	Study 2: East-West-German-IAT	c		a		
Livingston, 2002	Study 1b: Black/White-IAT	d			stimuli: Greenwald et al. (1998)	
Lowery et al., 2001	Study 1: Black/White-IAT	c			stimuli: Greenwald et al. (1998)	
	Study 2: Black/White-IAT	d			stimuli: Greenwald et al. (1998)	
	Study 3: Black/White-IAT	c			stimuli: Greenwald et al. (1998)	fake good instruction
Madon et al., 2005	Flawed/Ideal-Threatened/Comfortable-IAT	d				
Maison et al., 2001	Study 1: Fruit Juices/Sodas-IAT	d				
	Study 2: High/Low-Calorie-Foods-IAT	d				
Maison et al., 2004	Study 1: Danone-Bakoma-IAT	d			stimuli: Maison & Bruin (1999); targets: similar in size and form	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 2: McDonald's/Milk Bar-IAT	d				
	Study 3: Coca Cola/Pepsi-IAT	d			targets: similar in size and form	
Marsh et al., 2001	Condom-IAT; Condom/Self-IAT	d	a/–	–/self		
McConnell & Leibold, 2001	Black/White-IAT	d				
McFarland & Crouch, 2002	Study 1: Black/White-IAT; American/Foreign-IAT; Homo/Heterosexual-IAT; Non-/Delicious-Un-/Happiness-IAT; Flower/Insect-IAT	d			targets: (partially) Greenwald et al. (1998); attributes: moral/immoral instead of positive/negative ones	
	Study 2: Black/White-IAT; Homo/Heterosexual-IAT; Self-Esteem-IAT; Non-/Delicious-Un-/Happiness-IAT; Flower/Insect-IAT	(c), d	–/–/self/–/–		attributes: (partially) Greenwald & Farnham (2000)	
	Study 3: Black/White-IAT; Self-Esteem-IAT; Non-/Delicious-Un-/Happiness-IAT; Flower/Insect-IAT	(c), d	–/self/–/–		stimuli: (partially) Greenwald & Farnham (2000)	
	Study 4: Black/White-IAT; Self-Esteem-IAT; Non-/Delicious-Un-/Happiness-IAT; Flower/Insect-IAT	(c), d	–/self/–/–		stimuli: (partially) Greenwald & Farnham (2000)	
McGregor & Marigold, 2003	Study 3: Self-Esteem-IAT	d	self			

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Meagher & Aidman, 2004	Self-Esteem-IAT	d	self		attributes: Greenwald et al. (1998)	
Mierke & Klauer, 2001	Study 1: Flower/Insect-IAT	c	d	a	stimuli: familiarity (Celex, 1995)	
	Study 2: Flower/Insect-IAT	c	d	a	stimuli: familiarity (Celex, 1995)	
Mierke & Klauer, 2003	Study 1a: Contingent-Geometrical-Objects (CGO)-IAT	c	d			
	Study 1b: Flower/Insect-IAT	c	d	a	stimuli: Mierke & Klauer (2001)	
	Study 2: CGO-IAT; Flower/Insect-IAT	(d)	d/d	–/a	stimuli: Mierke & Klauer (2001)	
	Study 3: CGO-IAT; Self-Extraversion-IAT	(d)	d/self		attributes: evaluative differences of extraversion stimuli	
Mihailides et al., 2004	Children as sexual beings-IAT; Uncontrollability of sexuality-IAT; Sexual entitlement bias-IAT	d				
Milne & Grafman, 2001	Gender-Stereotype-IAT	d			stimuli: Rudman & Kilianski (2001)	
Mitchell, C. J., 2004	Study 1: Teeth/No Teeth-Flight/No Flight-IAT	c				mere acceptance effect; figure–ground recoding
	Study 2: Row Same/Row Different- *or* Column Same/Column Different-IAT	c				mere acceptance effect; figure–ground recoding

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Mitchell, C. J. et al., 2003	Study 1: Nonwords-Un-/Pleasantness-IAT	c				
	Study 2: Positive/Negative Colored Nonsense-Words-IAT	c				
Mitchell, J. P. et al., 2003	Study 1: Athlete/Politician-IAT; Black/White-IAT	c	d/d		attributes: Greenwald et al. (1998)	
	Study 2: Black/White-IAT	c	d		attributes: Greenwald et al. (1998)	
	Study 3: Athlete/Politician-IAT; Black/White-IAT	c	d/d		attributes: Greenwald et al. (1998)	
Monteith et al., 2001	Black/White-IAT	d			stimuli: Greenwald et al. (1998)	
Neumann et al., 2004	AIDS/Without AIDS-IAT	d	(c)		targets: attractiveness of photos	
Neumann & Seibt, 2001	German/Turks-IAT	d		a		
Nier, 2005	Black/White-IAT (faces)	c, d			targets: Cunningham et al. (2001); attributes: (partially) Greenwald et al. (1998)	
Nosek et al., 2002a	Black/White-IAT; Old/Young-IAT; Gender-Career-IAT; Gender-Science-IAT; Self-Esteem-IAT; Math/Arts-IAT; Election2000-IAT	d	–/–/–/–/self/–/–		stimuli: (partially) Greenwald et al. (1998)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Nosek et al., 2002b	Study 1: Math/Language-IAT; Math/Arts-IAT; Science/Arts-IAT; Math/Arts-Self-IAT	d		–/–/–/self		
	Study 2: Math/Arts-IAT; Math/Arts-Self-IAT; Math-Gender-IAT; Self-Gender-IAT	d	–/–/–/self	–/self/–/–		
Nosek et al., 2005	Study 1: Bush/Gore-IAT; Black/White-IAT; Gender-Science-IAT; Old/Young-IAT	d				
	Study 2: Black/White-IAT; Gender-Science-IAT; Old/Young-IAT	(c), d				
	Study 3: Black/White-IAT; Gender-Science-IAT; Old/Young-IAT	c, d				
	Study 4: Old/Young-IAT; Asian/White-IAT; Gender-Science-IAT; Black/White-IAT; Dark Skin/Light Skin-IAT	(c), d				
Olson & Fazio, 2001	Pokemon-IAT	c			targets: familiarity	
Olson & Fazio, 2003	Black/White-IAT	c			stimuli: Greenwald et al. (1998)	
Olson & Fazio, 2004	Study 1: Black/White-IAT (names)	(c), d			stimuli: Greenwald et al. (1998)	
	Study 2: Black/White-IAT (names)	(c), d			stimuli: Greenwald et al. (1998)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 3: Apples/Candy Bar-IAT	(c), d			stimuli: (partially) Karpinski & Hilton (2001)	
	Study 4: Gore/Bush-IAT	(c), d				
Ottaway et al., 2001	Study 1: Flower/Insect-IAT	c			targets: familiarity	
	Study 2: Black/White-IAT; Hispanic/White-IAT	d			targets: familiarity	
Paladino et al., 2002	Study 1: North African/Belgian-Primary/Secondary-Emotions-IAT	d			attributes: secondary emotions pretested to be more positive than primary emotions	
	Study 2: Spanish/Arabic-Primary/Secondary-Emotions-IAT	d			attributes: secondary/primary emotions pretested to be equally negative	
	Study 3: North African/Belgian-Primary/Secondary-Emotions-IAT; North African/Belgian-IAT	d			attributes: (partially) Greenwald et al. (1998)	
	Study 4: French/Flemish-Primary/Secondary-Emotions-IAT	d				
Palfai & Ostafin, 2003	Alcohol/Electricity-Approach/Avoid-IAT	d				

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Park & Schaller, 2005	Elaine/Carol-Family/Stranger-IAT; Elaine/Carol-IAT	d	–/(c)	–/(a)	targets: attractiveness; attributes: family stimuli more pleasant than stranger stimuli; evaluative stimuli presumably not associated with kindship relations	
Perugini, 2005	Study 1: Smoking/Exercise-IAT	d			attributes: Swanson et al. (2001)	
	Study 2: Fruits/Snacks-IAT	d				
Phelps et al., 2003	Black/White-IAT	c, d	(a)		targets: presumably neutral facial expressions	
Phelps et al., 2000	Study 1: Black/White-IAT	d	(a)		targets: presumably neutral facial expressions	
	Study 2: Black/White-IAT	d	b		targets: familiarity and positivity	
Phelps & Thomas, 2003*	Psychological and neural approaches	–	–	–	–	–
Pinter & Greenwald, 2005	Self/Other-IAT; Self-/Hitler-IAT; Other-Hitler-IAT	(c), d				
Plessner & Banse, 2001*	Editorial	–	–	–	–	–
Redding, 2004*	Politics of research on racial prejudice: Comment	–	–	–	–	–

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Richeson & Ambady, 2001	Gender-IAT; Gender-Competence-IAT	c		(a)/–	targets: cross-categorically associated stimuli excluded post hoc	
Richeson & Ambady, 2003	Black/White-IAT	c			stimuli: Greenwald et al. (1998)	
Richeson et al., 2003	Black/White-IAT (names)	d			stimuli: presumably Greenwald et al. (1998)	
Richeson & Shelton, 2003	Black/White-IAT	d			stimuli: Greenwald et al. (1998)	
Richeson & Shelton, 2005	Black/White-IAT (names)	d			stimuli: presumably Greenwald et al. (1998)	
Richetin et al., 2004	Study 1: Make Up/No Make Up-High/Low Status Professions-IAT; Make Up/No Make Up-IAT	d	–/(c)		targets: attractiveness of photos	
	Study 2: Make Up/No Make Up-High/Low Status Professions-IAT; Make Up/No Make Up-Positive/Negative Traits IAT	d			targets: attractiveness of photos	
	Study 3: Make Up/No Make Up-High/Low Status Professions-IAT; Make Up/No Make Up-Positive/Negative Traits IAT	d			targets: attractiveness of photos	
Roefs & Jansen, 2002	High/Low-Fat-Food-IAT	d				
Rothermund &	Study 1: Old/Young-IAT; Old/Young-	(c)			stimuli: Greenwald et al.	figure–ground recoding

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Wentura, 2001	Word/Nonword-IAT				(1998)	
	Study 2: Old/Young-IAT	(c)			stimuli: Greenwald et al. (1998)	figure–ground recoding
Rothermund & Wentura, 2004	Study 1a-e: Old/Young IAT; Old/Young-Word/Nonword-IAT; Old/Young-Siwob/No Siwob-IAT; Old/Young-Multicolored/Single colored-IAT	(c)	d/d/d/d		targets: young = positive, old = neutral; attributes: words = neutral, nonwords = neutral	figure–ground recoding
	Study 2a-b: Male/Female-Self/Other-IAT; Male/Female-Word/Nonword-IAT; East/West German-Self/Other-IAT; East/West-IAT; East/West-Words/Nonword-IAT	(c), (d)		self/–/ self/–/–		figure–ground recoding
	Study 3a-b: Old/Young-IAT; Old/Young-Yellow/Green-IAT	c	d/d		targets: young = positive, old = neutral	figure–ground recoding
	Study 4: Well known/Unknown Persons-IAT	(c)	d		experimental test of target-CCA influence of well-known target group	figure–ground recoding
Rowatt & Franklin, 2004	Black/White-IAT	d				
Rowatt et al., 2005	Muslim-Christian IAT	d				
Rudman, 2004a*	Sources of implicit attitudes	–	–	–	–	–
Rudman, 2004b*	Social justice	–	–	–	–	–

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Rudman, Ashmore et al., 2001	Study 1: Black/White-IAT; Black/White-Stereotype-IAT (neg. black & pos. white traits)	c		–/d	stimuli: Greenwald et al. (1998); Kawakami, Dovidio et al. (2000); Wittenbrink, Judd et al. (1997)	
	Study 2: Black/White-IAT	c			stimuli: Greenwald et al. (1998)	
Rudman et al., 2002	Christian/Jewish-IAT (names); Asian/White-IAT (faces); overweight/slim IAT; poor/rich-IAT	d				
Rudman & Goodwin, 2004	Study 1: Gender-IAT; Self-Esteem-IAT; Gender-Identity-IAT	d		a/self/self		
	Study 2: Gender-IAT; Parents-IAT; Gender-Power/Warmth-IAT	d		a/–/–		
	Study 3: Gender-IAT; Gender-Threat/Safe-IAT; Gender-Power/Warmth IAT	d		a/–/–		
	Study 4: Gender-IAT; Sex/No Sex-IAT	d	–/(c)	a/–	targets: (non-)sexual photos matched in attractiveness	
Rudman, Greenwald et al., 2001	Study 1: Gender-Powerful/Weak-IAT; Gender-Warm/Cold-IAT	d				
	Study 2: Gender-Powerful/Weak-IAT (1 × positve, 1 × neutral, 1 × negative)	(c), d		c		
	Study 3: Gender-Powerful/Weak-IAT; Self-Esteem-IAT; Self-Powerful/Weak-IAT	d	–/self/self			

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 4: Gender-Potency/Warmth-IAT; Self-Potency/Warmth-IAT	d	–/self			
Rudman et al., 1999	Study 1: Christian/Jewish-IAT	d			targets: word length and frequency	
	Study 2: Old/Young-IAT; Old/Young-Age Stereotype-IAT	d				
	Study 3: American/Soviet(both familiar)-IAT; American/Soviet(both unfamiliar)-IAT; American(familiar)/Soviet(unfamiliar)-IAT; American(unfamiliar)/Soviet(familiar)-IAT	c				
Rudman & Heppen, 2003	Study 1: Boyfriend/Other-Fantasy/Reality-IAT	d				
	Study 2: Partner/Other-Fantasy/Personality-IAT	d				
	Study 3: Partner/Other-Non-/Fantasy-Roles-IAT; Partner/Other-IAT	d				
Rudman & Kilianski, 2000	Gender-Roles-IAT; Gender-Authority-IAT; Gender-Stereotype-IAT	d			attributes: gender stereotype items matched in valence	
Rudman & Lee, 2002	Study 1: Black/White-IAT	c				
	Study 2: Black/White-IAT	d				
Rutland et al., 2005	Study 1: Black/White-Happy/Unhappy-IAT (faces)	c, d	(a)		targets: neutral facial expressions	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 2: British/German-Happy/Unhappy-IAT	c, d	(a)		targets: neutral facial expressions	
Schaller et al., 2003	Black/White-IAT; Black/White-Danger/Safety-IAT	d				
Schimmack & Diener, 2003*	Implicit Self-Esteem: Mentioning of IAT	–	–	–	–	–
Schmid Mast, 2004	Hierarchy-Gender IAT (paper & pencil)	d				
Schmukle & Egloff, 2004	Study 1: Self-Anxiety/Calmness-IAT	c	self		stimuli: presumably Egloff & Schmukle (2002)	
	Study 2: Self-Anxiety/Calmness-IAT	c	self		stimuli: presumably Egloff & Schmukle (2002)	
Schmukle & Egloff, 2005	Self-Extraversion/Introversion-IAT; Self-Anxiety/Calmness-IAT	d	self/self		stimuli: presumably Egloff & Schmukle (2002)	
Schultz et al., 2004	Study 1: Self-Nature/Built-IAT	d	self			
	Study 2: Self-Nature/Built-IAT	d	self			
Sears, 2004*	Implicit prejudice/Survey research: Comment	–	–	–	–	–
Seise et al., 2002	Homo-/Heterosexual-IAT (photos)	d			attributes: Schwibbe et al., 1994	
Shelton et al., 2005	Black/White-IAT (names)	d				
Sherman et al., 2003	Study 1: Cigarettes/Insects, Babies, Cuddly Animals – IAT	d			targets: familiarity	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 2: Cigarettes/Insects, Babies, Cuddly Animals – IAT	c			targets: familiarity	
Sinclair et al., 2005	Black/White-IAT (faces)	d			stimuli: Web-IAT (buster.cs.yale.edu/implicit)	
Skowronski & Lawrence, 2001	Gender-IAT	d				
Steffens, 2004	Study 1: Self-Conscientiousness-IAT	c	self		attributes: almost matched in valence	fake good/bad instruction
	Study 2: Self-Extraversion/Introversion-IAT	c	self		attributes: almost matched in valence	fake good/bad instruction
Steffens & Buchner, 2003	Study 1: Homo-/Heterosexual-IAT	d	(c)	a	targets: randomized selection of names; attributes: Hager & Hasselhorn (1994)	
	Study 2: Homo-/Heterosexual-IAT	d	c	a	attributes: Hager & Hasselhorn (1994)	
Steffens & Plewe, 2001	Gender-IAT	c		d	experimental test of attribute-CCA influence	
Suedfeld, 2004*	Racism in the brain	–	–	–	–	–
Swanson et al., 2001	Study 1: Smoking/Exercise-IAT; Smoking/Sweets-IAT	d				
	Study 2: Smoking/Stealing-IAT; White Meat/Other Protein-IAT; Smoking/Stealing-Self/Others-IAT; White Meat/Other Protein-Self/Others-IAT	d		–/–/self/self		

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 3: Smoking/Nonsmoking-IAT; Smoking/Nonsmoking-Self/Others-IAT; Self-Esteem-IAT	d	–/–/self	–/self/–		
Teachman et al., 2003	Study 1: Fat/Thin-IAT; Fat/Thin-Motivated/Lazy-IAT	d				
	Study 2a: Fat/Thin-IAT (words); Fat/Thin-IAT (pictures); Fat/Thin-Valuable/Worthless-IAT; Overweight/Underweight-IAT; Fat/Thin-Self/Other-IAT	d		–/–/–/–/self		
	Study 2b: Fat/Thin-Motivated/Lazy-IAT; Fat/Thin-Smart/Stupid-IAT	d				
Teachman et al., 2001	Spider/Snake-IAT; Spider/Snake-Danger/Safety-IAT; Spider/Snake-Disgusting/Appealing-IAT; Spider/Snake-Un-/Afraid-IAT	d	c/–/c/c		targets: equally negative/–/equally evoking fear/equally evoking disgust	
Teachman & Woody, 2003	Spider/Snake-IAT; Spider/Snake-Danger/Safety-IAT; Spider/Snake-Disgusting/Appealing-IAT; Spider/Snake-(Un)Afraid-IAT; Fruit/Garbage-IAT; Fire/Other-(Un)Afraid-IAT	d	c/–/c/c/–/		targets: equally negative/–/equally evoking fear/equally evoking disgust/–/–	
Teachman & Woody, 2004*	Staying tuned to research	–	–	–	–	–

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
Teige et al., 2004	Self-Shyness-IAT; Self-Angriness-IAT	d	self/self		attributes: Asendorpf et al. (2002); Schnabel (2003)	
Tetlock & Arkes, 2004*	The implicit prejudice exchange	–	–	–	–	–
Uhlman et al., 2002	Study 1: Blanco/Moreno-IAT, White/Hispanic-IAT (blanco), White/Hispanic-IAT (moreno)	d				
	Study 2: Blanco/Moreno-IAT; White/Hispanic-IAT (blanco); White/Hispanic-IAT (moreno)	d				
Uhlmann & Swanson, 2004	Self-Aggressive/Peaceful-IAT	c, d	self			
Vanman et al., 2004	Black/White-IAT (faces)	d	(c)		targets: attractiveness	
Vargas et al., 2004	Study 4: Religious/Atheistic-IAT	d				
Vartanian et al., 2004*	Implicit cognitions and eating disorders	–	–	–	–	–
von Hippel, 2004*	Implicit prejudice: Pentimento or Inquisition?	–	–	–	–	–
VonDras & LorVang, 2004	Old/Young-IAT; unspecified IAT	(c), d			stimuli: Web-IAT (www.tolerance.org)	
Wang et al., 2004	Study 1: Flower/Insect-IAT; Fat/Thin People-IAT	d				

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 2: 4 Thin/Fat people-Stereotype-IATs: good/bad; lazy/motivated; stupid/smart; worthless/valuable	d				
Wenger & Yarbrough, 2005	Self-Intrinsic/Extrinsic Religiousness-IAT	d	self		targets: Hummert et al., 2002; attributes: (partially) Maltby (1999) I/E-Scale-12	
Weyant et al., 2004 [unavailable]	–	–	–	–	–	–
Wiers et al., 2004*	How to change implicit drug use related cognitions in prevention	–	–	–	–	–
Wiers, Stacy et al., 2002*	Conference proceedings	–	–	–	–	–
Wiers, van Woerden et al., 2002	Alcohol/Soda-IAT; Alcohol/Soda-Arousal/Sedation-IAT	d				
Wittenbrink, 2004*	Ordinary form of prejudice	–	–	–	–	–
Wittenbrink et al., 2001	Study 1: Black/White-IAT; Flower/Insect-IAT	c			stimuli: Greenwald et al. (1998)	
Zayas & Shoda, 2005	Study 1: Partner-IAT; Self-IAT (represented by names)	d			attributes: Belezza, Greenwald & Banaji (1986)	

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Article (Authors, Year)[a]	*Study/IAT Applications*	*Inference Direction*[b]	*Pretests to control for stimulus effects*[c]			*Test of Strategic Processing*
			Target Stimuli	*Attribute Stimuli*	*Annotations/Stimulus Source/Other Pretests*	
	Study 2: Partner-IAT; Self-IAT; Mother-Supportive/Rejecting-IAT	d			attributes: supportive/ rejecting stimuli Zayas & Shoda (2004)	
	Study 3: Mother-Supportive/Rejecting-IAT	d			attributes: supportive/ rejecting stimuli Zayas & Shoda (2004)	
Ziegert & Hanges, 2005	Black/White-IAT (names)	d			stimuli: Greenwald et al. (1998)	

Coding of IAT articles, studies, and IAT applications as reported throughout the course of 5 years (up to 2004): causal vs diagnostic inferences (third column), stimulus pretests referring to cross-category associations of target and attribute stimuli (fourth and fifth columns), additional information provided on stimulus selections (sixth column), plus consideration of strategic processes and faking vulnerability (seventh column). Codings of tests of falsifiable IAT assumptions and explicit association models yielded empty columns.

Note: Codings in brackets indicate that a criterion was partially met.

[a]Articles marked with an asterisk did not provide a detailed report of an IAT application.

[b]Causal (experimental) or diagnostic (correlative) inferences are marked with "c" or "d", respectively.

[c]Pretests on cross-category associations, split for target and attribute stimuli. IATs using "self" as a category do not qualify for a meaningful test cross-category associations;
"a": stimuli free of cross-category associations; "b": balancing of stimuli containing congruent and incongruent cross-category associations;
"c": matching of the degree of cross-category associations; "d": experimentally intended cross-category associations.
If stimuli were taken from other studies, the respective source is indicated. Other pretest dimensions are reported accordingly.