A Meta-Analysis of Implicit and Explicit Attitudes in Children and Adolescents

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Abstract

We present a meta-analytic review of studies measuring implicit and explicit attitudes in child and adolescent samples. A meta-analytic structural equation model revealed that both implicit and explicit attitudes independently predicted behavior, with a larger effect size for explicit attitudes. Moderator analyses revealed larger effects of implicit measures on behavior for social bias behaviors compared to diet and health-related behaviors and aggression behaviors. Age did not moderate the size and relative contribution of both forms of attitude on behavior, and the implicit-explicit attitude correlation. Studies adopting a fixed order of attitude measure presentation, rather than counterbalanced, and those using the implicit association test to measure implicit attitudes exhibited stronger implicit attitude-behavior effects than those adopting other measures. Findings support an additive model for the effects of implicit and explicit attitudes on behavior in children and adolescents, and provide formative evidence to guide future research using implicit measures in younger populations.

Keywords: social cognition; beliefs; implicit association test; attitude development; meta-analytic structural equation model

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Since Allport's (1935) declaration on the importance of the attitude construct, theory and research on attitudes has been at the forefront of social psychology. The prominence of attitudes can be attributed to the commonly-held assumption that attitudes guide behavior. However, research in the first half of the twentieth century suggested that this assumption was misplaced, with only modest associations reported between attitudes and behavior (c.f., LaPiere, 1934; Wicker, 1969). The use of compatible measures of behavior and attitude, and assessment of pertinent moderators that magnify or diminish attitude effects on behavior, has since indicated a key role for attitudes as a predictor of behavior in multiple contexts and populations (Albarracín & Johnson, 2019; Armitage & Conner, 2001; Bentler & Speckart, 1979; Cooper & Croyle, 1984; Fishbein & Ajzen, 2011; Glasman & Albarracín, 2006; Schuman & Johnson, 1976).

Self-report instruments have been the predominant method for tapping attitudes, with individuals responding to statements of positive or negative evaluation of attitude objects or behaviors (Ajzen, 2006; Fishbein & Ajzen, 2011). Recognition that individuals' explicit attitude statements may be biased, for example by social desirability, has catalyzed research into measures that tap implicitly-held attitudes, that reflect beliefs about attitude objects or behaviors that may not be readily accessible to the individual and affect behavior and responses beyond an individual's awareness. This research has been facilitated by advances in measures of implicit attitudes using reaction time tasks, such as the Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998). These measures have resulted in a substantive literature on implicit attitudes in multiple domains, and inspired the development of new predictions on the effects of implicit and explicit attitudes on behavior (Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005; Perugini, 2005; Perugini, Richetin, & Zogmaister, 2010).

Compared to the literature on adult populations, there has been a relative dearth of research on the development of implicit attitudes, and implicit and explicit attitude links in children and adolescents. Notwithstanding, the literature measuring implicit attitudes in younger populations is expanding (McKeague, O'Driscoll, Hennessy, & Heary, 2015). This work has value as it may provide important indications on how implicit attitudes develop, and the extent to which implicit attitudes contribute to predicting behavior relative to explicit attitudes (e.g., Cvencek, Greenwald, & Meltzoff, 2011; Grumm, Hein, & Fingerle, 2011; Noles, 2004; Rae & Olson, 2017). The purpose of the current research was to conduct a meta-analytic synthesis of research on explicit and implicit attitudes in children and adolescents, and test hypotheses on the relative contribution of implicit and explicit attitudes in the prediction of behavior in these populations in a multivariate model based on the synthesized data research across studies. In addition, we aim to explore salient moderators of the relative contribution of both forms of attitudes on behavior including age, behavioral domain, methodological aspects of implicit measures of attitude, and study quality.

Implicit and Explicit Attitudes

Attitudes are commonly defined as positive or negative evaluations of a particular target, such as an object, person, or behavior (Ajzen, 1991; Albarracín & Johnson, 2019). Attitudes are considered belief based and evaluative, and are represented in long-term memory. They may also be linked in associative memory to other attitudes and knowledge structures such as behavioral scripts. Attitudes are typically measured by self-report on psychometric scales, which prompt individuals to report their evaluations of specific attitude objects. These measures tap individuals' considered evaluations with respect to the attitude object, typically labeled *explicit attitudes*. Explicit attitudes are purported to guide behavior in an deliberative, reasoned process: prior to undertaking action an individual may retrieve stored evaluations of the given attitude object from memory, consider them relative to the current context, and make a decision to act accordingly; referred to as an anchoring-and-adjustment process (Wilson, Lindsey, & Schooler, 2000).

The process by which explicit attitudes guide behavior is, however, relatively slow and ‘costly’ from a cognitive perspective. By contrast, many everyday behavioral decisions demand rapid responses with high precision and more efficient processes to guide behavior (De Houwer, Teige-Mocigemba, Spruyt, & Moors, 2009). In these instances, individuals likely make decisions based on learned experiences of targets and objects, and their positive or negative evaluations stored in associative memory (Fazio, Sanbonmatsu, Powell, & Kardes, 1986; Gawronski & Brannon, 2019; Greenwald & Banaji, 1995). The implicit evaluations of targets may become associated with behavioral responses that are concomitantly activated when the target is experienced or associated information with respect to the target becomes salient (e.g., the presentation of cues, contexts, or events that are closely related to stored information related to the target in memory). The stored associations between targets and their evaluations are referred to as *implicit attitudes*. Consistent with this definition, presentation or availability of information or cues relating to the target will activate the implicit attitude and associated learned responses, and guide behavior without need for excessive deliberation. Implicit attitudes belong to a broader group of constructs that reflect implicit social cognition (Fazio & Olson, 2003). Although implicit attitudes may be congruent with explicitly held beliefs and determine their expression, they affect behavior beyond an individual’s awareness and, as such, implicit attitudes may lead to behavioral responses that are inconsistent with explicitly-held beliefs (Fazio & Olson, 2014; Galdi, Gawronski, Arcuri, & Friesse, 2012; Gawronski & Houwer, 2011).

Measurement of Implicit Attitudes

Researchers have developed means to tap implicit attitudes using tasks that measure individuals’ reaction times to the presentation of stimuli related to attitude objects (Fazio & Olsen, 2003). Faster responses are assumed to correspond to the relative accessibility of evaluative information relating to the attitude object stored in memory and, therefore, serve to indicate the

strength of the implicit attitude (Fazio, 1990). Importantly, reliance on reaction times means that the tasks circumvent individuals' conscious awareness.

Based on these premises, Greenwald et al. (1998) developed the Implicit Association Test (IAT), which has become the predominant means to measure implicit attitudes. The IAT and its variants (see Cvencek, Greenwald, et al., 2011; Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005; Karpinski & Steinman, 2006; Nosek, Greenwald, & Banaji, 2005) are tasks that build upon the assumption that faster reaction times to pairing-up stimuli relating attitude objects with evaluations indicate ease of accessibility of the paired options. The standard IAT consists of two sets of binary categories, one of which represents the target attitude object (e.g., gender as *male* and *female*), and one which represents the comparative attributes (*good* and *bad*; *me* and *not me*). Stimuli for these categories consists of a series of words or pictures which are prototypical of that category, such as stereotypical male and female names as a set of binary gender stimuli, or pictures of Caucasian and African American faces to represent a binary set of black/white racial stimuli. The IAT assumes that participants will be adept at quickly and accurately responding to the stimuli when they are paired with the attributes that most closely correspond to their underlying evaluative associations in memory. For example, the IAT paradigm assumes someone who holds an implicit pro-male bias would be faster and more accurate at responding to stimuli when stereotypical male names and positive attribute words are paired, as compared to when negative attribute words were paired with male names. Further, to accommodate attitude categories where there is no obvious opposing category (e.g., *alcohol*) (Thush & Wiers, 2007), variants have also been developed using a single set of target stimuli, such as the single category IAT (Karpinski & Steinman, 2006). By examining the difference in performance between the compatible and incompatible trials the IAT infers the strength of the association between the attitude object and the relevant attribute (for detailed scoring see Greenwald, Nosek, & Banaji, 2003).

Although the IAT is the most prevalent measure of implicit attitudes for both adults and children (De Houwer et al., 2009; McKeague et al., 2015), other measures have also been used. Most of these measures, such as the Go/No Go Association Task (GNAT; Nosek & Banaji, 2001), Extrinsic Affective Simon Task (EAST; De Houwer, 2003), and the Implicit Relational Assessment Procedure (IRAP; Barnes-Holmes et al., 2006), rely on similar processes as the IAT; bypassing conscious processing by capitalizing on reaction times in tasks that reflect associative structures. However, not all implicit attitude measures rely on response times. For example, the Affect Misattribution Procedure (AMP; Payne, Cheng, Govorun, & Stewart, 2005) infers implicit attitude by assessing changes in evaluations of a neutral stimulus following a target prime (e.g., implicit attitudes towards unhealthy food through assessment of attitudes to a Chinese character following words such as pizza or chocolate; Hofmann, van Koningsbruggen, Stroebe, Ramanathan, & Aarts, 2010). While still showing evidence of predictive validity, alternative measures have not been able to demonstrate the same level of reliability and consistency of findings as the IAT (Gawronski & Houwer, 2011).

Predicting Behavior from Implicit Attitudes

Implicit attitudes have been shown to predict behavior in a variety of settings, with unique effects independent of explicit attitudes (Greenwald et al., 2009). Perugini (2005) proposed three possible models to explain the relative effects of implicit and explicit attitudes on behavior. The additive model posits that implicit and explicit attitudes represent two distinct yet related concepts, with each influencing behavior independently. The double dissociation model states that implicit and explicit attitudes are two distinct concepts predicting different types of actions: implicit attitudes were proposed to predict impulsive, spontaneous behaviors, while explicit attitudes were proposed to predict reasoned, deliberative behaviors (c.f. Evans & Stanovich, 2013; Strack & Deutsch, 2004). Multiplicative models do not include a direct role of implicit attitudes on the prediction of behavior. Instead, implicit attitudes are proposed to interact with explicit attitudes.

The theoretical basis of multiplicative models is that implicit attitudes predict behavior unless the individual has sufficiently strong explicit attitudes, in which case the relative impact of implicit attitudes on behavior is diminished (e.g., MODE; Fazio, 1990). Each of these models has received empirical support in research, and there is no predominant model favored by the weight of empirical evidence to explain relations between implicit attitudes, explicit attitudes, and behavior. Instead, the pattern of effects of the different forms of attitude on behavior is likely dependent on contextual moderators that determine their relative contribution (Gawronski & Houwer, 2011; Perugini et al., 2010).

The Implicit-Explicit Attitude Relationship

A meta-analysis of associations between implicit and explicit attitudes has demonstrated a significant but small-sized correlation with substantive heterogeneity across studies (Hofmann, Gawronski, et al., 2005). The MODE model provides a possible explanation for the small, highly variable association between implicit and explicit attitudes. Individuals may be inaccurate in reporting their explicit attitudes if they have sufficient motivation to control or adjust their responses (Fazio, 1990; Hofmann, Gawronski, et al., 2005). For example, the strength of a self-reported attitude is correlated with perceptions of the acceptability of the attitude (Crandall, Eshleman, & O'Brien, 2002), and self-reported social bias declines with age and the internalization of expectations against prejudice (Raabe & Beelmann, 2011; Rutland, Cameron, Milne, & McGeorge, 2005). In contrast, implicit biases remain relatively unaffected by these extraneous motives. Consequently, the MODE model suggests while implicit and explicit attitudes should be related, the strength of correlations vary in relation to factors which affect an individual's motivation to accurately portray explicit attitudes such as age or the behavior in question.

Alternatively, the small implicit-explicit attitude correlation may be a result of the independence of the decision-making systems with which they are associated, based on dual-process theories. This perspective is corroborated by their independent effects when behavior is

regressed on measures of both forms of attitudes (e.g., Hagger, Trost, Keech, Chan, & Hamilton, 2017; Hamilton, Gibbs, Keech, & Hagger, 2018; Houben & Wiers, 2006; Perugini, 2005).

However, even though they may reflect independent systems they are likely to share some variance as both systems share some common antecedents (Whitfield & Jordan, 2009). Implicit attitudes reflect beliefs developed over time through learned associations between objects and their evaluation, and such representations are also likely to be associated with evaluations that are consciously accessible. Evidence for this comes from Hofmann et al.'s (2005) meta-analysis. Level of spontaneity in self-report measures used to tap explicit attitudes (i.e., the extent to which people respond to survey items measuring attitudes according to their 'gut feeling') moderated the correlation between implicit and explicit social cognition. Therefore, if individuals respond to attitude measures such that the most accessible representation of the target or attitude object is most salient (as in a 'gut reaction' response), they are more likely to be congruent with the learned associations reflected in implicit measures.

Development of Implicit Attitudes

What is known about the relationship between implicit attitudes, explicit attitudes, and behavior is mostly derived from adult samples. To date, research has not tended to account for the potential moderating effects of developmental changes on these relations. Early models of implicit attitude development suggested a slow learning process, in which individuals gradually develop implicit attitudes over the course of childhood and adolescence. Implicit attitudes were proposed to be the cumulative result of long-term learning and conditioning processes (Sloman, 1996), or as a trace of older overlearned attitudes which may have been superseded by more recently-developed explicit attitudes (Wilson et al., 2000). However, implicit attitudes have been measured in children as young as three (Cvencek, Greenwald, et al., 2011; Thomas, Smith, & Ball, 2007). Furthermore, experimental research has been able to rapidly induce novel implicit attitudes in a variety of contexts in both children (Gonzalez, Dunlop, & Baron, 2017) and adults (Lai et al., 2014). This

research suggests implicit attitudes may not be deep-seated beliefs stemming from long-term developmental processes but could be developed after relatively brief exposure to an attitude object.

In addition, evidence indicates the strength of implicit attitudes in children is comparable to those held by adults (Baron & Banaji, 2006; Dunham, Baron, & Banaji, 2008, 2016; Dunham, Newheiser, Hoosain, Merrill, & Olson, 2014). However, the extent to which implicit attitudes guide behavior may differ by age. For example, children's capacity for impulse suppression and cognitive control are less developed than adults (Blakemore & Choudhury, 2006; Klenberg, Korkman, & Lahti-Nuuttila, 2001; Tao, Wang, Fan, & Gao, 2014). Therefore, they may lack capacity to suppress impulse-related processes that impact behavior. Considering implicit attitudes are proposed to affect behavior through an impulsive process beyond an individuals' awareness, it may be that children have a greater tendency to act on implicit attitudes than adults.

Further, children's implicit and explicit attitudes are likely to be less elaborated than adults, so they are likely to have fewer stored behavioral alternatives to guide decisions. On the other hand, the lack of elaborated schema and behavioral scripts means that children may have advantages over adults when it comes to flexible thinking (German & Defeyter, 2000). It is also possible that slower and wider variability in reaction times in younger people may affect responding to stimuli in decision tasks (Bucsuházy & Semela, 2017), which may have implications for the majority of implicit measures that are dependent on reaction time (Hofmann, Gschwendner, Nosek, & Schmitt, 2005; Nosek, Greenwald, & Banaji, 2007).

While these concerns are largely speculative, they present a plausible case for investigating potential variation in the implicit attitude-behavior relationship across adult and child samples. The extant research comparing these relations across older and younger samples is somewhat inconsistent. Several primary studies have found implicit and explicit attitudes to independently predict behavior in both adult and child samples (Cvencek, Greenwald, et al., 2011; Grumm et al.,

2011; Rae & Olson, 2017). However, this is not always the case. For example, Cha et al. (2016) found that while both implicit and explicit attitudes predicted non-suicidal self-injury in a univariate model, the size of the effect of implicit attitudes was notably reduced when predicting behavior in a multivariate model with explicit attitude. In the absence of a comprehensive synthesis of these effects across studies, it is difficult to interpret whether the observed differences are attributable to developmental variations or whether they are due to the methodological artifacts of the particular studies.

Similarly, research into age-related changes in the implicit-explicit attitude relationship is limited. Consistent with research findings in adult samples (Hofmann et al., 2005), there is evidence of a small but non-trivial correlation between implicit and explicit attitudes in children as young as four (Cvencek, Greenwald, et al., 2011). However, in terms of investigations of developmental effects, most studies focus upon changes in the absolute strength of implicit and explicit attitudes across age groups, rather than changes in the implicit-explicit attitude correlation (Baron & Banaji, 2006; Dunham et al., 2008, 2016; Dunham, Chen, & Banaji, 2013). For example, studies in the domain of prejudice have noted that mean implicit attitude strength remains relatively constant across development, while explicit attitude strength tends to decline after children reach 10 years of age. This change may reflect children learning to inhibit their expression of socially-undesirable attitudes as they develop. However, the currently available evidence does little to address whether this developmental divergence has a meaningful impact on the strength of the relationship or whether it is endemic of all attitudes or only those towards prejudicial behaviors.

The Current Study

In the current analysis, we aimed to synthesize research adopting explicit and implicit measures of attitudes to examine relations between explicit and implicit attitude and behavior, and implicit-explicit attitude relations, in children and adolescents. The current research was expected

to extend attitude research by examining the extent to which relations between implicit and explicit attitudes converge, and the relative relations between both types of attitudes and behavior across the literature on children and adolescents. While some studies have demonstrated consistency in these relations in both child and adult samples (e.g., Cvencek, Greenwald, et al., 2011), there is also research indicating variability (e.g., Baron & Banaji, 2006). The current research aimed to resolve these inconsistencies in the child and adolescent literature using meta-analysis.

Conceptually, relations between implicit and explicit attitudes, and between these attitude components and behavior, may vary across children and adolescents because implicit attitudes in these populations are likely to be less elaborated than adults due to lower opportunity to experience attitude objects. Furthermore, stage of development may also affect children and adolescents' responses to measures of implicit attitudes because they depend on reaction time. Specifically, we aimed to estimate the size and variability of effects of both explicit and implicit attitude on behavior, and their intercorrelation, across studies using meta-analyses. In addition, we aimed to test effects of salient moderators of the relationships, particularly variables related to development (age), measurement (type of implicit measure), and behavior type. Our analysis permitted tests of a series of hypotheses relating to relations between implicit and explicit attitudes, and the effects of implicit and explicit attitudes on behavior.

Our first set of hypotheses related to relations between implicit and explicit attitudes, and the relation of each attitude type on measures of behavior. We predicted that explicit and implicit attitudes would be positively correlated, and that both explicit and implicit attitudes would exhibit positive, non-zero relations with behavior across studies.

Our second set of hypotheses examined the simultaneous effects of each attitude type on behavior, based on the structural model illustrated in Figure 1. In the model, behavior is simultaneously regressed on both implicit and explicit attitudes. We expected positive non-zero effects of both explicit and implicit attitude on behavior, and that both forms of attitude would

positively covary. Estimation of this model also allowed us to test whether each component added to the prediction of behavior independently, or whether the relative contribution of each component was reduced due to the presence of the other (i.e., that each attitude component shared variance with behavior that they also shared with each other). To test this hypothesis, we compared the effect size for the zero-order relation between each attitude component and behavior with the same effect in the model. To the extent that effects were no different, we have confirmation of the independent effects. The model and predictions were tested using meta-analytic structural equation modeling.

Our third set of hypotheses concerned variations in the predictive strength of implicit and explicit attitudes as a function of moderator variables. A key moderator in the current analysis is the effect of age. Given evidence of increased motivation to control explicit attitudes with age (Crandall et al., 2002; Rutland et al., 2005), we expected the strength of relations between explicit and implicit attitudes and behavior, and the relative contribution of explicit attitudes to the prediction of behavior, to decline with age. Changes in the univariate prediction of attitudes to behavior were assessed by regressing the sample mean age against the effect size. Age related changes to the relative effects were assessed by the comparison of effect sizes for implicit and explicit attitudes on behavior in separate structural models estimated in samples of studies on children and adolescents.

We also examined the effect of the domain of behavior on effects of attitude constructs in the model by comparing effect sizes in groups of studies testing attitude effects on behaviors in similar domains. Although we propose no specific predictions in terms of patterns of effects across domains, we expected generally larger effects of implicit attitudes in domains of behaviors characterized by impulsive responses such as psychopathology, alcohol and substance use, and aggression compared to domains of behaviors that are likely dependent on more deliberative, reasoned decision making such as diet and exercise.

We also examined effects of methodological components of implicit attitude measurement on relative effects of explicit and implicit attitudes on behavior: type of implicit measure, presentation order, format of target stimulus and attribute type, and variability of implicit attitudes. Specifically, we expected effects of implicit attitudes to be: larger in studies using the IAT to measure implicit attitudes than other measures as the IAT has superior reliability (De Houwer et al., 2009); smaller when implicit attitudes were presented first relative to when explicit attitudes are presented first due to the lack of a priming effect by the implicit measure; and, smaller in samples with low variability in the measure of implicit attitudes, relative to samples with high measurement variability, as low variability may obscure correlations. No predictions are made regarding the effect of stimulus type (pictures vs. words); while evidence generally indicates word-based IATs demonstrate stronger implicit attitudes than those with pictorial stimuli (Foroni & Bel-Bahar, 2010; Greenwald, 2004), the effect of this discrepancy on the relationship between implicit and explicit attitude measures is inconsistent (Carnevale, Fujita, Han, & Amit, 2015; Hofmann, Gawronski, et al., 2005). Finally, we also examined the effect of study quality on relations between the attitude constructs and behavior, we expected study quality may attenuate effects among the attitude and behavior measures due to higher levels of method-related error variance.

Method

Search Strategy

We systematically searched seven electronic databases (PsycINFO, Embase, MEDLINE, Scopus, PubMed, ProQuest Theses, and the Psychology and Behavioral Sciences Collection) to identify studies meeting inclusion criteria published from 1990 to January 2018. Our search terms aimed to identify studies that had measured implicit attitudes in samples comprising exclusively of participants aged 18 years or younger. Notable authors in the field were also contacted for

unpublished data. The review protocol was pre-registered on Prospero (CRD42018089180)¹. Studies were eligible for inclusion in our meta-analysis if they included a measure of implicit attitudes and a measure of behavior or explicit attitudes, all making reference to the same attitude object or behavior; were conducted in samples comprised exclusively of participants aged 18 years or younger, or reported findings for a subsample aged 18 years or younger; and provided sufficient data, either in the original report or through direct contact, to compute effect sizes among the implicit attitude and the explicit attitude or behavioral measure.

Effect Size Data Extraction

Data were extracted from eligible studies with the zero-order correlation coefficient (r) adopted as the effect size metric. Some studies reported data from multiple implicit attitude, explicit attitude, or behavioral measures. As multiple effect sizes from a single sample violates assumptions of independence, correlations within studies were averaged to form an overall implicit attitude-explicit attitude, implicit-behavior, and explicit-behavior correlation for each sample. To minimize any bias caused by averaging correlations, effect sizes were converted to Fisher's z , averaged, and back-transformed to r (Silver & Dunlap, 1987). In studies that reported data from more than one type of implicit attitude measure, we selected the least frequently used measure in order to balance groups for subsequent moderator analyses. Extracted data are available in Appendix D.

Moderator Coding

Implicit attitude measure type. The IAT is the predominant measure of implicit attitudes used in participants age 18 years or younger. A number of other measures have been used, such as the AMP (Payne et al., 2005) and the GNAT (Nosek & Banaji, 2001), but with insufficient

¹The pre-registration document is available online from the Prospero prospective register of systematic reviews: https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=89180

frequency to make individual comparisons in effect sizes across different measure types. Instead, we segregated studies into those that used the IAT and variants of the IAT to measure implicit attitudes, and studies that used other reaction-time based and sorting tasks, and priming tasks. While all paradigms aim to investigate similar elements, we predicted that due to its superior reliability (references) attitudes measured by the IAT would be a better predictor of behavior than its alternatives.

Presentation condition. We also tested whether effects among implicit and explicit attitudes and behavior varied according to the order of presentation of the study measures. This is based on the premise that administration of measures of psychological constructs may affect the very constructs they are intended to measure; therefore, presentation of one measure of attitudes in close proximity to another may affect responses on the second measure (Spangenberg, Kareklas, Devezar, & Sprott, 2016). Any systematic effects on responses to attitude measures caused by presentation order can be controlled for through counterbalancing. We therefore coded presentation order as a categorical moderator variable with three groups: implicit attitude measures first, explicit attitude or behavioral measures first, and counterbalanced presentation order.

Target and attribute stimulus. There is evidence that relations between implicit and explicit attitudes may vary according to the different types of stimulus used in the IAT (Greenwald, 2004; Hofmann, Gawronski, et al., 2005). The evidence indicates the use of pictures or words as attributes or targets in IATs may affect attitude strength. Consequently, stimulus type is included as a categorical moderator for both target and attribute stimuli, coded as words (written or audio) or pictures. Given several IAT alternatives do not use attribute stimuli, the attribute stimuli moderator analysis is confined to studies using the IAT only.

Behavioral domain. Behavioral domain was included as a categorical moderator consistent with previous research (Greenwald, Poehlman, Uhlmann, & Banaji, 2009; Hofmann et al., 2005). We coded studies into one of seven categories: psychopathology, food and exercise,

social biases, alcohol and substance use, self-concept and personality, aggression, and other. A randomly-selected subsample of 20 studies was coded into behavioral domains by a second researcher independent of the research team with a high level of agreement ($\kappa = .94, p < .001$). Disagreements were resolved by discussion between assessors.

Age. We expected developmental changes in relations among implicit and explicit attitudes and behavioral outcomes in our proposed model (Baron & Banaji, 2006; Dunham et al., 2008, 2016; Dunham, Chen, & Banaji, 2013).. We therefore included mean sample age as a continuous moderator. In samples where the mean age was not reported, we were often able to infer age from other information (e.g., school grade). In addition to including age as a continuous moderator of effect sizes among study constructs using meta-regression, we also tested for effects of age among constructs in the estimated model using meta-analytic structural equation modeling. For the purpose of this analysis, we developed a categorical age variable coded as children (age ≤ 12 years) and adolescents (ages 13 to 18 years).

Study quality. Quality for each included study was assessed using an adapted version of the Newcastle Ottawa Quality Assessment Scale for cross-sectional studies (Modesti, 2016; Wells et al., 2000). Studies were scored on 10 criteria with a score of 1 allocated if a criterion was met, and 0 if the criterion was absent or not reported. A total quality score for each study was calculated by summing scores for each of the criteria. All included studies were assessed by at least one researcher, and a random sample of 20 was assessed by an independent researcher not on the research team with acceptable agreement (average intra-class correlation = .70, $p = .006$). Discrepancies were resolved by discussion between assessors. Quality scores were included as a continuous moderator of zero-order effects among implicit and explicit attitudes and behavior. In addition, quality scores were also dichotomized for comparison among effects in the proposed model using MASEM, with scores at or above the median scale score coded as studies of higher quality and scores below the median coded as studies of lower quality.

IAT sample variability. There is also evidence that IAT effects may be affected by low levels of sample variability (Greenwald et al., 1998; Hofmann, Gawronski, et al., 2005). As a result, the sample IAT standard deviation was included in meta-regression analyses as a continuous moderator. For studies in which multiple IAT effects were combined, a pooled IAT standard deviation was calculated using standard formulas (Cohen, 1988; Hedges & Olkin, 1985).

Data Analysis

Meta-analytic structural equation modeling. We aimed to estimate bias-corrected zero-order relations between implicit and explicit attitudes, between implicit attitudes and behavior, and between explicit attitudes and behavior. We also proposed to test the relative contribution of implicit and explicit attitudes in the prediction of behavior in a proposed structural model (Figure 1) in which behavior was regressed on each attitude component simultaneously. We applied meta-analytic structural equation modeling using the MASEM package (Cheung, 2014; Cheung & Hong, 2017) in R (R Development Core Team, 2017) to estimate both the zero-order effects and the effects relative among constructs in the proposed model (Figure 1). When testing regression and path analytic models among constructs a univariate approach is typically adopted, which involves initial correction of correlations among variables in the model for bias across studies using conventional meta-analytic techniques (see Viswesvaran & Ones, 1995). The resulting matrix of bias-corrected correlations is then used as input for a multiple regression analysis or path analysis to test model predictions. Although this method has been used in many previous studies (e.g., Hagger, Chan, Protogerou, & Chatzisarantis, 2016; Ng et al., 2012), it has been subject to criticism because it requires the use of a common sample size to estimate standard errors of model parameters, such as the harmonic mean of the sample size across studies, and assumes that the correlation matrix is a covariance matrix, which likely leads to bias in the standard errors, confidence intervals, and chi-square values of the model (Cheung, 2014; Cheung & Hong, 2017). Meta-analytic structural equation modeling offers a two-stage alternative method that addresses the

problems inherent in the univariate approach. In the first stage, correlation matrices among constructs of the proposed model from each study included in the analysis are transformed to account for study-specific random effects, enabling them to be analyzed as covariance matrices in a structural equation model. Parameter estimates (intercepts) produced in the first stage represent the zero-order bias-corrected correlations among constructs across studies with 95% confidence intervals. Cochran's (1952) Q statistic provides an overall test of the homogeneity of model estimates, with a statistically significant value indicative of substantive heterogeneity. Statistics to evaluate homogeneity in each of the model parameters are also provided: the τ^2 statistic and the I^2 statistic. Statistically significant τ^2 values with I^2 values exceeding 25% with wide confidence intervals are considered indicative of substantive heterogeneity. We also computed conventional fixed- and random-effects meta-analytic estimates and accompanying homogeneity statistics for each correlation using the metafor package (Viechtbauer, 2010) in R for comparison.

In the second stage of the analysis, a model representing predicted relations among study variables is fitted to the covariance matrix from the first stage. Effects among model constructs were evaluated based on the likelihood-based confidence intervals about model parameter estimates. To the extent that the interval does not include zero, we have confirmation for a significant effect. We evaluated differences in the effect sizes of the parameter estimates common to our proposed model by computing the 95% confidence intervals of the difference in the parameter estimates across the models (Tsui, Chou, Palmer, Lin, & Tsang, 2008). In cases where confidence intervals do not overlap we have confirmation of a statistically significant difference in the parameter estimates across models.

Moderator analyses. Effects of candidate moderator variables on the proposed effects in our model were tested by separate estimation of the model in groups of studies at each level of the moderator. One purpose of the moderator analysis was to establish whether the introduction of the moderator reduced the variability in the model estimates after correcting for methodological

artefacts by meta-analysis. We therefore compared the overall heterogeneity of the models in each moderator group using the Q statistic produced in the first stage of analysis. Consistent with previous model comparisons, differences in parameter estimates among model constructs across moderator groups were tested using the confidence intervals about the difference in the model parameter estimates (Schenker & Gentleman, 2001).

We also tested combined effects of continuous moderator variables on zero-order relations among the attitude constructs and behavior using meta-regression. As several potential moderators are only relevant to studies using the IAT, we conducted two sets of regression analyses. In the first set, effect size was regressed on mean age, study quality score, measure type, presentation order, target stimulus, and domain of study. In the second set of analyses, effect size was regressed on all moderators from the previous analysis with the inclusion of IAT standard deviation and attribute stimulus type, which only pertained to IAT studies. Measure type was excluded from this set of regressions as it was confined to only one measure. Meta-regressions were conducted using the metafor package in R using the Knapp and Hartung (2003) method with a restricted maximum likelihood estimator.

Assessment of bias. We also evaluated the potential effect of selective reporting bias in relations among our proposed model constructs across our sample of studies using regression analyses based on ‘funnel’ plots of effect size on estimates of precision. The plots are used to estimate the extent to which an averaged effect size derived from a meta-analysis deviates from the true effect due to selective biases in the sample of studies in the analysis. A principal source of bias may be ‘publication bias’, caused by a high incidence of studies in the sample with disproportionately large effect sizes relative to the sample size. Regressing effect size on study precision provides an estimate of the extent of bias and an estimate of the effect size corrected for bias (Egger, Smith, Schneider, & Minder, 1998; Stanley, 2008). Two methods are used: the precision effect test (PET) and the precision effect estimate with standard error (PEESE). The PET

regresses study effect size on the inverse of its variance estimate with the intercept serving as an unbiased estimate of the true mean effect size. However, the PET may underestimate the true mean effect size when there is evidence of a non-zero effect (Stanley & Doucouliagos, 2014). The intercept derived from regressing study effect size on the variance estimate, the PEESE, has been shown to provide a more precise estimate of the true mean effect in cases where there is evidence of a non-zero effect. Stanley and Doucouliagos, therefore, propose the PET-PEESE approach with decision rules based on the statistical significance of the PET bias-corrected estimate. In cases where the PET estimate is statistically significant, implying a non-zero effect, the PEESE estimate is taken, while in the absence of a statistically significant PET estimate, the PET estimate is used. We computed PET and PEESE estimates, with *t*-test for bias, and statistical significance of the corrected effect from zero to provide an indication of selective bias in each estimate using the PETPEESE function in R (Carter, Hilgard, Schönbrodt, & Gervais, 2017)².

Results

Zero-order Correlations and Bias Estimates

Correlations among implicit and explicit attitudes and behavior from the first stage of the MASEM analysis, and from conventional fixed- and random-effects meta-analyses, are presented in Table 1 along with variability and homogeneity statistics, and bias estimates using the PET-PEESE procedure. Estimates were statistically significant with moderate-to-high levels of heterogeneity. Effect sizes among overall implicit attitudes-explicit attitudes and implicit attitudes-behavior correlations exhibited statistically significant bias statistics. Given that PET estimates for the implicit-behavior and implicit-explicit effect sizes were statistically significant, the PEESE estimate was taken as the bias-adjusted effect size, consistent with the PET-PEESE approach (Stanley & Doucouliagos, 2014). However, the bias-adjusted PEESE estimates did not alter

²Raw data, R analysis scripts, and output for all analyses can be accessed online from <https://osf.io/hycbp/>

conclusions with respect to the difference from zero. Furthermore, as with many bias estimates, the precision of the estimates from correlational analyses may be affected by substantive levels of heterogeneity. These estimates should be indicative of potential bias rather than providing conclusive evidence for small study bias.

Moderator Analyses

Effects of moderators on relations among implicit and explicit attitudes and behavior were tested using categorical moderator analyses to assess the unique effects of each moderator and in meta-regression to assess the effect of all moderators simultaneously. Results of categorical moderator analysis are presented in Table 2. Differences across moderator groups were tested using confidence intervals about the averaged corrected correlations with a formal test provided by Schenker and Gentleman's (2001) standard method. We found that implicit attitudes measured using an IAT exhibited larger effects on behavior compared to reaction time based sorting tasks ($t(6588) = 3.404, p < .001, d = .084$). Effects of implicit measures on behavior were larger in studies on psychopathology behaviors than studies on diet and exercise ($t(1046) = 3.235, p < .001, d = .200$) and aggression ($t(1342) = 3.144, p = .002, d = .172$) behavioral domains. In addition, effects of implicit attitudes were larger in studies on social bias than studies on diet and exercise ($t(994) = 2.798, p = .005, d = .177$), and aggression ($t(946) = 2.545, p = .011, d = .165$) domains. The effects of implicit attitude measures were also larger in studies on self-concept than on diet and exercise ($t(1337) = 2.151, p = .032, d = .118$). Effects of explicit attitude measures on behavior were larger among studies on self-concept than studies in all other behavior domains ($ts > 2.861, ps < .004, ds > .180$). Effects of implicit attitude measures on behavior were larger when the explicit attitude measure ($t(3841) = 3.068, p = .002, d = .099$) or implicit attitude measure ($t(2098) = 2.429, p = .015, d = .106$) was presented first compared to when the presentation order was counterbalanced.

Results of meta-regression analyses for continuous and categorical moderators are presented in Table 3. The model was statistically significant for the analysis predicting the implicit attitude-behavior effect size only. For the analysis predicting the implicit attitude-behavior effect, studies using picture target stimuli and the IAT as the implicit attitude measure exhibited significantly larger effect sizes, while studies that counterbalanced presentation of stimuli and studies in the diet and exercise domain exhibited significantly smaller effect sizes compared to studies presenting explicit measures first and studies in the social bias domain, respectively.

We examined effects of IAT methodological artifacts on effects among studies using the IAT as the measure of implicit attitudes. Meta-regression analyses revealed statistically significant regression models for the implicit attitude-behavior and explicit attitude-behavior effect sizes. For the analysis predicting the implicit attitude-behavior effect, studies that counterbalanced the presentation of stimuli, and studies with high variability in IAT scores exhibited smaller effects. For the analysis predicting the explicit attitude-behavior effect, studies in the self-concept domain had significantly larger effect sizes than studies in the social bias behavior domain.

Testing the Structural Model

We tested our proposed model which aimed to assess the relative contribution of explicit and implicit attitudes in predicting behavior (see Figure 1) using meta-analytic structural equation modeling. Results from the analysis are presented in Table 4. Both implicit and explicit attitudes significantly predicted behavior consistent with an additive model (Perugini, 2005). Inspection of confidence intervals about the parameter estimates with those from the zero-order analysis showed no significant differences in the effect sizes of implicit or explicit attitude on behavior after accounting for the implicit-explicit covariance. The effect size for explicit attitudes was significantly larger than the effect for implicit attitudes based on 95% confidence intervals and Schlenker and Gentlemen's (2001) standard method ($t(13118) = 4.69, p < .001, d = .081$). The covariance between implicit and explicit attitudes was also significant.

We also estimated the model in groups of studies defined by levels of our categorical moderator variables, results are presented in Table 4. Implicit attitudes significantly predicted behavior in all but three moderator groups: studies using priming tasks as a measure of implicit attitudes, studies in the diet and exercise behavioral domain, and studies with a counterbalanced presentation order. We also found larger effects of implicit attitudes on behavior in studies in the psychopathology behavioral domain than studies in the alcohol/substance and aggression domains. The effect of explicit attitudes, and the covariance between explicit and implicit attitudes, was significant in all moderator groups. These results are largely consistent with the additive model. However, the variation in the implicit-behavior relationship suggests that contextual factors impact the relative contribution of implicit attitudes on behavior.

With respect to the methodological moderators, studies which used an IAT to measure implicit attitudes exhibited a significantly larger effect of implicit attitudes on behavior than studies adopting a reaction time sort-task. In addition, the effect of implicit attitudes on behavior was also larger when explicit attitude measures were administered first than studies where the order of presentation was counterbalanced, corroborating findings from the meta-regression. We found no other differences in the effects of implicit attitudes on behavior across the remaining moderator groups, and no differences in the effects of explicit attitudes on behavior, or in the implicit-explicit covariance, across moderator groups.

Discussion

The purpose of the present study was to conduct a meta-analytic synthesis of relationships between implicit and explicit measures of attitudes and behavior, and the relationship between implicit and explicit attitude measures, across studies in child and adolescent samples. Specifically, the project had three aims: to estimate the size and variability of the correlation between implicit and explicit attitude measures across studies on children and adolescents; to assess the size and variability of the simultaneous effects of implicit and explicit attitudes on behavior across studies;

and, to assess the effects of candidate moderator variables on these relationships: study quality, age, implicit attitude measure type, presentation order, target and attribute stimulus, behavioral domain, and IAT sample variability. We tested our hypotheses using meta-analytic structural equation modeling and conventional meta-analyses.

We found positive non-trivial averaged zero-order correlations between implicit and explicit attitudes, and between each attitude measure and behavior, albeit with substantive heterogeneity. Regressing behavior on implicit and explicit attitudes using meta-analytic structural equation modeling indicated that both attitude measures independently predicted behavior across studies, although the effects of explicit attitudes were significantly larger. Explicit attitudes were related to behavior in all categorical moderator groups, while implicit attitudes were related to behavior in all moderator groups, with studies in the diet and exercise behavioral domain the only exception. We found clear moderator effects for presentation order, with correlations and relative effects of implicit attitudes on behaviors stronger among studies that presented measures in a fixed rather than counterbalanced order. Studies using IATs to measure implicit attitudes reported larger effect sizes of implicit attitudes on behavior than studies adopting other response time sorting tasks. There were significant differences in sizes of effects of implicit and explicit attitudes on behavior across behavior domains, with the largest effects of implicit attitudes in the self-concept, psychopathology, and social bias domains, and the largest effect of explicit attitude in the self-concept domain. Among studies measuring implicit attitudes using the IAT, studies with more variability exhibited smaller effects of implicit attitudes on behavior. Meta-regression analyses reported notably lower levels of heterogeneity in effect sizes of implicit and explicit attitudes on behavior, although substantive heterogeneity remained.

One of the most consistent findings of this study is that implicit attitudes provide a unique contribution to predicting children and adolescent behavior alongside explicit attitudes in all but one behavioral domain. Current findings, therefore, corroborate the additive model in that implicit

attitudes account for unique variance in behavior when modeled alongside explicit attitudes – a similar pattern of effects to those of adult samples (Greenwald et al., 2009; Perugini et al., 2010). However, also in line with adult samples, there was significant variation in the size of these effects across behaviors. Examination of effects of behavioral domain on proposed relations indicated that effects of implicit attitudes on behavior were smaller in studies on diet and exercise relative to other behavioral domains. This is consistent with previous research demonstrating that implicit attitudes are a relatively modest (Hagger et al., 2017; Rebar et al., 2016) or even null (Hagger, 2018) predictor of participation in diet and physical activity. To speculate, these domains may be more subject to deliberation and reasoned decision making, an explanation which has been proposed by numerous authors (Adriaanse, Gollwitzer, De Ridder, De Wit, & Kroese, 2011; Hagger, 2018, 2019). Changing diet and physical activity are complex behaviors that require considerable forward planning and deliberation, which is consistent with the larger effect of explicit attitudes on behavior in these studies. This may particularly be the case for behaviors that tend to be strongly reinforced through dopamine-mediated rewards, like eating palatable food. Such behaviors may require considerable deliberation to alter their course (Gardner & Lally, 2018).

It is also important to note that the significant correlation observed between implicit and explicit attitude in the present study, indicate that the two forms of attitude are not entirely orthogonal in children and adolescents. This finding is also consistent with previous research on adults (Hofmann et al., 2005). A likely explanation for the substantive correlation is that a proportion of the child and adolescent population have implicit attitudes that are aligned with their explicit attitudes, but for others it diverges substantially. The correlation might also be expected to affect the prediction of behavior: a reasonable assumption given that some of the shared variance between explicit and implicit attitudes would likely also be shared with behavior. However, this did not appear to be the case in the present study, with standardized estimates of the size of the

effects of implicit and explicit attitudes on behavior in the proposed model no different in size to the zero-order effects of each form of attitude on behavior. To corroborate this, we re-estimated the structural equation models, alternately fixing the path for the effect of implicit and explicit attitude on behavior. Sure enough, excluding the effect of form of attitude on behavior did not drastically affect the size of the effect of the other³. Taken together, these data seem to suggest that effects of implicit attitudes are independent of effects of explicit attitudes in child and adolescent samples, and lends further support for the additive model (Perugini, 2005).

Contrary to hypotheses, we found no effects of age on the size of the effects of the two forms of attitude on behavior. This finding suggests that the observed variability in the implicit and explicit attitudes on behavior, and the relations between the two forms of attitudes, across studies may not be a function of developmental changes. Of course, the present research focuses on chronological rather than developmental stage, and age, particularly in early adolescence, may be limited as an indicator of cognitive and social development. So, current findings must be evaluated in light of age as a relatively crude index of development. We could find no studies that tested differences in implicit and explicit attitudes as predictors of behavior using a measure of developmental stage, which may be a more fit-for-purpose means for evaluating effects of development on implicit and explicit attitude effects. It is also important to note that the current analysis focuses on between-study comparisons from different cohorts. Cohort studies testing within-person changes in attitude effects on behavior over time would provide more robust evidence for developmental changes, and should be considered an important avenue for future research.

It is also important to note that our current data precluded an examination of interactions between age and specific behavioral categories. For example, individuals may become increasingly

³Raw data, R analysis scripts, and output for this alternative analysis are available online from <https://osf.io/hycbp/>

motivated to suppress attitudes relating to prejudice (e.g., racist, sexist, or homophobic attitudes) as they develop (Raabe & Beelmann, 2011; Rutland et al., 2005), while other attitude targets like physical activity may remain relatively constant during the course of development. As the literature examining implicit and explicit attitude expands, opportunities will become available to test moderating effects of age and, importantly, developmental stage on attitude-behavior relations for both types of attitude in specific behavioral domains.

We also found that effects of implicit attitudes on behavior varied according to some key methodological moderators, findings which have important implications for attitude research in children and adolescents. As expected, effects of implicit attitudes on behavior were larger when measured using an IAT compared to alternative implicit attitude measures. A possible reason for this moderator effect may be due to measurement reliability. Correlations are likely to be attenuated due to error variance attributable to low internal reliability (Spearman, 1904; Zimmerman & Williams, 1997), and the IAT has generally been found to exhibit acceptable internal reliability in both adults and children (Gawronski & Houwer, 2011; Williams & Steele, 2016). Conversely, alternative implicit attitude measures such as priming tasks often report low internal reliability coefficients. To speculate, a reason for the greater reliability may be due to the availability of detailed and highly precise instructions for the development of the IAT and existing protocols for use with many experimental software packages (Nosek et al., 2005). The same might apply for scoring protocols, which have been clearly outlined (Greenwald et al., 2003). Availability of protocols and scoring schemes for other implicit attitude measures, such as the IRAP and EAST, are not as readily available.

We also found a moderating effect of presentation order of measures of implicit attitude effects. Implicit measures had larger effects on behavior when either the implicit and explicit measures were presented first compared to studies in which the order of presentation was counterbalanced. We had originally expected that presentation of the explicit attitude measure first

may have biased participants' responses to the implicit measures, because the explicit measures may have served to 'prime' the attitude object (Spangenberg et al., 2016). However, that we found this effect for both measures suggests that presenting measures in a fixed order seems to result in larger implicit attitude effects on behavior compared to when measures are counterbalanced or randomized. However, it is important to note that the moderator group for studies with counterbalanced or randomized order was small ($k = 4$) and, therefore, may lack reliability. Nevertheless, current findings raise questions regarding the potential for presentation order to systematically bias findings and should be an avenue for future attitude research on children and adolescents.

In terms of stimulus items used in the implicit measures, studies using pictorial target stimuli exhibited larger implicit attitude-behavior relationships relative to studies using word stimuli. In addition, studies using IATs with word stimuli had larger implicit-explicit correlations. Moderation due to stimulus type was expected given that prior research on adults found differences in effects of implicit attitudes when pictorial and written stimuli are used (Hofmann, Gawronski, et al., 2005). These differences have been attributed to differences in the extent to which pictures and words effectively represent a target concept or attribute, and the higher level of processing activated by written stimuli (Carnevale et al., 2015; Foroni & Bel-Bahar, 2010). However, the research comparing stimulus types has looked only at the mean levels of implicit attitudes rather than effects on behavior or correlation with explicit attitudes. Consequently, current results may offer insight into an under-researched moderator of implicit attitude measurement. This may be of particular interest to research on children and adolescents given the focus of the child IAT on pictorial stimuli and the earlier development of visual as compared to verbal literacy (Avgerinou & Pettersson, 2011).

Implications for Theory and Practice

Considering that implicit attitudes may be conceptualized as representing implicit processes that lead to action, that is, processes that determine action beyond an individual's awareness, current findings may have implications for the further development of dual process theories and testing them in child and adolescent contexts. Many social cognitive models assume behavior is a function of reasoned processes and confine their analyses to constructs that reflect these deliberative processes and adopt measures of consciously-accessible predictors (see Ajzen, 1991; Bandura, 2011; Rogers, 1975). However, these perspectives have been extended to integrate constructs that represent more impulsive, non-conscious processes that determine behavior, such as habits, past behavior, and implicit constructs, including implicit attitudes (Frieze, Hofmann, & Wänke, 2008; Gibbons, Houlihan, & Gerrard, 2009; Hagger & Chatzisarantis, 2014; van Bree et al., 2015). Application of these integrated approaches may shed light on the processes by which implicit and explicit attitudes relate to behavior. For example, constructs like implicit attitudes that represent non-conscious routes to action should predict behavior directly, while effects of constructs representing the more deliberative route such that explicit attitudes should be mediated by intention. We did not test this mediation hypothesis in the current study. We look to future studies that include measures of implicit and explicit attitudes alongside measures of intentions to provide evidence that this pattern of effects is supported in children and adolescents.

What are the implications of current findings for practice? Current findings suggest that the relative contribution of implicit and explicit attitudes follow a similar pattern to that reported in the adult literature. If current findings serve to provide some formative evidence on which to base interventions aimed at promoting behavior change in children and adolescents, the results suggest that strategies adopted in adult samples targeting change in implicit and explicit attitudes may have utility in affecting change in behavior in younger samples. Given that we also found support for an additive model, with non-trivial effects for both implicit and explicit attitudes on behavior, it would be reasonable to target both forms when it comes to intervention. For example, approaches

used to alter explicit attitudes include persuasive communications highlighting the advantages or benefits of a particular course of action, and negating disadvantages or maladaptive outcomes, may be effective in changing behavior (Johnson, Wolf, Maio, & Smith-McLallen, 2018). Means to promote change in implicit attitudes might involve repeated exposure to associations between the attitude object (e.g., a behavior) and positive evaluative statements, for example, through evaluative conditioning (Gawronski & Brannon, 2018). These recommendations should, however, be accompanied by a word of caution. The high degree of heterogeneity in the effects of both forms of attitude on behavior across studies, suggest that interventions targeting each of the components may not have the expected effect on behavior. This may be, for example, dependent on the behavioral domain. For example, the small effect of implicit attitudes for diet and exercise behaviors suggests that interventions targeting implicit attitudes may have limited effectiveness.

Limitations and Future Directions

The current study had a number of strengths: adoption of an appropriate theory-driven model to test relations between implicit and explicit attitudes and their effects on behavior in children and adolescents; collection of a substantive sample of studies measuring the two forms of attitudes and behavior in child and adolescent samples; use of meta-analytic structural equation modeling to estimate relations among implicit and explicit attitudes and behavior consistent with the model; and testing the effects of candidate moderators on proposed relations. However, we should also note some limitations which may affect interpretation and generalizability of findings. Like all meta-analyses, the current study was restricted to the pool of available studies. We were unable to investigate relations among implicit and explicit attitudes for specific behaviors (e.g., racial prejudice, sexism, fruit consumption) as too few tests of effects for these specific behaviors in child and adolescent samples were available. As a result, we were confined to testing moderator effects in studies grouped by broader behavioral domains. These superordinate categories may have masked moderator effects for specific behaviors.

It should also be recognized that the current meta-analysis comprises exclusively of studies adopting correlational designs. While consistency in the relations between implicit and explicit attitudes and behavior increase confidence that an observed effect cannot be attributed to an unspecified third variable, the lack of experimental manipulation of the attitude constructs in the current research precludes any causal inference (Borsboom, Mellenbergh, & van Heerden, 2004). More research adopting experimental designs to affect changes in implicit and explicit attitudes in child and adolescents, and examine the effects of the manipulations on behavior, are needed. As research on implicit and explicit attitudes in younger samples expands, future meta-analytic syntheses may be able to estimate effects of experimental manipulations of both forms of attitude on behavior.

Conclusions

We set out to estimate relations between implicit and explicit forms of attitudes on behavior, and the implicit-explicit attitude relationship, across studies on child and adolescent samples using meta-analysis. We proposed a model to test the relative effects of the two forms of attitude on behavioral outcomes, and the correlation between the implicit and explicit attitudes, using meta-analytic structural equation modeling. Results supported an additive model with non-trivial effects of both forms of attitudes on behavior in children and adolescents, although effects of explicit attitudes were larger. Both implicit and explicit attitudes were correlated, although the effect size was small. Substantive heterogeneity was observed in the effects, suggesting the presence of moderators. We found evidence of variation in the effects of implicit attitudes on behavior across behavioral domains and key methodological artifacts including type of measure, presentation order, and stimulus format, but no evidence of variation due to age. Taken together, current research suggests that both forms of attitude account for non-trivial unique variance in behavior, with explicit attitudes likely to have larger effects. The pattern of effects seems to mirror those identified in research on adult samples. Findings corroborate an additive predictive model of

attitudes, and imply the presence of distinct conscious and non-conscious sets of determinants of behavior, consistent with dual-process theories. Current research should not be taken as evidence for inferring causality, or as definitive evidence for targeting either form of attitudes in interventions to change attitudes or behavior.

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Table 1

Zero-Order Parameter Estimates from Meta-Analytic Structural Equation Modeling (Stage 1) and Conventional Fixed and Random Effects Model Meta-Analysis for Relations Among Implicit and Explicit Attitudes and Behavior with Heterogeneity and Bias Statistics

Effect	MASEM estimates						Conventional meta-analyses						Bias statistics			
	Inter- cept	SE	Intercept		I^2	τ^2	k	Random effects model			Fixed effects model			r^+_{PET}	r^+_{PEESE}	$p\text{-BIAS}$
			CI_{95}					r^+_{RE}	SE	Q	r^+_{FE}	SE	Q			
			LL	UL												
Implicit Attitude-Behavior	.199	.020	.161	.239	.934	.014**	60	.217***	.022	274.879***	.171***	.010	202.006***	.005**	.120***	<.001
Explicit Attitude-Behavior	.342	.028	.287	.397	.951	.019**	35	.356***	.031	310.912***	.369***	.012	255.619***	.346***	.344***	.750
Implicit Attitude-Explicit Attitude	.145	.012	.121	.169	.886	.007***	111	.154***	.013	827.410***	.269***	.001	846.445***	.264***	.269***	<.001

Note. MASEM = Meta-analytic structural equation modeling; Intercept = Zero-order parameter estimate from MASEM analysis corrected for sampling error; CI₉₅ = 95% confidence interval of intercept; LL = Lower limit of 95% confidence interval; UL = Upper limit of 95% confidence interval; SE = Standard error of effect size estimate; I^2 = Higgins and Thompson (2002) I^2 statistic for effect size estimate; τ^2 = Estimated variance in population; r^+_{FE} = Corrected effect size estimate from conventional fixed effects meta-analysis model; r^+_{RE} = Corrected effect size estimate from conventional random effects meta-analysis model; Q = Cochran's Q statistic from conventional analyses; r^+_{PET} = Effect size estimate corrected for bias using the precision-effect estimate technique; r^+_{PET} = Effect size estimate corrected for bias using the precision-effect estimate with standard error technique; p_{BIAS} = Probability value for effect of precision estimate on effect size in regression analyses.

* $p < .05$ ** $p < .01$ *** $p < .001$

Table 2
Results of Categorical Moderator Analyses using Random Effects Meta-Analysis

Moderator	Implicit attitude-behavior							Explicit attitude-behavior							Implicit attitude-Explicit attitude						
	<i>k</i>	<i>r</i> ⁺	SE	CI ₉₅		<i>I</i> ²	<i>Q</i>	<i>k</i>	<i>r</i> ⁺	SE	CI ₉₅		<i>I</i> ²	<i>Q</i>	<i>k</i>	<i>r</i> ⁺	SE	CI ₉₅		<i>I</i> ²	<i>Q</i>
				LB	UB						LB	UB						LB	UB		
Measure																					
IAT (and variants)	41	.241***	.028	.187	.295	81.82	216.22***	26	.347***	.036	.276	.418	87.07	233.19***	78	.157***	.016	.125	.188	96.53	692.55***
Priming tasks	12	.177***	.049	.081	.274	59.04	23.99*	4	.449***	.079	.295	.603	52.36	6.39	10	.179***	.031	.119	.239	1.09	7.40
RT sort tasks	7	.109***	.027	.055	.162	25.37	10.30	5	.342***	.083	.179	.506	91.66	65.40***	23	.132***	.028	.078	.187	49.96	39.32*
Domain																					
Psychopathology	11	.296***	.043	.211	.381	72.43	39.89***	5	.305**	.105	.099	.510	86.22	41.03***	18	.147***	.030	.089	.207	21.46	18.02
Diet and exercise	5	.080	.051	-.020	.179	00.00	1.43	5	.215***	.063	.092	.337	21.62	3.30	7	.118*	.049	.022	.215	12.24	7.61
Social bias	12	.273***	.047	.181	.364	52.05	23.17*	7	.359***	.052	.258	.461	55.94	14.00*	51	.169***	.018	.134	.203	95.40	472.16***
Alcohol/subs. use	13	.119***	.017	.086	.153	12.08	11.46	7	.358***	.053	.254	.431	85.55	54.46***	9	.097***	.023	.046	.135	15.57	6.16
Self-concept	8	.349***	.104	.145	.552	93.88	15.11	4	.647***	.057	.535	.760	74.83	13.30**	14	.216***	.058	.102	.330	88.17	107.10
Aggression	9	.137***	.023	.087	.189	11.18	8.73	7	.339***	.032	.256	.401	46.51	11.09	7	.109***	.023	.055	.164	17.20	9.84
Presentation order																					
Implicit first	29	.197***	.027	.144	.249	61.67	65.81***	17	.312***	.040	.234	.391	83.40	99.70***	40	.161***	.019	.124	.198	83.27	302.34***
Explicit first	21	.261***	.043	.176	.346	89.37	175.23***	11	.425***	.057	.314	.536	89.66	95.38***	38	.175***	.028	.120	.231	75.40	147.63***
Randomized/counterbalanced	4	.082*	.039	.006	.159	00.00	2.07	4	.444	.071	.305	.582	76.21	12.60**	17	.120***	.028	.065	.147	92.64	164.50***
Target																					
Words	24	.208***	.029	.152	.264	73.08	77.18***	13	.341***	.042	.259	.422	78.20	68.92***	33	.147***	.022	.103	.190	77.63	161.10***
Pictures	32	.238***	.034	.171	.305	82.13	179.67***	20	.370***	.046	.281	.459	91.01	224.89***	64	.160	.018	.125	.197	91.69	582.06***
Attribute type																					
Words	34	.250***	.032	.188	.312	84.70	206.53***	20	.349***	.045	.262	.436	90.24	220.16***	59	.170***	.019	.134	.207	96.66	536.22***
Pictures	6	.191***	.048	.096	.285	26.89	7.09	6	.347***	.056	.238	.456	53.43	10.90	16	.114***	.033	.050	.178	56.60	32.02**
Study quality																					
Median or Higher	50	.216***	.024	.170	.262	80.26	236.04***	30	.359***	.033	.293	.424	89.35	305.38***	75	.156***	.017	.126	.190	87.57	428.44***
Below Median	10	.238***	.070	.100	.376	79.36	34.56***	5	.307***	.062	.186	.429	.00	3.37	36	.147***	.021	.106	.188	74.20	209.11***
Mean Age																					
Adolescents	35	.183***	.025	.134	.231	74.46	109.87***	20	.319***	.035	.249	.388	81.04	134.81***	38	.134***	.019	.096	.172	96.17	459.54***
Children	25	.268***	.039	.192	.344	80.36	148.82***	15	.402***	.051	.301	.502	89.91	167.89***	73	.166***	.017	.132	.199	68.04	184.76

Note. *k* = Sample size; *r*⁺ = Corrected effect size estimate; SE = Standard error of corrected effect size; CI₉₅ = 95% confidence interval of effect size; UL = Upper limit of 95% confidence interval; LL = Lower limit of 95% confidence interval; *I*² = Higgins and Thompson's (2002) *I*² statistic for effect size estimate; *Q* = Cochran's *Q* test of homogeneity of model effects; IAT = Implicit association test; RT = Reaction time.

Table 3

Results of Meta-Regression Analyses Predicting Effect Sizes from Study Quality, Mean Sample Age, Presentation Order, Target Stimuli, Attribute Stimuli, Domain of Study, and IAT Standard Deviation

	All Studies			IAT Studies Only		
	I→B	E→B	I↔E	I→B	E→B	I↔E
Model Statistics						
<i>k</i>	49	29	82	29	19	57
<i>F</i> Statistic	3.81**	2.06	0.91	4.56**	4.52*	1.30
<i>df F</i>	11, 37	11, 17	11, 70	12, 16	11, 7	12, 44
<i>Pseudo R</i> ^{2a}	.516	.330	.000	.779	.778	.009
<i>Q</i> Heterogeneity	105.87***	88.84***	331.00***	31.66*	14.27*	206.48***
<i>Df Q</i>	37	17	70	16	7	44
Regression Coefficients (β)^b						
Intercept	.255	.282	.296	.390	-.274	.243
Quality	-.028	.046	-.004	-.033	.053	.003
Mean Age	.002	-.007	-.007	.020	.025	-.007
Measure ^c	.167*	-.152	.005	—	—	—
Implicit First ^d	-.026	.005	.004	-.049	-.021	.034
Counterbalanced ^e	-.280**	.011	-.068	-.235*	.028	-.021
Target Stimulus ^f	.143*	-.009	-.012	.159	.106	.081
Attribute Stimulus ^g	—	—	—	-.064	-.011	-.153**
Psychopathology ^h	.049	-.114	.019	-.039	.198	.020
Diet and Exercise ^h	-.271*	-.013	-.052	-.329	-.051	-.078
Alcohol and Substance Use ^h	-.069	-.114	-.082	-.135	-.070	-.147
Self-Concept ^h	.083	.300*	.041	.198	.424**	.027
Aggression ⁱ	-.072	-.103	-.056	-.044	—	-.090
IAT Standard Deviation	—	—	—	-.408*	-.332	-.092

Note. ^aPseudo *R*² is calculated from $(\tau^2_{\text{Unmoderated Model}} - \tau^2_{\text{Moderated Model}}) / \tau^2_{\text{Unmoderated Model}}$. ^bCoefficients are standardized. ^cIATs as compared to other measures, positive betas indicate stronger effects in IATs.

^dStudies in which implicit measures were presented before explicit measures, positive betas indicate a stronger effect when implicit measures were presented first. ^eStudies in which the order of measures was counterbalanced as compared to studies where explicit measures were presented first, positive betas

indicate a stronger effect in counterbalanced studies. ^fPictures or words as IAT target stimuli, positive beta weights indicate stronger effects in studies with pictorial target stimuli. ^gPictures or words as IAT attribute stimuli, positive beta weights indicate a stronger effect in studies with pictorial attribute stimuli; ^hBehavior type moderator codes are compared to the social bias behavior category; ⁱNo studies tested effects of explicit measures on this behavior in studies using IAT. I = Implicit attitude; E = Explicit attitude; B = Behavioral measure; IAT = Implicit association test.

p* < .050 *p* < .010 ****p* < .001

Table 4
Standardized Parameter Estimates of Implicit-Behavior, Explicit-Behavior, and Implicit-Explicit Paths in Meta-Analytic Structural Equation Model

Moderator	Implicit attitude→Behavior			Explicit attitude→Behavior			Implicit attitude↔Explicit Attitude			ε	R ²	k
	β ^a	LB CI ₉₅		β ^a	LB CI ₉₅		β ^a	LB CI ₉₅				
		LL	UL		LL	UL		LL	UL			
Full sample	.153*	.112	.194	.320*	.263	.376	.145*	.122	.169	.860	.140	140
Moderator: Measure												
IAT (and variants)	.178*	.128	.228	.307*	.241	.372	.148*	.119	.177	.858	.142	97
Priming tasks	.079	-.019	.174	.432*	.301	.564	.172*	.111	.233	.795	.205	18
RT sort tasks	.066*	.015	.115	.327*	.179	.474	.121*	.068	.173	.884	.116	25
Moderator: Domain												
Psychopathology	.249*	.160	.337	.250*	.062	.438	.139*	.084	.194	.858	.142	25
Diet and exercise	.053	-.067	.172	.193*	.059	.326	.146*	.042	.251	.957	.043	8
Social bias	.199*	.111	.286	.311*	.222	.399	.164*	.130	.197	.844	.156	56
Alcohol/subs. use	.086*	.052	.122	.350*	.251	.448	.092*	.046	.137	.864	.135	16
Self-concept	.211*	.005	.411	.566*	.448	.682	.198*	.093	.302	.588	.411	18
Aggression	.101*	.054	.148	.317*	.271	.363	.106*	.062	.150	.882	.118	10
Moderator: Presentation order												
Implicit first	.137*	.089	.184	.259*	.191	.328	.151*	.117	.184	.903	.097	62
Explicit first	.184*	.101	.266	.380*	.283	.477	.163*	.112	.215	.799	.201	46
Randomized/ counterbalanced	.031	-.040	.100	.429*	.298	.559	.121*	.071	.171	.812	.188	19
Moderator: Target												
Words	.167*	.110	.224	.289*	.200	.377	.134*	.090	.178	.878	.124	40
Pictures	.195*	.106	.284	.325*	.223	.427	.158*	.119	.198	.836	.164	54
Moderator: Attribute type												
Words	.183*	.125	.242	.305*	.224	.385	.161*	.128	.194	.855	.145	77
Pictures	.142*	.051	.234	.316*	.223	.409	.105*	.045	.166	.870	.130	16
Moderator: Quality												
Median or Higher	.154*	.110	.197	.325*	.263	.386	.149*	.119	.178	.856	.144	98
Below Median	.155*	.024	.286	.254*	.125	.383	.141*	.101	.181	.900	.100	40
Moderator: Mean Age												
Adolescent	.129*	.085	.173	.292*	.224	.361	.128*	.092	.164	.888	.112	55
Children	.196*	.121	.270	.355*	.262	.449	.157*	.126	.188	.813	.187	84

Note. ^aStatistical significance is based on Wald confidence intervals as likelihood based confidence intervals are asymmetric and do not produce significance values. β = Standardized path coefficient; LB CI₉₅ = Likelihood-based 95% confidence interval; LL = Lower limit of CI₉₅; UL = Upper limit of CI₉₅; ε = Residual error variance of behavior; R^2 = Variance explained in behavior; k = Sample size. * $p < .050$ ** $p < .010$ *** $p < .001$

Figure 1. Hypothesized meta-analytic structural equation model.

Appendix A

PRISMA Flow Diagram for Study Search and Inclusion Strategy

Appendix B

Overall Methodological Quality

An Adaption of the Cross Sectional Newcastle Ottawa Scale (Modesti, 2016)

A) Selection: (Maximum 3 stars)

1) Representativeness of the sample:

- a) Truly representative of the average in the target population. * (all subjects or random sampling)
- b) Somewhat representative of the average in the target population. * (non-random sampling)
- c) Selected group of users.
- d) No description of the sampling strategy.

2) Sample size:

- a) Justified and satisfactory. *
- b) Not justified.

3) Non-respondents:

- a) Comparability between respondents and non-respondents characteristics is established, and the response rate is satisfactory. *
- b) The response rate is unsatisfactory, or the comparability between respondents and non-respondents is unsatisfactory.
- c) No description of the response rate or the characteristics of the responders and the non-responders.

B) Comparability: (Maximum 2 stars)

1) Confounding factors are controlled or Reported.

- a) The study controls for the most important factor (select one). *
- b) The study control for any additional factor. *

C) Outcome: (Maximum 5 stars)

1) Assessment of Outcomes:

- a) Behavioral Observations or Records **
- b) Self Report *
- d) No description.

2) Statistical test:

- a) The statistical test used to analyze the data is clearly described and appropriate, and the measurement of the association is presented, including confidence intervals and the probability level (p value). *
- b) The statistical test is not appropriate, not described or incomplete

4) Measures Used:

- a) Validated measurement tools. **
- b) Non-validated measurement tool, but the tool is available or described. *
- c) No description of the measurement tool.

Appendix C

Table C1

Title

Author(s)	Year	Title	Final Score	A1	A2	A3	B1	C1	C2	C3
Andrews, Hampson, Greenwald, Gordon, & Widdop	2010	Using the Implicit Association Test to assess children's implicit attitudes toward smoking	3	0	1	1	0	1	0	1
Askew & Field	2007	Vicarious learning and the development of fears in childhood	2	0	0	0	0	1	0	1
Axt, Ebersole, & Nosek	2014	The rules of implicit evaluation by race, religion, and age	6	1	1	1	1	1	1	1
Babcock, Malone-Beach, Hannighofer, & Woodworth-Hou	2016	Development of a children's IAT to measure bias against the elderly	5	0	1	1	0	1	1	1
Boiché, Plaza, Chalabaev, Guillet-Descas, & Sarrazin	2014	Social antecedents and consequences of gender-sport stereotypes during adolescence	1	1	1	0	2	1	1	2
Bos, Huijding, Muris, Vogel, & Biesheuvel	2010	Global, contingent and implicit self-esteem and psychopathological symptoms in adolescents	8	1	1	0	2	1	1	2
Bountress, Chassin, Presson, & Jackson	2016	The effects of peer influences and implicit and explicit attitudes on smoking initiation in adolescence	8	1	1	1	2	1	0	2
Bruni & Schultz	2010	Implicit beliefs about self and nature: Evidence from an IAT game	4	0	1	0	0	1	1	1
Cai, Wu, Luo, & Yang	2014	Implicit self-esteem decreases in adolescence: A cross-sectional study	5	0	1	0	0	1	1	2
Cha et al.	2016	Using implicit and explicit measures to predict nonsuicidal self-injury among adolescent inpatients	7	0	1	1	2	1	0	2
Cheetham, Turner-Cobb, & Gamble	2016	Children's implicit understanding of the stress-illness link: Testing development of health cognitions	4	0	1	0	0	1	1	1
Colder et al.	2014	Growth trajectories of alcohol information processing and associations with escalation of drinking in early adolescence	6	1	1	1	0	1	0	2
Craeynest, Crombez, De Houwer, Deforche, & De Bourdeaudhuij	2006	Do children with obesity implicitly identify with sedentariness and fat food?	6	1	1	0	0	1	1	2
Mietje Craeynest, Crombez, Haerens, & De Bourdeaudhuij	2007	Do overweight youngsters like food more than lean peers? Assessing their implicit attitudes with a personalized Implicit Association Task	5	1	1	0	0	1	1	1
Craeynest, Crombez, Koster, Haerens, & De Bourdeaudhuij	2008	Cognitive-motivational determinants of fat food consumption in overweight and obese youngsters: The implicit association between fat food and arousal	6	1	1	0	0	1	1	2
Cvencek et al.	2011	Measuring implicit attitudes of 4-year-olds: The Preschool Implicit Association Test	7	0	1	0	2	1	1	2

Author(s)	Year	Title	Final Score	A1	A2	A3	B1	C1	C2	C3
Cvencek, Meltzoff, & Greenwald	2011	Math-gender stereotypes in elementary school children	6	1	1	0	1	1	1	1
Cvencek, Meltzoff, & Kapu	2014	Cognitive consistency and math-gender stereotypes in Singaporean children	6	0	1	0	1	1	1	2
de Hullu, de Jong, Sportel, & Nauta	2011	Threat-related automatic associations in socially anxious adolescents	7	1	1	1	1	1	1	2
Deng, Sang, & Chen	2017	Implicit beliefs about emotion regulation and their relations with emotional experiences among Chinese adolescents	6	0	1	0	1	1	1	2
Dickstein et al.	2015	Self-injurious implicit attitudes among adolescent suicide attempters versus those engaged in nonsuicidal self-injury	8	1	1	1	1	1	1	2
Dunham & Emory	2014	Of affect and ambiguity: The emergence of preference for arbitrary ingroups	5	0	1	0	1	1	1	1
Dunham et al.	2016	The development of implicit gender attitudes	6	1	1	0	1	1	1	1
Dunham et al.	2014	From a different vantage: Intergroup attitudes among children from low-and intermediate-status racial groups	5	0	1	0	1	1	1	1
Field (Unpublished Data)	2005	Latent Inhibition	3	0	1	0	0	1	0	1
Flannigan	2013	Exploring occupational stereotyping (PhD Thesis)	7	0	1	0	2	1	1	2
Galdi, Cadinu, & Tomasetto	2014	The roots of stereotype threat: When automatic associations disrupt girls' math performance	8	1	1	1	2	1	1	1
Geng, Zhou, & Xu	2013	Explicit and implicit television cognition of left-behind children in China	4	0	1	0	0	1	0	2
Gibbons et al.	2016	Impulsivity moderates the effects of movie alcohol portrayals on adolescents' willingness to drink	7	0	1	0	2	1	1	2
Gibbs & Hovey	2010	Assessing suicidal cognitions in adolescents: Establishing the reliability and validity of the suicide cognitions scale (PhD Thesis)	7	1	1	0	1	1	1	2
Glenn, Kleiman, Cha, Nock, & Prinstein	2016	Implicit cognition about self-injury predicts actual self-injurious behavior: Results from a longitudinal study of adolescents	8	0	1	0	2	2	1	2
Glenn et al.	2017	Implicit identification with death predicts change in suicide ideation during psychiatric treatment in adolescents	8	1	1	0	2	1	1	2
Gollwitzer, Banse, Eisenbach, & Naumann	2007	Effectiveness of the Vienna Social Competence Training on explicit and implicit aggression: Evidence from an Aggressiveness-IAT	8	1	1	1	0	1	1	1
Gonzalez, Dunlop, & Baron	2017	Malleability of implicit associations across development	5	1	1	1	0	1	1	1
Gonzalez, Steele, & Baron	2017	Reducing children's implicit racial bias through exposure to positive out-group exemplars	6	1	1	1	0	1	1	1

Author(s)	Year	Title	Final Score	A1	A2	A3	B1	C1	C2	C3
Grumm, Hein, & Fingerle	2011	Predicting aggressive behavior in children with the help of measures of implicit and explicit aggression	7	1	1	1	0	1	1	2
Guidetti, Cavazza, & Graziani	2014	Healthy at home, unhealthy outside: Food groups associated with family and friends and the potential impact on attitude and consumption	7	1	1	0	2	1	1	1
Heyden, van Atteveltdt, Huizinga, & Jolles	2016	Implicit and explicit gender beliefs in spatial ability: Stronger stereotyping in boys than girls	7	1	1	0	1	1	1	2
Heyder & Kessels	2013	Is school feminine? Implicit gender stereotyping of school as a predictor of academic achievement	3	0	1	0	0	1	0	1
Hogendoorn et al.	2012	Perceived control in clinically anxious and non-anxious children indirectly measured with the Implicit Association Procedure	6	0	1	0	1	1	1	2
Hogendoorn et al.	2008	An indirect and direct measure of anxiety-related perceived control in children: The implicit association procedure	5	0	1	0	0	1	1	2
Hughes & Bigler	2011	Predictors of African American and European American adolescents' endorsement of race-conscious social policies	7	0	1	0	2	1	1	2
Kelly, Masterman, & Marlatt	2006	Adolescent tobacco-related associative memory: A cross-sectional and contextual analysis	4	0	1	0	0	1	1	1
Kessels, Rau, & Hannover	2006	What goes well with physics? Measuring and altering the image of science	7	0	1	1	2	7	0	1
Khan	2013	The validation of measures of implicit attitudes in the context of predicting disordered eating (Phd Thesis)	6	0	1	0	2	1	1	1
Klein et al.	2012	Subjective fear, interference by threat, and fear associations independently predict fear-related behavior in children	7	0	1	0	2	1	1	2
Lam, Chiu, & Lau	2007	What do we learn from the Implicit Association Test about intergroup attitudes in Hong Kong? The case of social identification inclusiveness and need for closure	4	0	1	1	0	1	1	1
Larsen et al.	2014	Implicit motivational processes underlying smoking in American and Dutch adolescents	7	1	1	0	1	1	1	2
Lee, Begun, DePrince, & Chu	2016	Acceptability of dating violence and expectations of relationship harm among adolescent girls exposed to intimate partner violence	8	1	1	1	1	1	1	2
Leeuwis, Koot, Creemers, & van Lier	2015	Implicit and explicit self-esteem discrepancies, victimization and the development of late childhood internalizing problems	6	1	1	1	0	1	0	2
Lemmer, Gollwitzer, & Banse	2015	On the psychometric properties of the aggressiveness-IAT for children and adolescents	7	1	1	1	0	1	1	2

Author(s)	Year	Title	Final Score	A1	A2	A3	B1	C1	C2	C3
Tian, Liu, & Gilman	2010	Explicit and implicit school satisfaction	4	0	1	0	0	1	0	2
Liu, Hu, Jiannong, & Adey	2010	Gender stereotyping and affective attitudes towards science in Chinese secondary school students	6	0	1	0	2	1	1	1
Mahonen, Jasinskaja-Lahti, Liebkind, & Finell	2011	Perceived importance of contact revisited: Anticipated consequences of intergroup contact for the ingroup as predictors of the explicit and implicit ethnic attitudes of youth	6	1	1	0	1	1	1	1
Melton	2009	Unsubstantiated bias toward foster care versus group home placements for wards of the state (PhD Thesis)	7	1	1	0	1	1	1	2
Neto, da Conceicao Pinto, & Mullet	2016	Can music reduce anti-dark-skin prejudice? A test of a cross-cultural musical education programme	5	0	1	0	0	1	1	2
Nock & Banaji	2007	Assessment of self-injurious thoughts using a behavioral test	7	1	1	0	1	1	1	2
Noel & Thomson	2012	Children's alcohol cognitions prior to drinking onset: Discrepant patterns from implicit and explicit measures	7	0	1	0	2	1	1	2
Nowicki & Lopata	2017	Children's implicit and explicit gender stereotypes about mathematics and reading ability	6	0	1	0	2	1	1	1
Nummenmaa, Peets, & Salmivalli	2008	Automatic activation of adolescents' peer-relational schemas: Evidence from priming with facial identity	6	1	1	1	0	1	1	1
O'Connor & Colder	2015	The prospective joint effects of self-regulation and impulsive processes on early adolescence alcohol use	3	0	1	1	0	1	0	0
O'Connor, Lopez-Vergara, & Colde	2012	Implicit cognition and substance use: The role of controlled and automatic processes in children	5	1	1	0	0	1	1	1
O'Driscoll, Heary, Hennessy, & McKeague	2012	Explicit and implicit stigma towards peers with mental health problems in childhood and adolescence	8	1	1	0	2	1	1	2
Olson, Key, & Eaton	2015	Gender cognition in transgender children	8	0	1	1	2	1	1	2
Pedersen, Harty, Pelham, Gnagy, & Molina	2014	Differential associations between alcohol expectancies and adolescent alcohol use as a function of childhood ADHD	6	0	1	1	2	1	0	1
Peeters, Koning, Monshouwer, Vollebergh, & Wiers	2016	Context effects of alcohol availability at home: Implicit alcohol associations and the prediction of adolescents' drinking behavior	7	1	1	1	0	1	1	2
Peeters et al.	2012	Automatic processes in at-risk adolescents: The role of alcohol-approach tendencies and response inhibition in drinking behavior	8	1	1	1	2	1	1	2
Plaza, Boiché, Brunel, & Ruchaud	2017	Sport = Male	6	1	1	0	0	1	1	2
Pouwels, Lansu, & Cillessen	2017	Adolescents' explicit and implicit evaluations of hypothetical and actual peers with different bullying participant roles	7	1	1	1	1	1	1	1

Author(s)	Year	Title	Final Score	A1	A2	A3	B1	C1	C2	C3
Qian et al.	2017	Perceptual individuation training	3	0	0	0	0	1	1	1
Rae & Olson	2018	Test–retest reliability and predictive validity of the Implicit Association Test in children	6	1	1	1	0	1	1	1
Roddy & Stewart	2012	Children's implicit and explicit weight-related attitudes	6	0	1	1	1	1	1	2
Rohner & Bjorklund	2006	Do self-presentation concerns moderate the relationship between implicit and explicit homonegativity measures?	7	1	1	0	2	1	1	1
Rooke & Hine	2011	A dual process account of adolescent and adult binge drinking	6	1	1	0	0	1	1	2
Ruhnau, Schröger, & Sussman	2017	Implicit expectations influence target detection in children and adults	3	0	1	0	0	1	1	0
Rutland et al.	2005	Social norms and self-presentation: Children's implicit and explicit intergroup attitudes	8	1	1	1	1	1	1	2
Sauzéon, Déjos, Lestage, Arvind Pala, & N’Kaoua	2012	Developmental differences in explicit and implicit conceptual memory tests: A processing view account	4	1	0	0	0	1	0	2
Scanlon	2007	The utility of the Implicit Relational Assessment Procedure (IRAP)	4	0	1	0	1	1	0	1
Schattke, Koestner, & Kehr	2011	Childhood correlates of adult levels of incongruence between implicit and explicit motives	8	1	1	0	2	1	1	2
Schmits, Maurage, Thirion, & Quertemont	2014	Dissociation between implicit and explicit expectancies of cannabis use in adolescence	8	1	1	0	1	2	1	2
Sherman, Chassin, Presson, Seo, & Macy	2009	The intergenerational transmission of implicit and explicit attitudes toward smoking: Predicting adolescent smoking initiation	6	1	1	0	0	1	1	2
Shono, Grenard, Ames, & Stacy	2014	Application of item response theory to tests of substance-related associative memory	4	0	1	0	0	1	1	1
Silke, Swords, & Heary	2017	The predictive effect of empathy and social norms on adolescents' implicit and explicit stigma responses	7	1	1	0	1	1	1	2
Sinclair, Dunn, & Lowery	2005	The relationship between parental racial attitudes and children's implicit prejudice	5	0	1	0	1	1	1	1
Solbes & Enesco	2010	Explicit and implicit anti-fat attitudes in children and their relationships with their body images	4	0	1	0	1	1	0	1
Steffens & Jelenec	2011	Separating implicit gender stereotypes regarding math and language: Implicit ability stereotypes are self-serving for boys and men, but not for girls and women	5	0	1	1	0	1	1	1
Sturge-Apple, Rogge, Peltz, Suor, & Skibo	2015	Delving beyond conscious attitudes: Validation of an innovative tool for assessing parental implicit attitudes toward physical punishment	7	1	1	1	0	1	1	2

Author(s)	Year	Title	Final Score	A1	A2	A3	B1	C1	C2	C3
Suter, Pihet, De Ridder, Zimmermann, & Stephan	2014	Implicit attitudes and self-concepts towards transgression and aggression: Differences between male community and offender adolescents, and associations with psychopathic traits	10	1	1	1	2	2	1	2
Suter et al.	2017	Predicting daily-life antisocial behaviour in institutionalized adolescents with transgression-related Implicit Association Tests	7	1	1	0	1	2	1	1
Thomas, Smith, & Ball	2007	Implicit attitudes in very young children: An adaptation of the IAT	7	0	1	0	2	1	1	2
Thush & Wiers	2007	Explicit and implicit alcohol-related cognitions and the prediction of future drinking in adolescents	7	0	1	0	2	1	1	2
Todd, Thiem, & Neel	2016	Does seeing faces of young black boys facilitate the identification of threatening stimuli?	7	1	1	0	2	1	1	1
Uhlmann & Swanson	2004	Exposure to violent video games increases automatic aggressiveness	9	1	1	1	1	2	1	2
van Goethem, Scholte, & Wiers	2010	Explicit and implicit bullying attitudes in relation to bullying behavior	4	0	1	0	0	1	1	1
Verkuyten	2003	Ethnic in-group bias among minority and majority early adolescents: The perception of negative peer behaviour	6	1	1	0	0	1	1	2
Vervoort et al.	2010	Automatic evaluations in clinically anxious and nonanxious children and adolescents	5	0	1	0	0	1	1	2
Vezzali, Capozza, Giovannini, & Stathi	2012	Improving implicit and explicit intergroup attitudes using imagined contact: An experimental intervention with elementary school children	4	0	1	0	1	1	1	0
Vezzali, Giovannini, & Capozza	2012	Social antecedents of children's implicit prejudice: Direct contact, extended contact, explicit and implicit teachers' prejudice	4	0	1	0	0	1	0	2
Williams, Steele, & Lipman	2015	Assessing children's implicit attitudes using the affect misattribution procedure	8	1	1	0	2	1	1	2
Žeželj, Jakšić, & Jošić	2015	How contact shapes implicit and explicit preferences: Attitudes toward Roma children in inclusive and non-inclusive environment	7	1	1	0	2	1	1	1
Zheng & Liang	2006	The research of disadvantaged students' implicit and explicit self-concept and their predicted fountain	8	1	1	0	2	1	1	2

Note. Refer to Appendix B for column meanings.

Appendix D

Table D1
Moderator Coding for Included Studies

Author	Year	Title	Study Qual.	Domain	Pres. Cond.	Measure Used	IAT stimulus		N	M Age	IAT SD	<i>r</i> IE	<i>r</i> IB	<i>r</i> EB
							Target	Attribute						
Andrews, J. A., Hampson, S. E., Greenwald, A. G., Gordon, J., & Widdop, C.	2010	Using the Implicit Association Test to assess children's implicit attitudes toward smoking (Study 1)	0	Alcohol and Substance	1	IAT	2	1	93	12.07	-	0.093 ^b	-	-
Askew & Field	2007	Vicarious learning and the development of fears in childhood	0	Psychopathology	1	APT	-	-	31	9.00	-	0.136	-	-
Axt, J. R., Ebersole, C. R., & Nosek, B. A.	2014	The rules of implicit evaluation by race, religion, and age (Study 2 Child Sample)	1	Social	3	IAT (Brief)	1	1	358	10.54	0.375	0.156 ^b	-	-
Axt, J. R., Ebersole, C. R., & Nosek, B. A.	2014	The rules of implicit evaluation by race, religion, and age (Study 3 Child Sample)	1	Social	3	IAT (Brief)	2	1	28	11.30	0.284	-0.005 ^b	-	-
Axt, J. R., Ebersole, C. R., & Nosek, B. A.	2014	The rules of implicit evaluation by race, religion, and age (Study 1 Child Sample)	1	Social	3	IAT (Brief)	2	1	45	11.45	0.367	0.409 ^b	-	-
Axt, J. R., Ebersole, C. R., & Nosek, B. A.	2014	The rules of implicit evaluation by race, religion, and age (Study 2 Adolescent Sample)	1	Social	3	IAT (Brief)	1	1	38850	16.75	0.344	0.244 ^b	-	-
Axt, J. R., Ebersole, C. R., & Nosek, B. A.	2014	The rules of implicit evaluation by race, religion, and age (Study 1 Adolescent Sample)	1	Social	3	IAT (Brief)	2	1	8482	16.80	0.338	0.241 ^b	-	-
Axt, J. R., Ebersole, C. R., & Nosek, B. A.	2014	The rules of implicit evaluation by race, religion, and age (Study 3 Adolescent Sample)	1	Social	3	IAT (Brief)	2	1	2903	17.10	0.297	0.073 ^b	-	-
Bevelander, Kirsten E Anschütz, Doeschka J	2013	The role of explicit and implicit self-esteem in peer modeling of palatable food intake: A study	1	Self-Concept	2	IAT	1	-	118	11.14	0.351	0.065	-	-

Appendix D: Moderator Coding

2

Creemers, Daan HM Kleinjan, Marloes Engels, Rutger CME		on social media interaction among youngsters												
Boiché, J., Plaza, M., Chalabaev, A., Guillet-Descas, E., & Sarrazin, P.	2014	Social antecedents and consequences of gender-Sport stereotypes during adolescence	1	Social	2	IAT (Sc)	1	1	23	15.00	0.220	0.132 ^b	-	-
Bos, A. E., Huijding, J., Muris, P., Vogel, L. R., & Biesheuvel, J.	2010	Global, contingent and implicit self-esteem and psychopathological symptoms in adolescents	1	Self-Concept	2	IAT	1	1	264	13.91	0.380	0.015 ^b	-	-
Bountress, K., Chassin, L., Presson, C. C., & Jackson, C.	2016	The effects of peer influences and implicit and explicit attitudes on smoking initiation in adolescence	1	Alcohol and Substance	1	IAT	2	1	709	-	-	0.130 ^b	0.177 ^b	0.412 ^b
Bruni, C. M., & Schultz, P.	2010	Implicit beliefs about self and nature: Evidence from an IAT game (Study 3)	0	Misc.	2	IAT (FlexiTwins Game)	2	1	30	10.50 ^a	0.370	0.121 ^b	0.360	-
Cai, H., Wu, M., Luo, Y. L. L., & Yang, J.	2014	Implicit self-esteem decreases in adolescence: A cross- sectional study	0	Self-Concept	3	IAT	1	1	599	14.10	0.370	0.030	-	-
Cha, C. B., Augenstein, T. M., Frost, K. H., Gallagher, K., D'Angelo, E. J., & Nock, M. K.	2016	Using implicit and explicit measures to predict nonsuicidal self-injury among adolescent inpatients	1	Psychopathology	1	IAT	1	1	123	14.80	-	-	0.451 ^b	0.196 ^b
Cheetham, T. J., Turner-Cobb, J. M., & Gamble, T.	2016	Children's implicit understanding of the stress- illness link: Testing development of health cognitions	0	Misc.	2	IAT (Ps)	-	2	32	-	0.562	0.370	-	-
Craeynest, M., Crombez, G., De Houwer, J., Deforche, B., & De Bourdeaudhuij, I.	2006	Do children with obesity implicitly identify with sedentariness and fat food?	1	Food and Exercise	1	IAT	2	1	78	13.17	-	-	0.117 ^b	-

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Craeynest, M., Crombez, G., Haerens, L., & De Bourdeaudhuij, I.	2007	Do overweight youngsters like food more than lean peers? Assessing their implicit attitudes with a personalized Implicit Association Task	1	Food and Exercise	1	IAT	-	-	80	-	-	0.090	-	-
Craeynest, M., Crombez, G., Koster, E. H. W., Haerens, L., & De Bourdeaudhuij, I.	2008	Cognitive-motivational determinants of fat food consumption in overweight and obese youngsters: The implicit association between fat food and arousal (Study 2)	1	Food and Exercise	-	IAT	2	1	58	13.21	-	0.142 ^b	0.155 ^b	0.134 ^b
Craeynest, M., Crombez, G., Koster, E. H. W., Haerens, L., & De Bourdeaudhuij, I.	2008	Cognitive-motivational determinants of fat food consumption in overweight and obese youngsters: The implicit association between fat food and arousal (Study 1)	1	Food and Exercise	-	IAT	2	1	58	14.34	-	-0.046 ^b	0.010 ^b	0.081 ^b
Cvencek, D., Greenwald, A. G., & Meltzoff, A. N.	2011	Measuring implicit attitudes of 4-year-olds: The Preschool Implicit Association Test (Study 1)	1	Misc.	2	IAT (Ps)	2	1	65	4.54	-	0.220	-	-
Cvencek, D., Greenwald, A. G., & Meltzoff, A. N.	2011	Measuring implicit attitudes of 4-year-olds: The Preschool Implicit Association Test (Study 2)	1	Social	2	IAT (Ps)	2	1	64	4.58	-	0.430	0.520	0.500
Cvencek, D., Meltzoff, A. N., & Greenwald, A. G.	2011	Math-gender stereotypes in elementary school children	1	Social	2	IAT (Ch)	1	1	247	7.98 ^a	-	0.376 ^b	-	-
Cvencek, D., Meltzoff, A. N., & Kapur, M.	2014	Cognitive consistency and math-gender stereotypes in Singaporean children	1	Self-Concept	3	IAT (Ch)	1	1	172	9.39	-	0.276	-	-
Cvencek, D., Nasir, N. S., O'Connor, K., Wischnia, S., & Meltzoff, A. N.	2015	The Development of Math-Race Stereotypes: "They Say Chinese People Are the Best at Math"	1	Social	2	IAT (Ch)	1	1	142	11.56	0.430	0.231 ^b	-	-
de Hullu, E., de Jong, P. J., Sportel, B., & Nauta, M. H.	2011	Threat-related automatic associations in socially anxious adolescents	1	Psychopathology	1	IAT (St)	1	1	384	14.44	0.392	0.070	0.210	0.050
Degner, J., Wentura, D.,	2007	Hostility-related prejudice against Turks in adolescents:	1	Social	1	Priming	-	-	59	14.00	-	0.305 ^b	0.340	0.240

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Gniewosz, B., & Noack, P.		Masked affective priming allows for a differentiation of automatic prejudice												
Deng, X., Sang, B., & Chen, X.	2017	Implicit beliefs about emotion regulation and their relations with emotional experiences among Chinese adolescents	1	Psychopathology	2	IAT	1	1	147	15.02	0.060	-	0.469	-
Dickstein, D. P., Puzia, M. E., Cushman, G. K., Weissman, A. B., Wegbreit, E., Kim, K. L., . . . Spirito, A.	2015	Self-injurious implicit attitudes among adolescent suicide attempters versus those engaged in nonsuicidal self-injury	1	Psychopathology	2	IAT	1	1	136	15.50	0.332	-	0.308 ^b	-
Dunham, Y., & Emory, J.	2014	Of affect and ambiguity: The emergence of preference for arbitrary ingroups (Study 2)	0	Social	-	AMP	2	-	50	3.90	0.220	0.212 ^b	-	-
Dunham, Y., & Emory, J.	2014	Of affect and ambiguity: The emergence of preference for arbitrary ingroups (Study 1)	0	Social	-	AMP	2	-	37	6.20	0.180	0.194 ^b	-	-
Dunham, Y., Newheiser, A.-K., Hoosain, L., Merrill, A., & Olson, K. R.	2014	From a different vantage: Intergroup attitudes among children from low-and intermediate-status racial groups	0	Social	1	IAT	2	2	253	9.08	0.480	0.055	-	-
Field Unpublished Data	2006	Devaluation	0	Psychopathology	-	APT	-	-	36	7.61	-	0.023	-	-
Field Unpublished Data	2005	Contingency	0	Psychopathology	-	APT	-	-	85	7.80	-	0.169	-	-
Field Unpublished Data	2007	Blocking	0	Psychopathology	-	APT	-	-	66	8.07	-	0.087	-	-
Field Unpublished Data	2007	Vicarious Learning	0	Psychopathology	-	APT	-	-	42	8.25	-	0.101	-	-
Field Unpublished Data	2006	Extinction	0	Psychopathology	2	IAT	2	-	39	8.40	0.186	0.237	-	-
Field Unpublished Data	2005	Latent Inhibition	0	Psychopathology	-	APT	1	-	63	8.54	-	0.120	-	-
Field Unpublished Data	2005	Blocking	0	Psychopathology	-	APT	-	-	52	8.80	-	-0.003	-	-

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Field Unpublished Data	2004	Consistency	0	Psychopathology	-	APT	-	-	92	8.85	-	0.122	-	-
Field Unpublished Data	2005	Vicarious Learning	0	Psychopathology	-	APT	-	-	60	9.06	-	0.019	-	-
Galdi, S., Cadinu, M., & Tomasetto, C.	2014	The roots of stereotype threat: When automatic associations disrupt girls' math performance	1	Self-Concept	1	IAT (Ch)	2	-	240	6.47	0.591	0.058 ^b	-	-
Geng, L., Zhou, W., & Xu, Q.	2013	Explicit and implicit television cognition of left-behind children in China	0	Misc.	2	IAT (Brief)	1	1	53	12.92	-	0.030	-	-
Gibbons, F. X., Kingsbury, J. H., Wills, T. A., Finneran, S. D., Dal Cin, S., & Gerrard, M.	2016	Impulsivity moderates the effects of movie alcohol portrayals on adolescents' willingness to drink	1	Alcohol and Substance	2	RT (Dot Probe Task)	1	1	143	14.00	-	-	0.090	-
Gibbs, D. (2010)	2010	Assessing suicidal cognitions in adolescents: Establishing the reliability and validity of the suicide cognitions scale. (PhD Thesis)	1	Psychopathology	1	IAT (Sc)	1	1	58	16.21	0.315	0.396 ^b	0.219 ^b	0.361 ^b
Glenn, C. R., Kleiman, E. M., Cha, C. B., Nock, M. K., & Prinstein, M. J.	2016	Implicit cognition about self-injury predicts actual self-injurious behavior: Results from a longitudinal study of adolescents	1	Psychopathology	2	IAT	1	1	662	13.14	0.390	-	0.128 ^b	-
Glenn, C. R., Kleiman, E. M., Coppersmith, D. D., Santee, A. C., Esposito, E. C., Cha, C. B., . . . Auerbach, R. P.	2017	Implicit identification with death predicts change in suicide ideation during psychiatric treatment in adolescents	1	Psychopathology	2	IAT	1	1	276	15.53	0.375	-	0.187	-
Glover, V. (2015)	2015	Assessing the effect of race saliency in measures of children's implicit bias. (PhD Thesis).	1	Social	1	IAT	2	1	81	-	0.428	-	0.300	-
Gollwitzer, M., Banse, R.,	2007	Effectiveness of the Vienna Social Competence Training on explicit and implicit aggression:	1	Aggression	1	IAT	1	1	283	13.00 ^a	0.438	0.060	0.110	0.280

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Eisenbach, K., & Naumann, A.		Evidence from an Aggressiveness-IAT												
Grumm, M., Hein, S., & Fingerle, M.	2011	Predicting aggressive behavior in children with the help of measures of implicit and explicit aggression	1	Aggression	2	IAT	1	1	101	9.70	0.260	0.180	0.277	0.301
Guidetti, M., Cavazza, N., & Graziani, A. R.	2014	Healthy at home, unhealthy outside: Food groups associated with family and friends and the potential impact on attitude and consumption	1	Food and Exercise	2	IAT (Sc)	1	1	128	17.80	0.490	0.024 ^b	0.020 ^b	0.324 ^b
Heiphetz, L., Spelke, E. S., & Banaji, M. R.	2013	Patterns of implicit and explicit attitudes in children and adults: Tests in the domain of religion (Study 5)	1	Social	2	IAT	1	1	24	7.33	0.330	0.337 ^b	-	-
Heiphetz, L., Spelke, E. S., & Banaji, M. R.	2013	Patterns of implicit and explicit attitudes in children and adults: Tests in the domain of religion (Study 2)	1	Social	2	IAT	1	1	24	7.66	0.330	0.109 ^b	-	-
Heiphetz, L., Spelke, E. S., & Banaji, M. R.	2013	Patterns of implicit and explicit attitudes in children and adults: Tests in the domain of religion (Study 4)	1	Social	2	IAT	1	1	17	7.00	0.360	0.027 ^b	-	-
Heiphetz, L., Spelke, E. S., & Banaji, M. R.	2013	Patterns of implicit and explicit attitudes in children and adults: Tests in the domain of religion (Study 3)	1	Social	2	IAT	1	1	35	7.42	0.370	0.211 ^b	-	-
Heyden, K. M., van Atteveldt, N. M., Huizinga, M., & Jolles, J.	2016	Implicit and explicit gender beliefs in spatial ability: Stronger stereotyping in boys than girls	1	Social	2	IAT (Ch)	1	1	237	10.82	1.170	0.141	-	-
Heyder, A., & Kessels, U.	2013	Is school feminine? Implicit gender stereotyping of school as a predictor of academic achievement	0	Self-Concept	1	GNAT	-	-	122	14.45	-	-	-0.098 ^b	-
Hogendoorn, S. M., Vervoort, L., Wolters, L. H., Prins, P. J., de	2012	Perceived control in clinically anxious and non-anxious children indirectly measured with the Implicit Association Procedure	1	Psychopathology	1	IAP	2	2	167	12.35	-	0.270 ^b	-	-

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Haan, E., Hartman, C. A., . . . Boer, F. Hogendoorn, S. M., Wolters, L. H., Vervoort, L., Prins, P. J., Boer, F., & de Haan, E.	2008	An indirect and direct measure of anxiety-related perceived control in children: The implicit association procedure	0	Psychopathology	2	IAP	2	2	33	12.40	-	0.100 ^b	0.432 ^b	0.320
Hughes, J. M., & Bigler, R. S.	2011	Predictors of African American and European American adolescents' endorsement of race-conscious social policies	1	Social	1	IAT (Ch)	2	1	210	15.60	0.470	0.264 ^b	-	-
Kessels, U., Rau, M., & Hannover, B.	2006	What goes well with physics? Measuring and altering the image of science (Study 1)	1	Self-Concept	1	IAT	1	1	66	16.50	0.381	-	0.343	-
Klein, A. M., Kleinherenbrink, A. V., Simons, C., de Gier, E., Klein, S., Allart, E., . . . Rinck, M.	2012	Subjective fear, interference by threat, and fear associations independently predict fear-related behavior in children	1	Psychopathology	1	AAT	2	-	68	10.20	-	0.054 ^b	0.159 ^b	0.620 ^b
Lam, S.-f., Chiu, C.-y., & Lau, I. Y.-m.	2007	What do we learn from the Implicit Association Test about intergroup attitudes in Hong Kong? The case of social identification inclusiveness and need for closure	0	Social	1	IAT	1	1	65	15.50	-	0.140	-	-
Lansu, T. A. M., Cillessen, A. H. N., & Karremans, J. C.	2012	Implicit associations with popularity in early adolescence: An approach-avoidance analysis	1	Social	2	AAT	2	-	241	11.00	-	0.150	-	-
Larsen, H., Kong, G., Becker, D., Cousijn, J., Boendermaker, W., Cavallo, D., . . . Wiers, R.	2014	Implicit motivational processes underlying smoking in American and Dutch adolescents	1	Alcohol and Substance	1	AAT	2	-	125	16.08	-	-	0.045	-
Lawson, J., Banerjee, R., & Field, A. P.	2007	The effects of verbal information on children's fear beliefs about social situations	0	Psychopathology	2	APT	2	-	80	-	-	0.106	-	-

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Lee, M. S., Begun, S., DePrince, A. P., & Chu, A. T.	2016	Acceptability of dating violence and expectations of relationship harm among adolescent girls exposed to intimate partner violence	1	Aggression	1	Priming	1	-	79	16.08	-	0.274	0.050	0.535
Lee, R.	2016	Language ideologies in the secondary school: attitude and identity in bilingual wales. (Ph.D. Thesis)	1	Misc	1	IAT	1	1	118	-	0.467	-	0.192 ^b	-
Leeuwis, F. H., Koot, H. M., Creemers, D. H. M., & van Lier, P. A. C.	2015	Implicit and explicit self-esteem discrepancies, victimization and the development of late childhood internalizing problems	1	Self-Concept	3	IAT (Brief)	1	1	330	11.20	0.650	-0.005 ^b	0.050 ^b	0.535 ^b
Lemmer, G., Gollwitzer, M., & Banse, R.	2015	On the psychometric properties of the aggressiveness-IAT for children and adolescents	1	Aggression	1	IAT	1	1	574	11.61	0.100	0.120	0.182	0.352
li Tian, L., Liu, W., & Gilman, R.	2010	Explicit and implicit school satisfaction	0	Self-Concept	3	IAT (SC)	1	1	124	17.45	0.340	0.064 ^b	-	-
Liu, M., Hu, W., Jiannong, S., & Adey, P.	2010	Gender stereotyping and affective attitudes towards science in Chinese secondary school students	1	Social	1	IAT	1	1	322	15.83		0.112 ^b	-	-
Mahonen, T. A., Jasinskaja-Lahti, I., Liebkind, K., & Finell, E.	2011	Perceived importance of contact revisited: Anticipated consequences of intergroup contact for the ingroup as predictors of the explicit and implicit ethnic attitudes of youth	1	Social	2	IAT (ST)	1	1	93	15.00	0.480	0.040	-	-
McNeill, J	2011	Using resilience building to increase self-esteem and attraction to school in at-risk youth (PhD Thesis)	0	Personality	1	IAT	1	1	14	-	0.607	0.570	0.661 ^b	0.574 ^b
Neto, F., da Conceicao Pinto, M., & Mullet, E.	2016	Can music reduce anti-dark-skin prejudice? A test of a cross-cultural musical education programme	0	Social	1	IAT	1	1	229	11.87	-	0.335 ^b	-	-
Nock, M. K., & Banaji, M. R.	2007	Assessment of self-injurious thoughts using a behavioral test	1	Psychopathology	-	IAT	1	1	89	17.10	0.399	-	0.453	-

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Noel, J. G., & Thomson, N. R.	2012	Children's alcohol cognitions prior to drinking onset: Discrepant patterns from implicit and explicit measures	1	Alcohol and Substance	3	IAT	2	1	183	8.30	0.466	0.086 ^b	-	-
Noles, E. C	2014	What's age got to do with it? Examining how the age of stimulus faces affects children's implicit racial bias (Young Child Sample)	1	Social	1	APT	2	-	32	-	-	-	0.130	-
Noles, E. C.	2014	What's age got to do with it? Examining how the age of stimulus faces affects children's implicit racial bias (Child Sample)	1	Social	1	APT	2	-	33	-	-	-	0.260	-
Noles, E. C.	2014	What's age got to do with it? Examining how the age of stimulus faces affects children's implicit racial bias (Adolescent Sample)	1	Social	1	APT	2	-	32	-	-	-	0.520	-
Nowicki, E. A., & Lopata, J.	2017	Children's implicit and explicit gender stereotypes about mathematics and reading ability	1	Self-Concept	3	IAT (IMAT)	2	2	165	11.30	-	0.014	-	-
Nummenmaa, L., Peets, K., & Salmivalli, C.	2008	Automatic activation of adolescents' peer-relational schemas: Evidence from priming with facial identity	1	Aggression	1	APT	2	-	30	13.00	-	-	0.346	-
O'Connor, R. M., Lopez-Vergara, H. I., & Colde, C. R.	2012	Implicit cognition and substance use: The role of controlled and automatic processes in children	0	Alcohol and Substance	4	IAT (Sc)	2	1	376	11.10	0.287	-	0.065	-
Olson, K. R., Key, A. C., & Eaton, N. R. (2015)	2015	Gender cognition in transgender children	1	Self-Concept	-	IAT	2	2	77	9.00	0.451	0.263 ^b	-	-
Payne, B., K. M. Lee, M. Giletta	2016	Implicit attitudes predict drinking onset in adolescents: Shaping by social norms	1	Alcohol and Substance	2	AMP	2	-	868	13.12	0.460	0.120	0.140 ^b	0.527 ^b
Peeters, M., Wiers, R. W., Monshouwer, K., van de Schoot, R.,	2012	Automatic processes in at-risk adolescents: The role of alcohol-approach tendencies	1	Alcohol and Substance	2	AAT	2	-	374	13.60	0.300	-	0.150	-

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Janssen, T., & Vollebergh, W. A.		and response inhibition in drinking behavior												
Pieters, S., Burk, W. J., Van der Vorst, H., Engels, R. C., & Wiers, R. W.	2014	Impulsive and reflective processes related to alcohol use in young adolescents	1	Alcohol and Substance	1	AAT	2	-	427	13.96	0.710	0.000 ^b	0.030 ^b	0.154 ^b
Pouwels, J., Lansu, T. A., & Cillessen, A. H.	2017	Adolescents' explicit and implicit evaluations of hypothetical and actual peers with different bullying participant roles	1	Social	2	IAT (ST)	2	2	1477	16.38	0.354	0.040 ^b	-	-
Pozzoli, T., Gini, G., & Thornberg, R.	2016	Bullying and defending behavior: The role of explicit and implicit moral cognition	1	Aggression	2	Priming (IAMS)	2	-	279	11.75	0.380	0.115 ^b	0.090 ^b	0.238 ^b
Rae, J. R. and K. R. Olson	2018	Test–retest reliability and predictive validity of the Implicit Association Test in children (Study 5)	1	Self-Concept	2	IAT	2	1	97	7.72	0.337	-	0.640	-
Rae, J. R. and K. R. Olson	2018	Test–retest reliability and predictive validity of the Implicit Association Test in children (Study 4)	1	Self-Concept	2	IAT	2	1	107	7.82	0.375	0.520	0.586 ^b	0.739 ^b
Rae, J. R. and K. R. Olson	2018	Test–retest reliability and predictive validity of the Implicit Association Test in children (Study 2)	1	Social	2	IAT	2	2	107	8.32	0.360	0.310	0.170	0.280
Rae, J. R. and K. R. Olson	2018	Test–retest reliability and predictive validity of the Implicit Association Test in children (Study 3)	1	Self-Concept	2	IAT	2	1	102	8.76	0.386	0.540	0.522 ^b	0.692 ^b
Rae, J. R. and K. R. Olson	2018	Test–retest reliability and predictive validity of the Implicit Association Test in children (Study 1)	1	Social	2	IAT	2	2	106	8.93	0.360	-0.080	0.280	0.250
Rohner, J. C., & Bjorklund, F.	2006	Do self-presentation concerns moderate the relationship between implicit and explicit homonegativity measures? (Study 1)	1	Social	1	IAT	2	1	70	17.89	0.378	0.270	-	-

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Rosen, P. J.	2008	The victim schema model: A longitudinal study of social - cognitive processing, emotional distress, and peer victimization in childhood (PhD Thesis)	1	Self-Concept	1	IAT	1	1	193	10.82	0.690	-	0.130 ^b	-
Rosen, P. J., Milich, R., & Harris, M. J.	2007	Victims of their own cognitions: Implicit social cognitions, emotional distress, and peer victimization	1	Aggression	1	IAT	1	1	83	10.96	0.510	-	0.157 ^b	-
Rutland, A., Cameron, L., Milne, A., & McGeorge, P.	2005	Social norms and self-presentation: Children's implicit and explicit intergroup attitudes (Study 1)	0	Social	3	IAT	2	2	155	10.92	-	0.045 ^b	-	-
Rutland, A., Cameron, L., Milne, A., & McGeorge, P.	2005	Social norms and self-presentation: Children's implicit and explicit intergroup attitudes (Study 2)	0	Social	3	IAT	2	2	134	11.11	-	0.050 ^b	-	-
Salemink, E., van Lier, P., Meeus, W., Raaijmakers, S., & Wiers, R.	2015	Implicit alcohol-relaxation associations in frequently drinking adolescents with high levels of neuroticism	1	Alcohol and Substance	2	IAT (Brief)	1	-	367	17.00	0.453	-	0.113	-
Schmits, E., Maurage, P., Thirion, R., & Quertemont, E.	2014	Dissociation between implicit and explicit expectancies of cannabis use in adolescence	1	Alcohol and Substance	1	IAT (ST)	1	1	130	16.40	0.330	0.018 ^b	0.169 ^b	0.357 ^b
Schreiber, F., Bohn, C., Aderka, I. M., Stangier, U., & Steil, R.	2012	Discrepancies between implicit and explicit self-esteem among adolescents with social anxiety disorder	1	Self-Concept	1	AMP	1	-	40	17.50	-	0.443	-	-
Shepard, D. N.	2009	Assessing implicit and explicit bias toward overweight individuals (Masters Thesis).	0	Food and Exercise	1	IAT	2	1	64	9.88	0.065	0.110	0.141	0.200
Sinclair, S., Dunn, E., & Lowery, B. S.	2005	The relationship between parental racial attitudes and children's implicit prejudice	0	Social	2	IAT (Ch)	2	1	71	10.00 ^a	2.070	0.020	-	-
Solbes, I., & Enesco, I.	2010	Explicit and implicit anti-fat attitudes in children and their relationships with their body images	0	Food and Exercise	2	IAT	2	1	40	6.90	0.300	0.330	-	-

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Suter, M., Pihet, S., de Ridder, J., Zimmermann, G., & Stephan, P.	2014	Implicit attitudes and self-concepts towards transgression and aggression: Differences between male community and offender adolescents, and associations with psychopathic traits	1	Aggression	2	IAT	1	1	36	14.90	0.396	-0.028	-	-
Suter, M., Pihet, S., Zimmermann, G., Urban, S., & Stephan, P.	2017	Predicting daily-life antisocial behaviour in institutionalized adolescents with transgression-related Implicit Association Tests	1	Aggression	1	IAT	1	1	87	14.80	0.871	0.253 ^b	0.139 ^b	0.325 ^b
Thush, C., & Wiers, R. W.	2007	Explicit and implicit alcohol-related cognitions and the prediction of future drinking in adolescents	1	Alcohol and Substance	-	IAT (ST)	-	-	100	-	-	0.106	0.176	0.271
Thush, C., et al.	2007	Apples and oranges? Comparing indirect measures of alcohol-related cognition predicting alcohol use in at-risk adolescents	1	Alcohol and Substance	1	EAST (Unipolar)	1	-	88	16.34	-	0.099 ^b	0.127 ^b	0.378 ^b
Turner, R. N., Hewstone, M., & Voci, A.	2007	Reducing explicit and implicit outgroup prejudice via direct and extended contact: The mediating role of self-disclosure and intergroup anxiety (Study 1)	1	Social	3	IAT	2	2	60	10.00	0.390	0.050	0.240	0.410
Turner, R. N., Hewstone, M., & Voci, A.	2007	Reducing explicit and implicit outgroup prejudice via direct and extended contact: The mediating role of self-disclosure and intergroup anxiety (Study 2)	1	Social	3	IAT	2	2	96	13.30	0.470	0.200	0.105 ^b	0.543 ^b
Turner, R. N., Hewstone, M., & Voci, A.	2007	Reducing explicit and implicit outgroup prejudice via direct and extended contact: The mediating role of self-disclosure and intergroup anxiety (Study 3)	1	Social	3	IAT	2	2	164	13.60	0.440	0.010	0.070 ^b	0.255 ^b

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van Goethem, A. A., Scholte, R. H., & Wiers, R. W.	2010	Explicit and implicit bullying attitudes in relation to bullying behavior	1	Aggression	2	IAT	2	1	240	11.41	0.575	-0.010 ^b	0.043 ^b	0.378 ^b
van Hemel-Ruiter, M. E., de Jong, P. J., & Wiers, R. W.	2011	Appetitive and regulatory processes in young adolescent drinkers	0	Alcohol and Substance	1	AST	2	-	43	15.09	-	0.130	0.295	0.370
Vervoort, L., Wolters, L. H., Hogendoorn, S. M., Prins, P. J., de Haan, E., Nauta, M. H., & Boer, F.	2010	Automatic evaluations in clinically anxious and nonanxious children and adolescents	1	Psychopathology	-	EAST	2	-	38	12.75	-	-	0.307	-
Vezzali, L., Capozza, D., Giovannini, D., & Stathi, S.	2012	Improving implicit and explicit intergroup attitudes using imagined contact: An experimental intervention with elementary school children	0	Social	2	IAT (Ch)	2	1	44	10.42	0.330	0.370	-	-
Vezzali, L., Giovannini, D., & Capozza, D.	2012	Social antecedents of children's implicit prejudice: Direct contact, extended contact, explicit and implicit teachers' prejudice	0	Social	1	IAT	2	1	30	8.25	0.230	-	0.400	-
Williams, A. T.	2012	I like me, I like you not? The development of implicit racial attitudes in childhood (Study 1 Child Sample)	1	Social	1	IAT (Ch)	2	2	54	6.50	0.281	0.300	-	-
Williams, A. T.	2012	I like me, I like you not? The development of implicit racial attitudes in childhood (Study 1 Young Child Sample)	1	Social	1	IAT (Ch)	2	2	37	9.50	0.407	0.050	-	-
Williams, A., Steele, J. R., & Lipman, C.	2016	Assessing children's implicit attitudes using the affect misattribution procedure (Study 3)	1	Self-Concept	1	AMP (Ch)	2	-	84	7.75	-	0.390	-	-
Xu, Nosek, & Greenwald	2017	Psychology data from the ace Implicit Association Test on the project implicit demo website (Adolescent Sample)	0	Social	1	IAT	2	1	449423	-	0.421	0.272	-	-
Xu, Nosek, & Greenwald	2017	Psychology data from the Race Implicit Association Test on the	0	Social	1	IAT	2	1	5679	-	0.435	0.148	-	-

Xu, Nosek, & Greenwald	2017	project implicit demo website (Child Sample)	0	Social	1	IAT	2	1	553	-	0.567	0.133	-	-
		Psychology data from the Race Implicit Association Test on the project implicit demo website (Young Child Sample)												
		How contact shapes implicit and explicit preferences: Attitudes toward Roma children in inclusive and non-inclusive environment (Study 2)												
Zezelj, I., Jaksic, I., & Josic, S.	2015	How contact shapes implicit and explicit preferences: Attitudes toward Roma children in inclusive and non-inclusive environment (Study 1)	1	Social	2	IAT (Ch)	2	1	60	10.40	0.310	0.100	-	-
		How contact shapes implicit and explicit preferences: Attitudes toward Roma children in inclusive and non-inclusive environment (Study 1)												

Note. Study qual. = Study methodological quality score based on the Newcastle Ottawa Scale, coded as 1 = scores at or above the median, higher quality, 2 = scores below the median, lower quality; Pres. Cond. = Presentation condition coded as 1 = implicit first, 2 = explicit or behavior first, 3 = randomised or counterbalanced; Target = Format of target stimulus items from IAT, coded as 1 = word stimuli, 2 = pictorial stimuli; Attribute = Format of attribute stimulus items from IAT, coded as 1 = word stimuli, 2 = pictorial stimuli; IAT (Ch) = Child IAT; IAT (Ps) = Preschool IAT (Cvencek, Greenwald, et al., 2011); ^aMean age estimated from sample characteristics (e.g., school grade); ^bCorrelation averaged within studies; *r*IE = Correlation between implicit and explicit attitude measure; *r*IB = Correlation between implicit and behavioral measure; *r*EB = Correlation between explicit attitude and behavioral measure.