A Meta-Analysis on the Correlation Between the Implicit Association Test and Explicit Self-Report Measures

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Theoretically, low correlations between implicit and explicit measures can be due to (a) motivational biases in explicit self-reports, (b) lack of introspective access to implicitly assessed representations, (c) factors influencing the retrieval of information from memory, (d) method-related characteristics of the two measures, or (e) complete independence of the underlying constructs. The present study addressed these questions from a meta-analytic perspective, investigating the correlation between the Implicit Association Test (IAT) and explicit self-report measures. Based on a sample of 126 studies, the mean effect size was .24, with approximately half of the variability across correlations attributable to moderator variables. Correlations systematically increased as a function of (a) increasing spontaneity of self-reports and (b) increasing conceptual correspondence between measures. These results suggest that implicit and explicit measures are generally related but that higher order inferences and lack of conceptual correspondence can reduce the influence of automatic associations on explicit self-reports.

Keywords: *associative processes; dual-process theories; Implicit Association Test; implicit-explicit correlation; meta-analysis*

Arguably one of the most important contributions in social cognition research within the last decade was the development of implicit measures of attitudes, stereotypes, self-concept, and self-esteem (e.g., Fazio, Jackson, Dunton, & Williams, 1995; Greenwald, McGhee, & Schwartz, 1998; Nosek & Banaji, 2001; Wittenbrink, Judd, & Park, 1997). These measures—most of them based on reaction times in response compatibility tasks (cf. De Houwer, 2003)—are intended to assess relatively automatic mental associations that are difficult to gauge with explicit self-report measures.

Evidence for the success in assessing meaningful constructs that are difficult to tap with self-reports is implied by the finding that implicit measures often show rather low correlations with explicit measures (Blair, 2001; Dovidio, Kawakami, & Beach, 2001) yet reliably predict behavior (e.g., Asendorpf, Banse, & Mücke, 2002; Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997; Egloff & Schmukle, 2002; Gawronski, Ehrenberg, Banse, Zukova, & Klauer, 2003). A highly controversial question is, however, why implicit and explicit measures sometimes show substantial correlations (e.g., Banse, Seise, &

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Zerbes, 2001) but sometimes are completely unrelated (e.g., Karpinski & Hilton, 2001).

From a general point of view, there are at least five possible explanations for why correlations between explicit and implicit measures show such large variations. First, one could argue that implicit measures are generally unbiased by motivational influences, whereas explicit self-reports are often influenced by social desirability concerns. This assumption is most prominently reflected in Fazio's MODE model (Fazio & Olson, 2003), stating that explicit and implicit measures should be highly correlated unless people are motivated and able to control their responses on the explicit measure (e.g., Banse & Gawronski, 2003; Dunton & Fazio, 1997; Fazio et al., 1995; Gawronski, Geschke, & Banse, 2003; Hofmann, Gschwendner, & Schmitt, 2005). Thus, correlations between implicit and explicit measures may be high for relatively mundane topics (e.g., consumer preferences) but correlations may be low for socially sensitive topics (e.g., prejudice against minority groups).

Second, implicitly assessed representations may differ as to whether they are introspectively accessible for explicit self-reports. This explanation can be derived from Greenwald and Banaji's (1995) definition of implicit representations as "introspectively unidentified (or inaccurately identified) traces of past experience" that mediate overt responses (p. 5). Drawing on this definition, one could argue that variations in correlations are due to differences in people's awareness of implicit representations. Moreover, because introspection may increase the awareness of formerly subconscious implicit representations (e.g., Hofmann et al., 2005), correlations between explicit and implicit measures may be higher the more time people spend on introspection.

Third, one could argue that explicit and implicit measures tap two independent representations that differ with regard to the cognitive effort that is required for their retrieval from memory. This explanation is implied in Wilson, Lindsey, and Schooler's (2000) dual attitudes model, arguing that implicit measures reflect old representations that are activated automatically upon encounter of a relevant stimulus. Explicit measures, in contrast, are assumed to reflect such old representations only when people lack either the motivation or the cognitive capacity to retrieve more recently acquired representations from memory. As such, correlations between explicit and implicit measures may be high when people make their judgment spontaneously, but correlations may be low when people engage in deliberate processing (e.g., Florack, Scarabis, & Bless, 2001b; Koole, Dijksterhuis, & Van Knippenberg, 2001).

Fourth, there might be method-related factors that influence correlations between explicit and implicit measures. These factors could be rooted in characteristics of either the explicit or the implicit measure. For instance, randomizing the order of trials in the implicit measure may confound individual differences in the assessed representation with individual differences in the particular order of trials (cf. Gawronski, 2002). As such, correlations to explicit self-reports may be reduced due to the influence of systematic error variance. Furthermore, the conceptual correspondence of indicators (cf. Ajzen & Fishbein, 1977) may influence the implicit-explicit relationship, such that correlations may be reduced when the self-report measure is only indirectly rather than directly related to the representation assessed by the implicit measure.

Finally, the constructs assessed by explicit and implicit measures could be completely independent. In this theoretically possible case, significant correlations between explicit and implicit measures may still emerge. However, such correlations should be random such that (a) the mean correlation across studies should be close to zero and (b) variations in correlations should be random rather than systematic.

The main goal of the present research was to investigate the actual relation between explicitly and implicitly assessed representations meta-analytically. Meta-analyses provide a quantitative summary of the available evidence and thus offer a better basis for resolving debates that have a high level of empirical ambiguity (Hunter & Schmidt, 1990). As such, we consider the method of meta-analysis as a useful way to gain a clearer picture of the actual relationship between explicit and implicit measures. This expectation is based on three essential characteristics of such a meta-analysis. First, the accumulation of findings across studies allows for a proper estimation of the mean population correlation between implicit and explicit measures because variability due to chance (sampling error) and other artifacts can be controlled. The mean correlation over a large sample of studies should provide generalizable evidence to the population of all possible studies as to whether explicit and implicit measures are correlated at all or whether their overall correlation is negligible. Second, the variance of population correlations can be estimated to judge whether substantial variability due to moderator variables exists or whether all observed implicit-explicit correlations stem from one fixed population correlation, varying across studies only due to sampling error (Hunter & Schmidt, 1990). This question is important to determine whether correlations reflect a complete independence of explicitly and implicitly assessed representations or whether systematic variation in correlations due to moderators exists. Third, given that substantial variability among population correlations exists, the effect of potential moderators can be investigated. In the present context, we were particularly interested in whether correlations between explicit and implicit measures vary as a function of motivational, cognitive, or method-related factors, such as implied by the accounts outlined above.

THE IMPLICIT ASSOCIATION TEST

In the present meta-analysis, we focused on correlations revealed by a particular implicit measure: the Implicit Association Test (IAT), developed by Greenwald et al. (1998). The IAT is based on a double discrimination task in which participants are asked to assign single stimuli (e.g., words, pictures) as fast as possible to a given pair of target categories. Associative strength between two concepts is assessed by combining a given pair of target categories (e.g., Caucasian vs. African American) with a supposedly associated pair of attributes (e.g., positive vs. negative) both in an association-compatible and an association-incompatible manner. The difference between the mean response latencies for association-compatible and association-incompatible assignments is usually interpreted as an indicator of the relative associative strength between the two pairs of concepts (for a discussion of different scoring algorithms, see Greenwald, Nosek, & Banaji, 2003).

Research using the IAT seems particularly suitable for the present meta-analysis because the IAT has already stimulated a great deal of research on a large number of topics. So far, the IAT has been applied in nearly all psychological disciplines, such as social psychology (e.g., Rudman, Greenwald, Mellott, & Schwartz, 1999), personality psychology (e.g., Asendorpf et al., 2002), clinical psychology (e.g., Teachman, Gregg, & Woody, 2001), consumer psychology (e.g., Maison, Greenwald, & Bruin, 2001), health psychology (e.g., Wiers, Van Woerden, Smulders, & De Jong, 2002), gerontology (e.g., Hummert, Gartska, O'Brien, Greenwald, & Mellott, 2002), and neuropsychology (e.g., Phelps et al., 2000). This extraordinary body of research provides not only a sufficiently large database for a meta-analysis on the relationship between explicitly and implicitly assessed representations but it also offers the possibility to investigate potential moderators of the correlation between the IAT and explicit self-reports, such as motivational and cognitive factors associated with the topic under investigation. In addition, focusing particularly on the IAT allowed us to test the potential influence of several method-related factors that may influence correlations between the IAT and explicit self-reports. This question seems particularly important in the present debate because method-related factors could artificially influence correlations into one or the other direction and thus lead to inaccurate conclusions about the true relationship between explicitly and implicitly assessed representations. Finally, of all implicit measures that have been developed so far, the IAT seems to be the only one with a sufficiently high reliability, such that negligible correlations with low variation can actually be attributed to independence rather than to low internal consistency (cf. Blair, 2001; Dovidio et al., 2001; see also Cunningham, Preacher, & Banaji, 2001).[1]

QUESTIONS ADDRESSED IN THE PRESENT META-ANALYSIS

Drawing on the considerations outlined above, the present meta-analysis consisted of two steps. The first step was to estimate the mean and variance of the population correlation for the IAT and corresponding self-report measures. These data were expected to provide a better picture of the overall correlation between explicitly and implicitly assessed representations. Depending on whether this analysis revealed significant variability among correlations, the second step was to investigate potential moderators of this relationship. Specifically, we were interested in how motivational and cognitive factors associated with the topic under investigation affect correlations between the IAT and explicit self-report measures. In addition, we sought to investigate several method-related factors that could influence correlations into one or the other direction, thus leading to inadequate conclusions about the actual relationship between explicitly and implicitly assessed representations. Specifically, our moderator analyses addressed the following questions:

Does the relationship between the IAT and explicit measures vary as a function of the topic under investigation? As a first empirical question, we investigated whether implicit-explicit relations differ systematically as a function of the research topic. For example, correlations between explicit and implicit measures may be lower when people are motivated to control their explicit responses (cf. Fazio & Olson, 2003). As such, correlations should depend on how strongly such motivational concerns are triggered by the research topic under investigation. In a similar vein, implicit-explicit relations may depend on people's awareness of implicitly assessed representations (cf. Greenwald & Banaji, 1995). Because introspection may increase the awareness of formerly subconscious representations (cf. Hofmann et al., 2005), correlations may be higher for topics that are associated with a high amount of introspection. Finally, implicit-explicit relations may depend on whether people engage in the effortful process of retrieving recently formed representations from memory (cf. Wilson et al., 2000). As such, correlations may be higher for topics that are associated with a higher level of spontaneity in self-report. To test these assumptions, we first investigated on a rather general level whether implicit-explicit correlations vary as a function of the general research domain. For example, do explicit self-reports from a relatively mundane area such as consumer attitudes correlate higher with the IAT than self-reports in a socially sensitive domain such as group attitudes? Second, to investigate more adequately the simultaneous influence of the theoretically important topic attributes mentioned above, we collected ratings of social desirability, introspection, and spontaneity for each specific topic in the database (e.g., attitudes toward vegetarianism, spider phobia) and tried to predict implicit-explicit correlations from these ratings.

Does the relationship between the IAT and explicit measures vary as a function of characteristics of the explicit measure? Another source of variability in implicit-explicit correlations may stem from certain characteristics of the explicit measure. This assumption is based on previous research on attitude-behavior consistency, showing that the relationship between attitudes and behavior is usually stronger when the respective measures correspond than when they do not correspond with regard to the particular attitude object (Ajzen & Fishbein, 1977). Applied to the present question, one could argue that lack of conceptual correspondence also could reduce correlations between the IAT and explicit self-reports. For instance, implicit measures are often considered to reflect affective rather than cognitive evaluations. Hence, correlations may be higher for affective as compared to cognitive self-report measures (e.g., Banse et al., 2001). Moreover, because of its integration of two different target concepts (e.g., Caucasians vs. African Americans), the IAT has to be considered a relative rather than an absolute measure. Accordingly, correlations may be higher for relative as compared to absolute self-report measures.

Does the relationship between the IAT and explicit measures vary as a function of characteristics of the implicit measure? In this context, we were interested in whether explicit-implicit relations depend on certain characteristics of the implicit measure. Specifically, we investigated whether correlations are influenced by (a) the order of compatible and incompatible blocks, (b) the order of explicit and implicit measurement, (c) the particular kind of stimulus material, or (d) aspects of the stimulus presentation. For example, it is often recommended to counterbalance the order of compatible and incompatible blocks because the order in which compatible and incompatible blocks are administered can influence the size of IAT scores (Greenwald & Nosek, 2001). However, in contrast to this recommendation, several authors argued that counterbalancing may artificially reduce implicit-explicit correlations as compared to a fixed block order (e.g., Banse et al., 2001; Gawronski, 2002). Specifically, these researchers proposed that counterbalancing may produce two displaced distributions with values that are not comparable to one another. Most important, collapsing such incomparable distributions will introduce a large amount of error variance that may attenuate theoretically meaningful correlations to any kind of related measure (see also Perugini & Gallucci, 2004). Hence, correlations may be artificially reduced for statistical reasons as a consequence of counterbalancing. In a similar vein, correlations between the IAT and explicit self-reports may be influenced by other procedural or stimulus-related aspects, such as the order of explicit and implicit measurement, the particular kind of stimulus material, or aspects of the stimulus presentation. Even though we did not have specific expectations regarding these factors, we nevertheless included them in the meta-analysis for exploratory purposes because these factors could either improve or deteriorate IAT measures and thus affect correlations to explicit self-reports.

METHOD

Literature Search

In our search, we focused on articles, dissertations, or book chapters published between 1998 (the publication year of the original article by Greenwald et al.) and April 1, 2004. We retrieved published literature through a detailed search in PsycLIT and PsycINFO, the two main databases for psychological research articles, as well as ProQuest, the main database for doctoral dissertations. The following keywords were used: *Implicit Association Test*, *IAT*, *implicit measurement*, *implicit and explicit*, and *automatic association(s)*. After exclusion of obviously ineligible articles (e.g., articles on implicit memory, theoretical reviews without empirical data), this search yielded a total of 261 independent studies for possible inclusion in the meta-analysis.

Inclusion Criteria for Study Eligibility

The following three criteria were applied to determine the eligibility of each study for inclusion in the meta-analysis of implicit-explicit correlations:

1. Studies must include at least one IAT and one explicit self-report measure. Based on this criterion, 91 studies were excluded from further analyses.
2. Studies must report IAT-explicit measure correlations precisely, and not selectively. Studies were excluded if correlations were not reported at all ($n = 29$), reported imprecisely (e.g., "all rs ranged from x to y," $n = 3$), or reported selectively ($n = 2$). The last point is important because selective reporting of correlational information is usually systematic rather than random (i.e., only significant correlations are reported) and thus may bias the results of the meta-analysis.

3. To avoid duplication, data were not included if they had already been reported in previously published work included in the meta-analysis ($n = 10$).

Studies written in languages other than English or German (i.e., Chinese, Dutch, Polish, and Spanish) were checked for eligibility with the help of native speakers. After application of the exclusion criteria, 126 independent studies were retained for coding.[2]

Treatment of Internet Studies

One important question we had to deal with was the handling of Internet-based research. After application of our inclusion criteria, there was one Internet-based work by Nosek, Banaji, and Greenwald (2002a), reporting nine studies with sample sizes of more than 25,000 participants each. Because of the implied weighting of studies by sample size (see Meta-Analytic Procedure below), our standard treatment would have granted these studies more than 300 times the weight of all other studies ($M\ N = 80$), implying that they would have almost exclusively predominated results. This problem was resolved by assigning to the Internet studies a weight of the maximum N in the remaining data set ($N = 302$), thereby treating them as high-precision studies without undermining the informational value of the other studies.[3]

Coding of Study Characteristics

Eligible studies published in English or German were coded either by the first or the third author; other language studies were coded with the help of native speakers. The coding was done by using a data coding form and a clearly arranged coding manual, which included a list of all relevant variables, a brief explanation, and the respective category assignments. If the information given did not allow for a definite coding judgment, data were marked as missing. Data from the coding form were entered into the computer by the respective author who did not do the coding. While doing so, all correlational and sample size data were checked a second time by comparing them with the original source. The codings of general topic, characteristics of self-report measures, and characteristics of the IAT were done by both coders and interrater agreement (Kappa) was determined. Cases with disagreement were resolved through discussion.

Characteristics of the topic. Both raters categorized the data set according to general research domain into the following broad categories (Kappa = .99): group attitudes (e.g., evaluations of Whites vs. Blacks), stereotyping (e.g., social roles of men and women), self-esteem (i.e., evaluation of self), self-concept (e.g., shyness), consumer attitudes (e.g., apples vs. candies), clinical applications (e.g., spider phobia), and other attitudes (i.e., flowers vs. insects, math vs. arts, new stimulus evaluation, Bush vs. Gore, political parties, romantic fantasies, religious attitudes, partner attitudes, death attitudes).

To test the influence of theoretically important topic attributes, the authors and 7 additional raters (5 from North America, 2 from Germany) provided ratings for each of the 53 specific topics in the database. Specifically, raters judged each topic with regard to social desirability (i.e., How much are people in general concerned about whether their attitudes or personality characteristics are socially acceptable?), introspection (i.e., In everyday life, how much time do people spend thinking about their attitudes and personality characteristics?), and spontaneity (i.e., How much do people rely on their gut reactions when asked to report their attitudes and personality characteristics?). Ratings were made on 7-point scales; order of topics was randomized for each characteristic. The intraclass correlation coefficients for the 12 raters amounted to .94 for social desirability, .89 for introspection, and .83 for spontaneity.

Characteristics of self-report measure. We first categorized explicit measures according to their general format (Kappa = .98). Categories were scales (i.e., aggregate measures of several items, such as the Modern Racism Scale or Rosenberg Self-Esteem Scale), semantic differentials (i.e., ratings of basic evaluative dimensions toward a given attitude object), feeling thermometers (i.e., thermometer-like scales designed to measure the general feeling toward a certain attitude object), adjective ratings (i.e., trait ratings regarding a given target group or person), and single-item measures. Concerning more abstract features of explicit measures, we categorized those measures that clearly focused on affective responses as “affective” (e.g., valence ratings, feeling thermometers, semantic differentials with predominantly affective poles) and those that were clearly cognition-related as “cognitive” (e.g., trait-ratings, semantic differentials with predominantly trait-related poles, Modern Racism Scale). Interrater reliability for these codings was reasonably high (Kappa = .84). Second, we coded explicit measures according to their dimensionality. Measures with just one target concept (e.g., evaluations of Blacks) were coded as “absolute.” A measure was judged as “relative” when it integrated item wordings or response formats including both poles of the IAT target dimension (e.g., evaluations of Blacks in comparison to Whites) or when the final score reflected difference scores of two absolute measures for each of the two target concepts (e.g., the difference between feeling thermometer ratings for Blacks and Whites). Interrater reliability for these codings was high (Kappa = .90).

Characteristics of the IAT. With regard to procedural aspects of the IAT, studies were coded as to whether the compatible and incompatible blocks in the IAT were presented in a counterbalanced or in a fixed order (Kappa = .97).[4] In addition, we coded the order of IAT and self-report measure as to whether they were presented in a counterbalanced manner, with the explicit measure first, with the implicit measure first, or in two independent experimental sessions (Kappa = .97). With regard to stimulus-related aspects of the IAT, we classified the manner of trial/stimulus presentation in the critical IAT blocks depending on whether target and attribute trials were presented in a randomized versus alternating fashion and on whether the stimuli were drawn randomly from each category or prearranged in a fixed sequence (Kappa = .95). This dual classification implied four possible combinations of trial/stimulus presentation: random/random, random/fixed, alternating/random, and alternating/fixed. In addition, we registered the type of target as well as attribute stimuli used in each IAT (Kappa = .92 and .87, respectively). For target stimuli, categories were names (e.g., first names of members of different groups), pictures (e.g., pictures of Black and White individuals), acoustic stimuli (e.g., sounds of birds and insects), thematic words that are prototypical of the respective target category (e.g., *web* to refer to the category of *spiders*), pronouns reflecting a general self/other contrast (e.g., *me* vs. *them*), and idiographic stimuli (e.g., participant's name, date of birth).[5] Categories for attribute stimuli were positive and negative nouns (e.g., *peace* vs. *war*), positive and negative adjectives (e.g., *good* vs. *bad*), and thematic words reflecting personality characteristics (e.g., *quiet* vs. *outgoing*), stereotypes (e.g., *career* vs. *household*), or other specific concepts. Furthermore, we registered the number of target and attribute stimuli by summing up the number of stimulus exemplars for each dimension; codings were correlated .99 for both dimensions.

Coding of Correlations

For the initial database, each correlation between an IAT measure and an explicit self-report measure was registered. The total sample correlation was preferred when both total sample and subgroup correlations (e.g., male vs. female participants) were provided. However, for studies in which only subgroup correlations were reported, correlations were coded separately for each subgroup. These correlations were later combined to achieve a single average correlation per study (see below). Special care was taken to ensure that the sign of each correlation was entered correctly, with a positive sign indicating that implicit and explicit measures were polarized in the same direction. In rare cases where the appropriate sign of the correlation could not be determined from the text and table notes, the correlations were not entered into the data file ($n = 6$).

Because our initial data set contained correlations of the IAT with any kind of explicit self-report measure, both coders categorized each explicit measure according to the following five categories (Kappa = .93):

Self-reported representation. This assignment was made when a given self-report measure was used to assess the same underlying construct as the IAT with which it was correlated. For example, the correlation between a Black-White IAT and the Modern Racism Scale can be regarded as theoretically corresponding because both measures supposedly gauge the evaluative representation of African Americans. Overall, 517 correlations from 126 studies were judged as self-reported representations.

Self-reported intention. This assignment was given when the explicit measure assessed the intention to engage in a particular behavior that was thematically related to the implicitly assessed representation, such as the intention to choose a certain consumer product ($n = 10$ correlations).

Self-reported behavior. Some researchers asked participants for a retrospective report of behavior, such as the number of cigarettes smoked in the last week. These kinds of self-reports were coded as self-reported behavior ($n = 31$ correlations).

Self-reported demographics. A special category was assigned to self-report measures that asked participants to indicate a relatively stable sociodemographic characteristic, such as sex, religion, or ethnicity, which corresponded thematically to the IAT in question. For example, Greenwald and Farnham (2000, Study 2) reported correlations between participant sex and two IAT versions designed to assess implicit gender self-concept. Such kinds of self-report measures were coded as self-reported demographics ($n = 8$ correlations).

Noncorresponding self-reports. To this category we assigned all correlations for which the explicit measure did not thematically relate to the implicit one. This was the case when thematically different IATs within one study were applied, leading to noncorresponding relationships between divergent implicit and explicit measures. For instance, in a study by Swanson, Rudman, and Greenwald (2001), attitudes toward vegetarianism and smoking were assessed within one sample. In such cases, implicit-explicit correlations between measures for different attitude objects were coded as noncorresponding ($n = 65$ correlations).

Because the major question of the present meta-analysis concerns the relationship between implicitly and explicitly assessed representations, our analyses were particularly concerned with the first type of self-report measure. However, because IAT correlations with secondary reflections of attitudes or personality—such as self-reported intentions, self-reported behavior, and self-reported demographics—and correlations with noncorresponding self-reports might be of value for comparison purposes, we performed global analyses on all types of self-report measures (see Overall Analyses) before focusing particularly on self-reported representations.

Meta-Analytic Procedure

Effect size. Almost all effect sizes were retrieved in the form of Pearson product moment correlations. When no correlations were given, we sought to apply transformation formulas to compute r from other information available (Rosenthal, 1994), such as the t value resulting from an IAT score median-split comparison of explicit attitude scores. Following recommendations by Hunter and Schmidt (1990), correlations were not transformed into Fisher's z scores for meta-analytic calculations because this transformation produces an upward bias in the estimation of mean correlations. This upward bias is usually higher than the negligible downward bias produced by the use of untransformed correlations (for further details, see Hunter & Schmidt, 1990; Schmidt, Hunter, & Raju, 1988).

Correction for measurement error. Because of measurement error, observed correlations are usually attenuated (Hunter & Schmidt, 1990). We corrected for unreliability in the implicit and explicit measures individually by dividing each observed correlation by the product of the square root of reliabilities in the implicit and the explicit measures (see Hunter & Schmidt, 1990). For the total of 231 IAT measures in the database, 61 reports of reliability could be obtained. Separated by the kind of reliability index, the mean reported reliability of the IAT amounted to .79 ($n = 50$) for coefficients of equivalence (internal consistency and split-half) and .51 for test-retest reliability ($n = 11$). To allow for an individual correction of effect sizes, the reported coefficients of equivalence were used as the database and reliability was estimated for the remaining IAT measures. Test-retest reliabilities were not used for this correction procedure because they are not comparable to coefficients of equivalence such as Cronbach's alpha and split-half reliability (see Schmidt, Le, & Ilies, 2003). Because coefficients of equivalence were reliably related to the number of trials of the critical IAT condition ($r = .54$), we predicted the reliabilities of the remaining IAT measures on the basis of the number of trials via linear regression. For the remaining cases where both reliability and number of trials information were missing (21%), we imputed the average reliability of .79 as the best estimate.

Corresponding to reliability corrections for the IAT, we corrected for measurement error in the explicit measures, 43% of which were supplied with reliability information. From this information, we were able to employ the mean reliabilities for all of the repeatedly used measures (e.g., Modern Racism Scale) for which reliability was given at least once in the data set (an additional 18%). Scale construction information taken from published articles yielded information for some of the remaining scales employed (3%). Finally, the reliabilities for all other remaining measures (36%) were estimated by imputing the mean reliability for the type of explicit measure in question, or the grand mean of reliabilities for all single-item measures for which internal consistency cannot be determined.

Combination of single correlations within studies. On average, there were 1.8 implicit and 3.1 explicit measures per study. Thus, most studies reported more than one implicit-explicit correlation. To ensure independence of the correlations entered into the meta-analysis (Hunter & Schmidt, 1990), multiple single correlations within studies were averaged first to form the uncorrected study correlation r_u and the corrected study correlation r_c.[6] All subsequent meta-analytic computations were then performed on the study correlations rather than on the single correlations. This two-stage procedure was repeated for all runs of the meta-analysis such that different sets of single correlations were averaged, depending on the analysis in question (e.g., the total set of self-reported representations, all self-reported representations from clinical applications, etc.).

Meta-analytic computations on study correlations. Following Hunter and Schmidt (1990), we estimated for each set of study correlations the average population correlation ρ (corrected for measurement error) and var(ρ), the variance of population correlations. For these computations, study correlations were weighted by sample size and reliability (see the appendix for more details on meta-analytic computations). The standard deviation SD_ρ estimated from var(ρ) was used to construct the 90% credibility interval around ρ as an index of true variation due to moderators (Whitener, 1990). Furthermore, we calculated V%, the ratio of sampling error variance var(e) to the observed variance in the corrected correlations var(r_c) to judge whether substantial variation due to moderators exists. Heuristically, if V% is equal to or larger than 75%, it can be concluded that there is no substantial variation in population correlations (Hunter & Schmidt, 1990). In such cases, effect sizes can be diagnosed as homogeneous, that is, they can be assumed to stem from the same population parameter.

To judge whether mean correlations differ reliably as a function of the moderator variables in question, we

TABLE 1: Overall Meta-Analytic Results

	Type of Self-Report						
(Q_{bet} = 29.25, df *= 2,* p *< .001)*	ρ	C	K	S	N	SD_ρ	*V%*
Self-reported representations	.240	a	126	517	12,289	.140	44
Self-reported intentions	.223	—	4	10	231	.000	100
Self-reported behaviors	.259	a	15	31	1,297	.016	100
Self-reported demographics	.618	—	4	8	584	.103	39
Noncorresponding self-reports	.029	b	10	65	1,162	.000	100

NOTE: Q_{bet} = ANOVA between groups sum of squares; ρ = mean population correlation; *C* = contrast index: different subscripts indicate significant differences ($p < .05$) as indicated by contrasts (categories with fewer than five study correlations were not included); *K* = number of independent study correlations; *S* = number of single correlations on which study correlations are based; *N* = total sample size; SD_ρ = estimated standard deviation of population correlations; V% = percentage variance accounted for by sampling error.

performed weighted least squares ANOVAs for categorical moderator variables and weighted least squares regression analyses for continuous moderators (Hedges, 1994) using the same study correlation weights as above. For the WLS-ANOVAs, subsets with fewer than five cases were not included in the analyses. The between-groups sum of squares Q_{bet} from the WLS-ANOVA on effect sizes follow a χ^2 distribution with $p - 1$ degrees of freedom given the null hypothesis of no variation across groups (Hedges, 1994). Simple contrasts were applied to determine significant differences between moderator categories.[7] Furthermore, the regression coefficients for the continuous moderators were tested for significance by correcting the standard error of the unstandardized regression weight by dividing by the square root of the residual mean square (Hedges, 1994).

RESULTS

Prior to the data analyses, we checked the distribution of uncorrected study correlations for outliers because outliers may bias results (Hunter & Schmidt, 1990), especially when they fall into relatively small categories. For the distribution of implicit-explicit correlations, two outlier correlations were indicated by a box-plot: one negative study correlation of –.25 (derived from Karpinski & Hilton, 2001, Experiment 1b) and one positive study correlation of .60 (derived from Teachman et al., 2001, Experiment 1). To control for the impact of these two outlier studies, all analyses were performed with and without them. Because the estimates converged to a very high extent (on average, correlations affected by outlier exclusion differed only by .005 units from correlations for the full data set), and because statistical conclusions drawn were not affected by outlier treatment, we will present only the full results with outlier inclusion.

Overall Analyses

We first performed overall analyses for self-reported representations, self-reported intentions, self-reported behaviors, self-reported demographics, and noncorresponding self-reports (see Table 1). For self-reported representations, a total of 126 independent study correlations derived from 517 single correlations were included, with a total sample size of 12,289 participants.[8] The mean uncorrected correlation was .191. Corrected for attenuation due to measurement error, the average population correlation ρ amounted to .240, with an estimated standard deviation of .140. Thus, employing a credibility interval of 90% (Whitener, 1990), population correlations ranged between .011 and .471. Of the observed variance in correlations between the IAT and self-reported representations, 44% can be attributed to sampling error, leaving 56% of "real" variance that can possibly be accounted for by moderator variables to be identified. Thus, these data suggest that (a) explicitly and implicitly assessed representations are indeed related and (b) there is considerable variability across correlations.

With regard to other kinds of self-reports, correlations for self-reported intentions and self-reported behaviors were similar in magnitude to correlations for self-reported representations (see Table 1). As expected, correlations for noncorresponding self-reports were close to zero. Of interest, correlations for self-reported demographics were substantially larger than correlations for all other kinds of self-reports, but the number of independent observations on which the estimate is based was very low. An ANOVA by type of self-report (including only moderator categories with five or more study correlations) yielded a significant overall effect (see Table 1). Contrast analyses indicated that self-reported representations did not significantly differ from self-reported behaviors but that both categories differed significantly from noncorresponding self-reports.

Moderator Analyses for Self-Reported Representations

The second major question of the present meta-analysis concerns the moderation of the relationship between implicitly and explicitly assessed representations. Specifically, we were interested in whether correlations between explicitly and implicitly assessed representations systematically vary as a function of the proposed psychological and methodological factors.[9]

Characteristics of the topic. As a first potential moderator, we tested whether implicit-explicit relations differ systematically as a function of the general research domain. As can be seen from Table 2, an overall effect was found. Above-average correlations were obtained in consumer research and group attitudes applications. Below-average correlations resulted for stereotypes and self-esteem. Contrast analyses revealed that the former categories differed significantly from the latter.

To test whether the obtained differences for topics reflect an influence of theoretically important topic attributes, we related implicit-explicit correlations to the indices of social desirability, introspection, and spontaneity. These indices were formed by calculating the mean value of the respective topic ratings by the 12 coders. Indices were coded such that higher numerical values indicate higher construct values. Social desirability showed a positive correlation of $r = .68$ with introspection and a negative correlation of $r = -.64$ with spontaneity. Introspection was negatively correlated with spontaneity at $r = -.67$. To judge the impact of each moderator adequately, we performed a regression analysis in two steps: In the first step, we entered each predictor independently into a WLS-regression analysis with effect size as criterion; in the second step, all three predictors were entered simultaneously.

Results for the regression analyses are depicted in Table 3. When predictors were entered independently, the expected negative relationship between social desirability and correlations did not reach statistical significance. Introspection exhibited a negative relationship to effect sizes. In contrast to the assumption that introspection increases conscious awareness of implicitly assessed representations, correlations between explicitly and implicitly assessed representations decreased (rather than increased) the more time people spend thinking about a given topic in everyday life. However, consistent with the present predictions, spontaneity showed a positive relationship to effect sizes, such that correlations between explicitly and implicitly assessed representations increased with increasing reliance on gut reactions in the course of making an explicit self-report. When all three predictors were entered simultaneously, spontaneity remained the main predictor. The negative regression weight for introspection did not reach the conventional level of significance any more. The regression weight for social desirability changed sign and became significant in the unexpected direction, indicating a suppressor effect.

Characteristics of self-report measure. With regard to characteristics of self-report measures, we were interested in whether lack of conceptual correspondence reduces correlations between implicitly and explicitly assessed representations (cf. Ajzen & Fishbein, 1977). To test this assumption, we first investigated whether correlations differ as a function of the type of self-report measure. As can be seen from Table 2, estimated population correlations with self-reported representations were above average for adjective ratings and semantic differentials, average for feeling thermometers and single item measures, and below average for scales. Type of self-report measure revealed a significant overall effect. Contrast analyses further indicated that semantic differentials, adjective ratings, and feeling thermometers differed reliably from scales. However, the contrast between one-item self-reports and scales did not reach the level of statistical significance.

To investigate whether these differences reflect an influence of more general characteristics of the employed self-report measures, we tested whether implicit-explicit correlations vary systematically as a function of affectivity and dimensionality (see Table 2). Consistent with the assumption that the IAT is primarily a measure of affective responses, affective self-report measures showed significantly higher correlations with the IAT than cognitive self-report measures. Moreover, consistent with the assumption that dimensionality may influence implicit-explicit correlations, relative self-report measures showed higher correlations with the IAT than did absolute self-report measures. Both differences were statistically significant. To check whether effects of affectivity and dimensionality share redundancies, we also computed effect sizes for all possible combinations of dimensionality (relative vs. absolute) and affectivity (affective vs. cognitive). As can be seen from Table 2, correlations were highest for relative/affective measures and lowest for absolute/cognitive measures, with absolute/affective and relative/cognitive measures being in between. Contrast analyses indicate that affective measures of a relative nature differed significantly from all other categories and that affective measures of an absolute nature differed significantly from cognitive measures of an absolute nature. These results are consistent with the assumption that lack of correspondence may systematically reduce correlations between explicitly and implicitly assessed representations and that such a lack of correspondence can have multiple sources (e.g., affectivity, dimensionality).

Characteristics of the IAT. In addition to characteristics of self-report measures, we were interested in whether procedural or stimulus-related characteristics of the IAT influence correlations with explicit self-reports. As a first hypothesis, we tested whether counterbalancing

TABLE 2: Moderator Analyses for Self-Reported Representations: Categorical Moderator Variables

	Moderator Variable (ANOVA-Statistics)						
	ρ	C	K	S	N	$SD_ρ$	*V%*
General research domain (Q_{bet} = 21.76, *df* = 6, *p* < .001)							
Consumer attitudes	.336	a	11	36	841	.000	100
Group attitudes	.253	ab	51	192	4,070	.008	100
Other attitudes	.230	b	18	49	1,711	.227	24
Self-concept	.210	bc	25	70	2,891	.197	25
Clinical	.194	bc	10	57	783	.171	40
Stereotypes	.167	c	19	65	2,431	.076	68
Self-esteem	.128	c	11	48	1,142	.098	61
Type of self-report measure (Q_{bet} = 24.22, *df* = 4, *p* < .001)							
Scale	.177	b	74	293	6,385	.144	46
Semantic differential	.280	a	51	87	5,965	.127	45
Feeling thermometer	.236	a	46	89	3,449	.129	56
Adjective rating	.294	a	11	25	738	.000	100
One-item self-report	.242	ab	8	15	640	.000	100
Affectivity (Q_{bet} = 26.53, *df* = 1, *p* < .001)							
Affective	.284	a	73	174	7,614	.164	35
Cognitive	.181	b	83	309	7,491	.112	57
Dimensionality (Q_{bet} = 21.73, *df* = 1, *p* < .001)							
Relative	.268	a	65	168	6,928	.150	39
Absolute	.185	b	79	340	6,754	.126	53
Dimensionality/affectivity (Q_{bet} = 29.57, *df* = 3, *p* < .001)							
Relative/affective	.298	a	53	118	5,528	.171	33
Absolute/affective	.231	b	23	54	2,304	.158	38
Relative/cognitive	.214	bc	21	46	1,975	.037	92
Absolute/cognitive	.174	c	71	252	6,149	.127	52
Compatibility order (Q_{bet} = 4.70, *df* = 1, *p* = .030)							
Counterbalanced	.251	a	89	376	9,835	.128	46
Fixed	.183	b	26	120	1,863	.152	48
I-E-order (Q_{bet} = 5.69, *df* = 2, *p* = .056)							
Implicit first	.218	a	48	197	3,366	.089	74
Explicit first	.237	a	53	210	6,784	.154	33
Counterbalanced	.311	a	16	81	1,339	.163	39
Independent	.194	—	2	4	222	.000	100
Trial/stimulus presentation (Q_{bet} = 0.01, *df* = 1, *p* = .903)							
Random/random	.290	a	26	121	1,593	.000	100
Random/fixed	.232	—	2	4	231	.000	100
Alternating/random	.286	a	30	104	4,617	.146	31
Alternating/fixed	.283	—	3	7	305	.099	59
Type of target stimuli (Q_{bet} = 18.40, *df* = 4, *p* < .001)							
Names	.242	a	40	141	2,888	.048	90
Thematic words	.226	a	37	113	3,917	.169	33
Pictures	.254	a	24	113	2,364	.098	62
Pronouns	.146	b	28	102	3,026	.133	45
Idiographic	.322	a	6	24	727	.039	89
Acoustic	.105	—	3	15	230	.000	100
Type of attribute stimuli (Q_{bet} = 7.83, *df* = 2, *p* = .020)							
Pos./neg. nouns	.270	a	71	284	6,937	.149	40
Pos./neg. adjectives	.203	b	26	84	2,173	.116	59
Thematic words	.212	b	31	103	3,436	.142	41

NOTE: Q_{bet} = ANOVA between groups sum of squares; ρ = mean population correlation; *C* = contrast index: different subscripts indicate significant differences (*p* < .05) as indicated by contrasts (categories with fewer than five study correlations were not included); *K* = number of independent study correlations; *S* = number of single correlations on which study correlations are based; *N* = total sample size; $SD_ρ$ = estimated standard deviation of population correlations; V% = percentage variance accounted for by sampling error.

TABLE 3: Regression of Effect Size on Social Desirability, Introspection, and Spontaneity

Regression Step	K	β	R^2
Step 1: Independent predictors			
Social desirability	151	–.02	.001
Introspection	151	–.13*	.017
Spontaneity	151	.20**	.041
Step 2: Simultaneous predictors			
Social desirability	151	.16**	.056
Introspection		–.10	
Spontaneity		.23**	

NOTE: *K* = number of independent study correlations; β = standardized regression coefficient; R^2 = squared multiple correlation. *K* exceeds number of studies in the data set because in some studies multiple topics were assessed.
$*p < .05$. $**p < .01$.

TABLE 4: Regression of Effect Size on Number of Target and Attribute Stimuli

Predictor	K	β	p	R^2
Number of target stimuli	109	.03	.32	.001
Number of attribute stimuli	107	.06	.17	.004

NOTE: *K* = number of independent study correlations; β = standardized regression coefficient; R^2 = squared multiple correlation.

compatible and incompatible blocks attenuates implicit-explicit correlations as compared to fixed block orders (cf. Banse et al., 2001; Gawronski, 2002; Perugini & Gallucci, 2004). In contrast to this assumption, correlations were significantly higher for studies in which the order of compatible and incompatible blocks was counterbalanced as compared to fixed order studies (see Table 2).

With regard to our more exploratory analyses, order of implicit and explicit measurement did not produce a significant effect on implicit-explicit correlations (see Table 2).[10] The same was true for the particular kind of stimulus presentation (see Table 2). However, significant effects were obtained for type of target and attribute stimuli (see Table 2). With regard to target stimuli, correlations were highest for idiographic stimuli and lowest for pronouns and acoustic stimuli. Contrast analyses indicated that pronouns yielded significantly lower correlations than all other types of target stimuli. Among attribute stimuli, correlations were significantly higher for positive/negative nouns as compared to positive/negative adjectives and thematic words (see Table 2). Finally, implicit-explicit correlations did not vary as a function of number of target stimuli or number of attribute stimuli (see Table 4).

Publication Bias

A possible danger to the validity of any meta-analysis is the presence of publication bias against nonsignificant findings. This so-called file-drawer problem (Rosenthal, 1979) usually leads to an overestimation of effect sizes. Thus, we investigated the presence of potential bias for self-reported representations with a "funnel graph" (e.g., Light & Pillemer, 1984), a plot of sample size versus effect size. A publication bias against nonsignificant findings, and thus against the independence account, would imply that only large effects are reported by small sample size studies, because only large effects reach statistical significance in small samples. Thus, a publication bias should manifest itself graphically in a cutoff of small effects for studies with small sample size. From the plot, an exclusion of null results was not visible because many small or negative correlations were reported by studies with small samples. In addition, the rank correlation between effect size and sample size was nonsignificant at the level of uncorrected single ($r = -.01$, $p = .84$) as well as uncorrected study correlations ($r = .04$, $p = .63$). As a final consideration, it should be mentioned that—from the very start of implicit social cognition research—reporting nonsignificant relationships between implicit and explicit measures has never been at odds with the most prominent theorizing in the field (e.g., Greenwald & Banaji, 1995). Drawing on these findings, a publication bias can be ruled out for the present meta-analysis.

DISCUSSION

The main goal of the present meta-analysis was to investigate the relation between the IAT and explicit self-reports. Specifically, we were interested in whether low implicit-explicit correlations are due to (a) motivational biases in the report of consciously accessible representations, (b) lack of introspective access to implicitly assessed representations, (c) factors influencing the retrieval of information from memory, (d) method-related characteristics of the two measures, or (e) complete independence of the constructs assessed by explicit and implicit measures. In contrast to the independence account, we found a small but significant positive mean population correlation of .24 between self-reported representations and representations assessed with the IAT (Greenwald et al., 1998). Moreover, analyses of the variance of population correlations indicated that approximately half of the variability across correlations could be attributed to moderator variables. Specifically, correlations between the IAT and explicit self-report measures systematically increased as a function of (a) increasing spontaneity of self-reports and (b) increasing conceptual correspondence between measures. In addition, correlations were shown to vary (c) as a function of several method-related characteristics of the IAT.

Characteristics of the Topic

On the rather broad level of the general research domain, results indicate that the size of implicit-explicit correlations is not constant across domains. However, these results are inconclusive about the underlying psychological mechanisms that cause implicit-explicit consistency to vary as a function of the topic. Therefore, we tried to pinpoint how the degree of social desirability, introspection, and spontaneity associated with each specific topic affects correlations. Most important, we found a reliable increase in correlations as a function of increasing spontaneity in the course of making an explicit judgment. This finding is consistent with the assumption that implicit measures primarily reflect automatic associations, whereas explicit self-reports depend on the effortful retrieval of information from memory (Wilson et al., 2000). As such, explicit self-reports reflect automatic associations to a greater extent when people do not have the motivation or the cognitive capacity to retrieve additional information from memory. Thus, correlations should be higher for topics that are associated with a higher level of spontaneity in explicit self-report but they should be lower for topics that elicit higher order inferences.

Of interest, we did not find any evidence that correlations were influenced by the degree of social desirability or introspection associated with the topic. Specifically, one could suspect that correlations should be lower when strong social desirability concerns are triggered by the research topic under investigation. Moreover, correlations may be higher for topics that are associated with a high level of introspection. These assumptions were not confirmed in the present meta-analysis. It has to be noted, however, that these results do not imply that social desirability or introspection have no effect at all. Rather, social desirability and introspection may still affect correlations on an individual difference level. More precisely, even though social desirability and introspection associated with a particular topic may leave explicit-implicit correlations unaffected, individual differences in the motivation to control overt responses (e.g., Banse & Gawronski, 2003; Dunton & Fazio, 1997; Fazio et al., 1995; Gawronski, Geschke, & Banse, 2003; Hofmann et al., 2005) or individual differences in introspection (e.g., Hofmann et al., 2005) may still influence explicit-implicit correlations. In other words, even though the two constructs do not seem to have a topic-related influence by themselves, they may still exert a dispositional influence. Future research investigating topic-related influences in concert with dispositional ones may help to clarify the interplay of both factors.

Characteristics of the Self-Report Measure

In addition to the obtained influence of spontaneity, the present findings also point to the importance of characteristics of the explicit measure. Specifically, we found that correlations between the IAT and explicit self-reports increase as a function of increasing conceptual correspondence between the two. Explicit-implicit correlations were higher for affective as compared to cognitive and for relative as compared to absolute self-report measures. These results are consistent with previous research on attitude-behavior consistency, showing that the relation between attitudes and behavior is higher when the two measures correspond than when they do not correspond with regard to the particular attitude object (Ajzen & Fishbein, 1977). Applied to the present question, one could argue that the IAT represents an affective rather than cognitive measure and a relative rather than absolute measure. Thus, correlations to explicit self-reports should be higher when these self-reports imply an affective rather than a cognitive judgment and when they imply a relative rather than an absolute judgment.

Characteristics of the IAT

Finally, exploratory analyses regarding procedural and stimulus-related aspects of the IAT also revealed several significant effects. Even though implicit-explicit correlations seem to be relatively robust against the order of implicit and explicit measurement, the particular kind of stimulus presentation, and the number of target and attribute trials (see also Nosek, Greenwald, & Banaji, 2005), there was a significant influence of the order of compatible and incompatible blocks (i.e., fixed vs. random). However, in contrast to the assumption that counterbalancing the order of compatible and incompatible blocks may attenuate correlations with explicit self-reports (Banse et al., 2001; Gawronski, 2002), implicit-explicit correlations increased as a function of counterbalancing. Even though this finding seems somewhat surprising, one could argue that counterbalancing might not only reduce correlations but also (under certain conditions) artificially increase correlations. Perugini and Gallucci (2004), for example, identified two kinds of biases resulting from counterbalancing: an attenuation bias that generally decreases effect sizes and an offset bias that may distort effect sizes by either increasing or decreasing them. With regard to the present findings, it is possible that counterbalancing produced an offset bias enhancing correlations. Even though this interpretation is only post hoc and cannot be tested with the present data, future studies may help to clarify the particular influence of counterbalancing on implicit-explicit correlations.

In addition to this procedural effect, we also found significant effects of the particular kind of target and attribute stimuli. With regard to target stimuli, correlations were particularly low for pronouns as compared to all other kinds of target stimuli. This finding is consistent with previous research by Karpinski (2004), who argued that the "other" category employed in IATs using pronouns (e.g., *self* vs. *other*) may be ambiguous with regard to its specific referent and thus may undermine a reliable assessment of the relevant associations. This problem could possibly be resolved by using more specific contrast categories or by developing measures that employ a single target category only (e.g., Nosek & Banaji, 2001).

With regard to attribute stimuli, correlations were significantly higher for evaluative nouns as compared to evaluative adjective or thematic words. Even though we do not have a solid explanation for this finding, one could argue that the particular selection of evaluative adjectives and thematic words may be more likely to have additional cross-category associations that may undermine a reliable assessment of the intended association (Blümke & Friese, 2004; Steffens & Plewe, 2001). Such cross-category associations may be less likely for evaluative nouns, which in most cases are thematically unrelated to the target category (e.g., *cancer* as a negative attribute word in Black-White IAT). In any case, future studies may help to clarify how the particular kind of stimulus material affects correlations between the IAT and explicit self-report measures.

Associative Versus Propositional Processes

From a theoretical perspective, the present findings might be best explained in terms of recent dual-systems models distinguishing between two different kinds of processes: associative and propositional processes (e.g., Sloman, 1996; Smith & DeCoster, 2000; Strack & Deutsch, 2004). Specifically, one could argue that propositional judgments—such as those required in explicit self-reports—are usually based on automatically activated associations. However, propositional judgments also may be independent of automatically activated associations when these associations are rejected as a valid basis for judgment. This may be the case when other relevant propositions question the validity of automatically activated associations (e.g., Gawronski & Strack, 2004). Perceived validity, in turn, depends on the consistency with all propositions that are considered to be relevant for a particular judgment (Gawronski, Strack, & Bodenhausen, in press). As such, the likelihood that automatic associations are reflected in propositional judgments (or explicit self-reports) should be higher when the relative number of momentarily considered propositions is low rather than high (i.e., high level of spontaneity) and when automatic associations are directly rather than indirectly relevant for the required judgment (i.e., high level of conceptual correspondence).

Range and Limits of the Present Findings

A major strength of the present meta-analytic approach is that it provides a more general picture of the correlation between implicitly and explicitly assessed representations. Meta-analyses offer a quantitative review of the available evidence and thus provide a better basis for resolving controversies with a high level of empirical ambiguity, such as the debate about the actual relation between explicitly and implicitly assessed representations. Moreover, the present meta-analytic findings are independent of specific characteristics of a single study—at least for those analyses where the number of observations was large. This offers a better foundation for generalizations across a wide range of applications.

Nevertheless, it has to be noted that our data also include some weaknesses. First, although a simultaneous inclusion of all moderator variables in one and the same analysis would have been desirable to assess potential redundancies among them, a complete simultaneous test was not feasible on the level of study correlations because the aggregated study correlations (i.e., the dependent variable) changed depending on which moderator variable was investigated. A complete simultaneous analysis would have been possible only on the level of single correlations. However, because the number of single correlations strongly exceeded the number of studies, this procedure would have clearly violated the assumption of independence and would have distorted estimations.

Second, the present meta-analysis was concerned with a particular implicit measure: the Implicit Association Test (Greenwald et al., 1998). This decision was based on three essential aspects: (a) the extraordinary amount of research employing the IAT, (b) the wide range of topics investigated with the IAT, and (c) the high reliability of the IAT as compared to other implicit measures. The last aspect is particularly important because low reliability may attenuate correlations with any kind of measure, thus leading to inadequate conclusions about the true correlation when reliability is not reported, and thus cannot be controlled (see Note 1). Nevertheless, it seems desirable to investigate whether representations assessed with other kinds of implicit measures share the same features as those assessed with the IAT. Our assumption is that the present findings can be generalized to other kinds of implicit measures (e.g., Fazio et al., 1995; Wittenbrink et al., 1997). This, however, is an empirical question that should be resolved as such.

Conclusion

In sum, the present findings indicate that (a) the IAT and explicit self-reports are systematically related to one another and (b) variations in correlations can be explained by the degree of spontaneity of explicit self-reports, the level of conceptual correspondence between measures, and method-related aspects of the IAT. These results challenge the assumption that explicitly and implicitly assessed representations are completely dissociated and that correlations between the two are purely random. In contrast, it seems that the two measures are systematically related but that higher order inferences and lack of conceptual correspondence can reduce the influence of automatic associations on explicit self-reports.

APPENDIX
Computation of the Average Population Correlation ρ and var(ρ)

According to Hunter and Schmidt (1990), the best estimator of the average population correlation ρ is the weighted average of corrected study correlations, $\bar{r}_c$:

$$\rho = \bar{r}_c = \sum w_i \bullet r_{ci} / \sum w_i, \qquad (1)$$

with the use of weights $w_i = N_i \bullet A_i^2$. For each study *i* this weighting scheme takes into account the sample size N_i on which a correlation is based (i.e., large studies receive a larger weight) as well as an index for the amount of correction for systematic artifacts, called the squared artifact multiplier A_i^2. In our case, the only systematic artifact corrected for was measurement error in both the implicit and the explicit measure. Thus, weighting by A_i^2 assigns low-reliability studies less weight than high-reliability studies. The most convenient way to compute A_i^2 was to take the squared ratio of the uncorrected to the corrected study correlation, $A_i^2 = (r_{ui} / r_{ci})^2$ (Hunter & Schmidt, 1990).

To estimate the variance of population correlations, var(ρ), we first computed the observed variance of corrected correlations var(r_c), using weights w_i:

$$\text{var}(r_c) = \sum w_i \bullet (r_{ci} - \bar{r}_c)^2 / \sum w_i. \qquad (2)$$

However, var(r_c) generally overstates var(ρ) because it contains sampling error variance. Hence, to arrive at var(ρ), the sampling error variance var(*e*) was estimated from the observed correlations. Var(*e*) is the weighted average of the sampling error variance v_i of individual studies:

$$\text{var}(e) = \sum w_i \bullet v_i / \sum w_i. \qquad (3)$$

The sampling error variance v_i of study *i* amounts to:

$$v_i = (1 - \bar{r}_u^{\,2})^2 / (N_i - 1) \bullet A_i^2$$
(see Hunter & Schmidt, 1990), (4)

where $\bar{r}_u$ = the weighted average uncorrected correlation.

To estimate the desired variance of population correlations, we corrected for sampling error by subtracting the sampling error variance from the variance of corrected correlations:

$$\text{var}(\rho) = \text{var}(r_c) - \text{var}(e). \qquad (5)$$

If the estimate for the error variance exceeded the variance of observed correlations, the standard deviation of population correlations was set to the value of zero (see Hunter & Schmidt, 1990).

NOTES

1. Unfortunately, it is still quite uncommon to report indices of reliability for implicit measures. The only exception seems to be research using the Implicit Association Test (IAT), for which we could obtain reliability estimates for 26% of all studies included in the meta-analyses. For other commonly used measures, such as affective priming (Fazio, Jackson, Dunton, & Williams, 1995), the number of studies reporting reliability estimates was close to zero.

2. A list of the excluded studies can be provided upon request.

3. Excluding the Internet studies from analyses did not qualify any of the obtained results.

4. Another possible question is whether a particular order (i.e., compatible-incompatible, incompatible-compatible) produces higher correlations with self-report measures than others. As Greenwald, McGhee, and Schwartz (1998) noted, means and standard deviations of the IAT effect are somewhat higher when the compatible block is administered first than when the incompatible block is administered first. Hence, it is possible that because of the increased variance, correlations with explicit measures are higher when the compatible block is administered first. However, determining whether the compatible versus incompatible block was presented first requires an a priori definition of what has to be considered the compatible and incompatible assignment. Because such a judgment was difficult to make in many cases (e.g., preference for fruits vs. sodas), we had to restrict our analyses to a more general contrast of counterbalanced versus fixed compatibility order.

5. Note that in some applications, pronouns or idiographic stimuli also could be interpreted as attribute stimuli (e.g., Nosek, Banaji, & Greenwald, 2002b). For the sake of simplicity, we generally classified these stimuli as representing the target dimension.

6. Averaging was done by using full artifact weights for each single correlation entered into the study average correlation (for a definition of A^2, see the appendix). Weighting by *N* was necessary because within some studies *N* varied with the explicit measure used.

7. Again, weights w_i were applied and the appropriate χ^2 distribution was used (Hedges, 1994).

8. All *N*s were computed from adjusted *N*s rather than from the original *N*s of the Internet studies.

9. Separate moderator analyses for the four other kinds of self-report measures could not be pursued further because of the low number of correlations in these categories.

10. When outliers were excluded from analyses, the population correlation for counterbalanced I-E-order dropped to $\rho = .288$, resulting in a substantially weaker ANOVA effect, $Q_{bet} = 2.66$, $p = .265$.

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