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Age Invariance in Implicit Bias: Alternate Perspectives and their Implications for the Development of Implicit Cognition

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Abstract

Current theories of social cognition assume that implicit bias is influenced by early socialization experiences. To the extent that implicit bias reflects traces of past experiences, implicit biases should form slowly over time and grow with repeated experience. However, most research examining implicit bias in children indicates that levels of bias do not vary across age groups (i.e., age invariance). This article reviews the dominant theoretical interpretation of age invariance in implicit bias and considers alternate interpretations for these findings in light of several methodological and theoretical limitations. Specifically, the available evidence cannot distinguish between the effects of cohort versus development, category versus exemplar, attitude activation versus application, ingroup versus outgroup evaluation, or attitude- versus control-oriented processes. When considered from a developmental perspective, these issues suggest plausible alternative interpretations of age invariance, with important implications for understanding the mechanisms underlying the formation of implicit cognition, and theories of implicit cognition.

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Age Invariance in Implicit Bias: Alternate Perspectives and their Implications for the Development of Implicit Cognition

Many, if not all, current theories of implicit social cognition follow the basic conceptualization of implicit cognition as somehow reflecting "traces of past experiences" (Greenwald & Banaji, 1995, p.5). Building upon this assumption, most theories also assume, either explicitly or tacitly, that early socialization experiences play a crucial role in the formation and development of social cognition (e.g., Devine, 1989). To the extent that implicit bias reflects traces of past experience, it follows that implicit biases should form slowly over time, and grow with repeated experience (e.g., Cunningham, Zelazo, Packer, & van Bavel, 2007; Smith & DeCoster, 2000; Wilson, Lindsay, & Schooler, 2000). However, a small but growing body of research employing implicit measures with children and adolescents has found a different pattern of results: that levels of implicit bias do not vary across age groups (i.e., *age invariance*) and that children's biases appear indistinguishable from adults' biases. The purpose of this article is to review the dominant theoretical interpretation of age invariance in implicit bias and propose alternate interpretations for these findings, all in the service of advancing theory in implicit cognition.

Reviewing the available developmental literature on 'implicit bias' inevitably faces the difficulty of highly divergent theoretical conceptualizations of the implicit construct (e.g., Corneille & Hütter, 2020) and fuzzy criteria for labeling a measure as implicit (e.g., Nosek, 2011). This issue is amplified in the developmental domin because many authors use the term 'implicit' without offering theoretical clarification and the implied meaning has to be derived from their use of the concept and interpretations of measurement outcomes. In our impression, most authors use a hybrid-conceptualization of implicit-as-indirectly-measured and implicit-as-

related-to-automatic processes (Corneille & Hütter, 2020), but often treat automatic as synonymous with unconscious (Cvencek, Greenwald, & Melzhoff, 2011) or 'less conscious' (Baron & Banaji, 2006, Dunhamn, Baron, & Banaji, 2006; Dunheim, Newheiser, Hossain, et al., 2012; Heipetz, Spelke, & Banaji, 2013; Newheiser & Olson, 2012), which we perceive as empirically unsupported simplification. Throughout this paper, we therefore use the term 'implicit' merely in reference to a class of indirect measurements tools that have become associated with this term (i.e., the Implicit Association Test and a variety of sequential priming measures) and the term 'implicit bias' in reference to their behavioral outcomes, such as distribution and/or latency of response to ingroup and outgroup stimuli (De Hower, 2006). Importantly, we do not assume that responses on implicit measures are isomorphic with underlying mental representations nor with underlying mental processes. Moreover, we use the term 'association' in accord with traditional social cognitive theory, but make no strong assumptions about the underlying representational structure of the process(es) that contribute to responses on implicit measures (Amodio, 2019; De Houwer, Van Dessel, & Moran, 2020).

Age Invariance: The Dominant Perspective

The currently available research on implicit bias in children paints a surprisingly consistent picture across different intergroup domains: In the vast majority of studies, young children's response in implicit measures do not differ from older children or adults – at least when measured in children belonging to higher status majority groups. This age invariance has been reported in evaluations of racialized groups (e.g., Baron & Banaji, 2006; Dunham, Baron, & Banaji, 2006; Newheiser & Olson, 2012; Rutland et al., 2005), ethnic groups (e.g., Chas, Betancor, Delgado & Rodríguez-Pérez, 2018; Williams & Steele, 2019), national groups (e.g., Rutland et al., 2005), and religious groups (e.g., Heiphetz, Spelke, & Banaji, 2013). Similarly,

implicit measures of stereotypes reveal age invariance of gender-related stereotypes regarding academic ability (math vs. language; Cvencek, Greenwald, & Meltzoff, 2011; Galdi, Cadinu, & Tomasetto, 2014; Steffens & Jelenec, 2011; Steffens, Jelenec, Noack, 2010) and gendered toy stereotypes (Degner & Dunham, 2020; Meyer & Gelman, 2016, for reviews see Baron, 2015; Dunham, Baron, & Banaji, 2008; Rae & Olson, 2018).

This apparent age invariance is often interpreted as evidence that implicit intergroup attitudes emerge early in young children in a form *indistinguishable from adult attitudes*. Consequently, Dunham, Baron, and Banaji (2008) theorized that implicit intergroup attitudes form as soon as children acquire basic social category knowledge and associated ingroup memberships, and are immediately represented in memory as strong and highly accessible associations that can be automatically activated. This assumption is further supported by minimal group studies with children, in which assignment to novel groups quite immediately leads to responses in implicit measures that indicate ingroup preferences (e.g., Dunham, Baron, & Carey, 2011, Yang & Dunham, 2019).

Alternative Interpretations of Age Invariance

While these findings are without doubt intriguing and highly valuable, we urge caution in over-interpreting evidence of age invariance to reflect the cognitive mechanisms underlying the formation and development of implicit cognition. Below we highlight several issues that challenge the dominant interpretations of age invariance. Specifically, all available evidence for age invariance comes from a single research design -- cross-sectional research -- which limits the conclusions that can be drawn from this evidence. Additionally, almost all evidence of age invariance comes from a single implicit measure, the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998), which implies that we have to consider the IAT-specific method

characteristics when interpreting observed effects: The IAT, as commonly operationalized, cannot distinguish between category- and exemplar-based effects, attitude activation and application, ingroup favoritism and outgroup derogation, or attitude- and control-oriented processes. When considered from a developmental perspective, each of these issues suggest plausible alternative interpretations of age invariance, which have implications not only for our understanding of the mechanisms underlying the formation of intergroup cognition, but our theories of social cognition more broadly. Taking these alternatives seriously could lead to very interesting new insights into the development of intergroup attitudes and underscores the need for more systematic research in the future.

Cross-sectional Versus Longitudinal Evidence

All extant evidence from the use of implicit measures in the developmental domain relies on a cross-sectional approach, which either compares measurement outcomes obtained from children belonging to different age groups or compares children with adults. Interpretation of cross-sectional findings are always limited: Age differences observed in cross-sectional research may not reflect development-related differences but, instead, reflect cohort effects when children of different age groups have been exposed to different (known or unknown) socialization experiences. For example, if a hypothetical study conducted in the USA in the year 2020 compared 6- and 10-year-old children and found that the older children demonstrated less racial bias than the younger children, such a result could reflect developmental processes that take place between the age of six and ten that result in decreased bias, or could reflect different contexts experienced by the older versus younger children at a formative age (e.g., repeated exposure to a Black versus White president at the age of four to six).

A similar confound applies to the evidence of age invariance: Bias scores that do not vary across age groups may either indicate developmental stability or conceal individual countervailing effects. For example, based on individual experiences and learning histories, some children might show developmental increases and others show developmental decreases in intergroup bias. Thus, cross-sectional research alone cannot assess the developmental trajectories of intergroup bias. Strong conclusions about age-invariance require additional data from longitudinal research that demonstrate individual *mean-level stability over time.* From such longitudinal assessments, mean levels of bias, changes in bias, and individual differences in bias change can be modelled and estimated. This, however, is a far from trivial endeavor, because in order to conclude individual stability of a measurement outcome in a within-participants design across time, repeated assessments require (a) established measurement invariance across age groups (e.g., evidence that the IAT measures the same construct in 6-year olds, 10-year olds and adults, see below), (b) establish retest-reliability of the measure (e.g., in adults individual-level outcomes of implicit measures tend to be highly unstable even over short periods of times; Gawronski, Morrison, Phills, & Galdi, 2017, but see Rae & Olson, 2018 for a first demonstration of acceptable IAT re-test reliabilities in children) and (c) control for potential carry-over effects of repeated measurement (e.g., in adults, repeating an IAT over short periods of time can lead to smaller effects; e.g., Lai et al., 2016). It is furthermore challenging to develop a substantiated theoretical rationale at which ages and with which time lags these measurements should occur (see Bigler & Liben 2006) – which, however, also applies to the cross-sectional approach.

The above critiques notwithstanding, apparent age invariance effects repeatedly demonstrated in cross-sectional studies are still informative. For example, age invariance observed on implicit measures stands in stark contrast to age differences observed on explicit

(i.e., self-report) measures of intergroup bias in children. Specifically, explicit intergroup bias tends to peak in middle childhood (5-7 years), followed by a decrease until late childhood (8-10 years; e.g., Raabe & Beelmann, 2011). By analogy, this pattern of results suggests that age-related differences that may affect the development of explicit expressions of intergroup attitudes, such as cognitive maturation (e.g., Aboud, 1988; 2008), age-related shared experiences (such as school transitions), or social identity development and normative peer-orientation (e.g., Nesdale, 2004) may not have the same effects on the effects of intergroup attitudes on implicit measures (but see our discussion about executive functions below). This issue underscores the need for further research into individual and contextual effects that determine the formation and development of the core social group representations that underlie intergroup bias. Ideally, this research should combine cross-sectional and longitudinal approaches to capitalize on the strengths of each approach and investigate the individual trajectories of children across different age cohorts. Such research can shed light on the extent to which evidence of age (in)variance reflects developmental stability or change, social context stability or change, or a combination of both.

IAT Versus Other Implicit Measures

Not only does all evidence in this research domain rely on a single research design, but almost all of it also relies on a single measure: the IAT. A brief look into the published literature identifies at least 50 publications that include child-adapted versions of the IAT to study intergroup cognition, but only a handful of publications that used other implicit measures (e.g., Degner, Gniewosz, Noack, & Wentura, 2007; Degner & Wentura, 2010; Williams & Steele, 2019; see also Banse, Gawronski, Rebetez, Gutt, & Morton, 2010; Dunham, Chen, & Banaji, 2013).

Whereas developmental research using the IAT very consistently reveals age invariance of bias in members of dominant groups (e.g., Baron & Banaji, 2006; Chas, et al., 2018; Cvencek et al., 2011; Dunham et al., 2006; Heiphetz et al., 2013; Newheiser & Olson, 2012; Rutland et al., 2005; Steffens & Jelenec, 2011; Steffens et al., 2010; but see Dunham et al., 2016), significant age differences emerge in the few studies that have used priming measures (i.e., Degner & Wentura, 2010; Williams & Steele, 2019). Notably, both of these studies used a priming measure as well as an IAT, with evidence of age invariance emerging on the IAT but not on the priming measures. At this point, the patterns of the observed age differences are inconsistent across the few available studies, and for the extent to which these inconsistent results can be attributed to the specific intergroup domains, age groups, cultural contexts, or measurement characteristics remains unclear, thus impeding us from drawing firm conclusions. However, the contrasting juxtaposition of age invariances observed in IATs and age differences observed in other measures raises important questions. Why might age invariance be observed on the IAT but not on other measures? In the following sections, we consider a number of measurement characteristics that may be responsible for this difference.

Categorical Versus Exemplar-based Attitude Measurement

Though several IAT variants have been developed over the years (e.g., Karpinski & Steinman, 2006; Meissner & Rothermund, 2013; Nosek, Bar-Anan, Sriram, Axt, & Greenwald, 2014; Teige-Mocigemba, Klauer, & Rothermund, 2008; Wigboldus, Holland, & van Knippenberg, 2005) in addition to the original paradigm introduced by Greenwald et al. (1998), one procedural feature shared across all of them is that stimuli have to be categorized using predetermined category labels. This distinction is important because other implicit measures make no explicit reference to categories, or rely on correspondence between stimuli and

categories (e.g,. Fazio, Jackson, Dunton, & Williams, 1995; Payne, Cheng, Govorun, & Steward, 2005).

The IAT's reliance on categories has been brought up in the context of adult research as a possible explanation for the observed low correspondence between IAT scores and other implicit measures. For example, when categories are made salient and task-relevant in an evaluative priming measure of racial attitudes, priming effects became larger in magnitude and correlated more strongly with the IAT score, relative to when categories are not made salient in the priming measure (Olson & Fazio, 2003). In the context of developmental research, the issue of categorization has additional implications: There may be substantial developmental constraints related to both category acquisition and category application that need to be considered when trying to understand the formation and development of intergroup cognition. For example, Developmental Intergroup Theory (Bigler & Liben, 2007) assumes that during initial category acquisition children create a first mental representation of dominant social categories and their evaluations in society. However, this category acquisition does not necessarily lead to immediate category application, which instead depends on children's general categorization skills (a cognitive skill that undergoes age-related changes) and environmental experiences (such as the number of encounters with category exemplars and the relative importance that certain social categorizations have in their immediate and larger environments). The latter assumption is supported by a series of our own studies on ethnic intergroup attitudes in Europe: Evidence of intergroup bias emerged several years earlier on measures that relied on a forced-choice categorization task versus measures that do not (Degner & Wentura, 2010). This pattern of results supports the notion that category acquisition may be fundamentally different from category application. Thus, cross-sectional evidence of age invariance observed in the IAT may

reflect invariance of the activation of categorical associations, whereas age-related differences may still exist in category application (Dunham & Degner, 2013).

Social cognitive theory has long assumed fundamental differences between category availability, activation, and application as antecedents of intergroup behavior in adults (e.g., Krieglmeyer & Sherman, 2012; Roth, Deutsch, & Sherman, 2018), and it would be beneficial to include this perspective in developmental research in order to understand the developmental antecedents and constraints of category acquisition, activation, and application. Similarly, it would be useful to include this developmental perspective in current adult-focused theorizing, thus enlarging the scope of the available learning theories by considerations of category acquisition and use. For example, the associative-propositional evaluation model (APE; Gawronski & Bodenhausen, 2018) proposes that associative and/or propositional learning processes underlie the formation of mental representations of social groups. Future applications of this model to intergroup bias may include postulations about how these learning processes are related to category-based versus exemplar-based acquisition, activation, and application processes.

Ingroup Favoritism Versus Outgroup Derogation

Most implicit bias measures need to be interpreted relatively, i.e., as reflecting relative. preference for one group versus another. The limitations of relative measurement have been repeatedly stressed in the context of the IAT (e.g., Teige-Mocigemba, Klauer, & Sherman, 2010) as well as in the context of evaluative priming tasks, the AMP, or other task that rely on two or more social groups for measurement (e.g., Wentura & Degner, 2010). In principle, a positive IAT score (or any other relative score) indicates a net preference for the ingroup over the outgroup, but this preference may reflect a variety of underlying evaluations: positive ingroup

and neutral/ambivalent outgroup evaluations, negative outgroup and neutral/ambivalent ingroup evaluations, positive outgroup and stronger positive ingroup evaluations, negative ingroup and stronger negative outgroup evaluations (e.g., Blanton, Jaccard, Gonzales, & Christie, 2006). Similarly, a negative score on a relative implicit measure may indicate preference for the outgroup over the ingroup (e.g., Newheiser & Olsen, 2012), but does not indicate the extent to which this preference reflects outgroup positivity, ingroup negativity, or any combination thereof. And finally, a score that does not differ from zero on a relative implicit measure may reflect equally positive, equally negative, or equally ambivalent evaluations of both groups, or may reflect no attitude at all.

Given the multiple potential interpretations of a relative scores of implicit measures, it is possible that apparently identical (e.g., age invariant) effects may conceal different underlying patterns of evaluations for different individuals or different groups of individuals – such as children and adults. This point is crucial because most developmental theories draw clear conceptual distinctions in the formation of ingroup and outgroup evaluations, assuming a very early onset of ingroup preference (e.g., Aboud, 1988; 2008; Dunham et al., 2011), while negative outgroup attitudes are presumed to form later and in relatively nuanced and context-dependent manners (e.g., Nesdale, 1999; 2001). From this perspective, evidence of age invariance in implicit measures might reflect complementary developmental changes in ingroup and outgroup evaluations, rather than stability. For example, if decreasing ingroup positivity was accompanied by increasing outgroup negativity, a stable IAT effect would be observed, masking fundamental developmental changes.

One way to investigate the contributions of ingroup and outgroup evaluations is to use process modeling approaches, which separately estimate the contributions of multiple processes

to responses on implicit measures. For example, Dunham, Baron, and Banaji (2016) applied process modeling to the responses of children and adults on an IAT configured to measure gender attitudes to estimate the contributions of same-gender and opposite-gender evaluations. They found consistent evidence that children and adults alike demonstrated stronger positive evaluations of their own genders than they did negative evaluations of the opposite gender, suggesting that the IAT scores of both genders reflected more ingroup favoritism than outgroup derogation. That said, the specific patterns of evaluations varied by gender. Both girls and women demonstrated positive female evaluations and (weaker) negative male evaluations. In contrast, both boys and men demonstrated positive male evaluations but no negative female evaluations. Importantly, girls' evaluations did not differ from women's evaluations (i.e., age invariance), but boys' evaluations did differ from men's evaluations. To our knowledge, Dunham et al. (2016) is the only published example of process modeling in the developmental research using implicit measures, and is equivocal on the issue of age invariance in ingroup and outgroup evaluations. Consequently, additional research using process modeling may help to clarify this issue.

Another option to investigate the contributions of ingroup and outgroup evaluations to intergroup bias is to use measures that allows separate estimates of the two constructs. For example, single-target IATs (Steinman & Karpinski, 2006; Wigboldus et al., 2005) assess positive versus negative evaluations of one social category and have been successfully used in research with children and adolescents (Hennessy, Heary, McKeague, Murphy, & O'Driscoll, 2013; Mähönen, Jasinskaja-Lahti, Liebkind, & Finell, 2010). Other measures, such as evaluative priming or the AMP, can provide separate estimates of ingroup and outgroup evaluations when they include control stimuli for base-line computations (Wentura & Degner, 2010)[1]. For

example, Degner and Wentura (2010) separately calculated ingroup and outgroup effects in an evaluative priming measure and their analyses indicated a relatively stable effect of ingroup preferences across age groups but different levels of outgroup evaluation that were increasingly more negative in older children. We view these results as tentative but encouraging -- longitudinal studies would provide stronger evidence -- and discuss them here as an illustration that a more direct operationalization of the group evaluations in question (i.e., own group attitude vs. outgroup attitude) would be especially advantageous in the developmental context (see also Williams & Steele, 2019).

Automaticity Versus Control-oriented Processes

Implicit measures were built on the assumption that the indirect nature of the assessment and characteristics of task procedures (e.g., short/masked stimulus presentation; short response deadlines, etc.) can minimize the extent to which responses are influenced by control-oriented processes that would constrain the expression of attitude-related representations. However, a growing body of evidence indicates that control-oriented processes can also influence responses on implicit measures, which can include basic cognitive control required to following the explicit task instruction (e.g., Ito, Friedman, Bartholow, Correll, Loersch, Altamirano, & Miyake, 2015; Klauer & Mierke, 2005; Klauer, Schmitz, & Teige-Mocigemba, 2010) or higher order motivations or goals (e.g., Monteith, 1993; Moskowitz, Gollwitzer, Wasel, & Schaal, 1999). Consequently, the magnitude of an implicit bias score cannot be interpreted as a direct indication of an attitude or an attitude's strength because responses on implicit measures also reflect the influence of attitude-unrelated processes (Calanchini, Sherman, Klauer, & Lai, 2014; Corneille & Hütter, 2020). Control-oriented processes depend heavily on development: The age of three is typically seen as the beginning of very dynamic changes in executive functions in human

development, but the different cognitive functions increasingly differentiate throughout early and middle childhood, follow neither linear nor parallel developmental pathways (e.g., Carlson, 2010), reach mature levels at differnet periods in late adolescence or even adulthood (e.g., Chevalier & Clark, 2017; McAuley & White, 2011; Prencipe, Kesek, Cohen, Lamm, Lewis, & Zelazo, 2011). Moreover, different implicit measures reflect different types of control: priming tasks are influenced by the ability to pursue task goals in the face of interference (i.e., inhibition or "common executive function"), whereas the IAT is influenced by the ability to flexibly adapt behavior based on changing situational demands (i.e., task switching or "shifting": Ito et al., 2015; Miyake & Friedman, 2012). Consequently, any comparisons between the outcome of any implicit measure of adults and children are necessarily confounded by developmental differences in cognitive control. For example, evidence of age invariance in the IAT might reflect two countervailing age-related differences: children could have weaker attitudes (or lower levels of automatic activations of these attitudes) than adults, but at the same time possess less-developed control abilities such as task-switching or shifting abilities and working memory capacity than adults, which are required to constrain the expression of those attitudes in the IAT (e.g., Ito et al., 2015; Klauer et al., 2010). From this perspective, children's implicit bias scores may be artificially inflated by their weaker cognitive control (see also Gonsalkorale, Sherman, and Klauer; 2014).

In contrast to apparent age invariance in the IAT possibly reflecting countervailing development-related processes, the processes underlying observed age differences in priming tasks (Degner & Wentura, 2010; Williams & Steele, 2019) pose a bit of a puzzle. To be sure, cognitive control also influences responses on priming tasks: For example, participants make more biased responses on the weapons identification task (WIT: Payne, 2001) when their control

abilities are temporarily depleted (Govorun & Payne, 2006) or are generally lower (Ito et al., 2015). While the age-related decreases of bias in priming scores observed by Williams & Stelle (2019) may be potentially confounded with age-related increase in cognitive control, the age-related increases in bias observed by Degner & Wentura (2010) go against the developmental trajectory of maturing executive functions. Clearly, more basic research is needed to understand if and which cognitive control capacities moderate the translation of intergroup attitudes translate into performance biases in different bias measures.

The possibility that age invariance in implicit bias conceals countervailing developmental changes in mental representation and automatic and controlled processes points to fundamental issues when interpreting implicit bias scores in the lense of developmental models of bias formation and application. However, summary statistics such as the IAT *D*-score (Greenwald, Nosek, & Banaji, 2003) or response time difference score in an evaluative priming measure cannot determine the extent to which responses reflect the influence of attitudes versus control-oriented processes.

One approach to deal with this problem is to investigate the extent to which aspects of executive functions impact the magnitude of an implicit bias score. This can be accomplished, in principle, by pairing the implicit bias assessment with additional executive functions tasks and statistically controlling for the influence of executive function on measurement outcomes as has been repetaedly done in adult research (e.g., Klauer et al., 2010; Ito et al., 2015). However, in practice, this approach is limited by the number and complexity of tasks that can be conducted with younger children. Another option to quantify the contributions of attitudes versus control-oriented processes to implicit bias is the use of multinomial processing trees (MPTs: Batchelder & Riefer, 1999). MPTs are based on the assumption that observable responses reflect the joint

contribution of multiple latent cognitive processes, and consist of a system of equations that specify the interplay of processes that produce different responses (for a review of MPTs in social cognition, see Hütter & Klauer, 2016). Indeed, MPTs have been applied to questions of age invariance in implicit measures – mainly on the other end of development. For example, previous research indicates that older and younger adults alike demonstrate pro-young bias on the IAT (e.g., Hummert, Garstka, O'Brien, Greenwald, & Mellott, 2002). Through MPT modeling, Gonsalkorale, Sherman, and Klauer (2014) found that this apparent age invariance in implicit age bias reflected two countervailing effects: Older people have weaker age-related attitude activations than do younger people, and also have weaker control-oriented abilities than do younger people.

The analog between age invariance observed between younger and older adults and age invariance observed between children and adults seems clear. Lack of differences in terms of summary performance statistics like *D*-scores is insufficient evidence to draw conclusions about the qualitative nature of the processes that contribute to performance. For example, Dunham and colleagues (2016) applied process modeling to the responses of children and adults on an IAT configured to measure gender attitudes to estimate the contributions of same-gender and opposite-gender evaluations. Though not of central interest to their hypotheses, they report in supplementary materials that MPT parameters reflecting two forms of control (i.e., accuracy; inhibition) vary with age, such that adults demonstrate stronger control than do children. This example illustrates that process modeling may be well-positioned to move forward hand-in-hand with research on the development of implicit social cognition to partial out development-related differences in control from the construct of interest, i.e., associations.

Attitudes Versus Behaviors

One prominent definition of attitudes as a psychological construct operationalizes attitudes as reflecting a predisposition to respond positively or negatively towards an attitude object (e.g., Eagly & Chaiken, 1993). However, the extent to which implicit attitudes can, or should be expected to, predict behavioral responses, has been hotly debated. Research in adults indicates that outcomes of implicit measures are only weakly and inconsistently associated with intergroup behavior (e.g., Kurdi et al., 2019; Oswald, Mitchell, Blanton, Jaccard, & Tetlock, 2013). Whereas mean levels of implicit bias do not appear to vary across age groups, pronounced differences do emerge between age groups in terms of discriminatory behaviors, with young children being considerably less likely to discriminate between ingroup and outgroup than older children and adults (for a recent overview, see Dunham, 2017).

To our knowledge, correspondence between implicit measures of intergroup bias and behavior has not yet been systematically investigated in children. That said, it is possible that the psychological function of an attitude as an antecedent to behavior differs between age groups. For example, very young children might form mental representations of social groups and their evaluations (e.g., through direct learning, observation, etc.), but it is possible that these representations do not begin to influence behavior until later in development. One reason for such a disconnect between mental representations and behavior may be that behaviors most often measured in children are directed at individuals (e.g., playmate choices, reward allocations), whereas implicit bias is measured in the context of categories (i.e., the IAT). This mismatch often applies to adult research as well. Empirical evidence suggests that children who have a basic evaluative representation of social categories (e.g., race) may nevertheless not be able to accurately apply these categories to individual members (Bigler & Liben, 2006), perhaps because they rely on different visual features for categorization than do adults (Dunham et al.,

2016). Alternately, children may be able to categorize, but do not categorize as frequently, spontaneously and ubiquitously as we presume adults do (e.g., Degner & Wentura, 2010). Thus, if children do not make routinely use of social categories in the course of social interactions, their behavior in these interactions is less likely to be influenced by category-based evaluative or stereotypic associations (see Dunham & Degner, 2013). Given the potential disconnect between representations and actions, social cognitive theorizing would do well to specify the developmental and/or environmental conditions and constraints necessary for that connection to take place.

Personal attitudes versus cultural learning. The issue of correspondence between implicit attitudes and behavior speaks to the related issue of whether implicit attitudes reflect a stable property of the individual versus something that originates from and/or exists outside of the individual. For example, the bias of crowds account (BoC; Payne et al., 2017) suggests that implicit bias may be interpreted as an indicator of concept accessibility that can be a function of the individual (i.e., chronic accessibility) but is thought to be primarily a function of the individual's social context (i.e., situational accessibility). From this perspective, implicit bias should not be conceptualized as a feature of individual minds but, rather, as a feature of the context. Consequently, Payne and colleagues interpret cross-sectional evidence of age invariance as reflecting the shared context in which both children and adults live.

The BoC perspective is based, in part, on the apparent conflict between developmental age invariance and low temporal individual stability of implicit bias measures in adults (e.g., Gawronski et al., 2017), but the BoC has not yet been discussed from a developmental perspective. At first glance, the BoC perspective appears consistent with Devine's (1989) account of automatically-activated bias reflecting mere knowledge, but not necessarily

endorsement, of cultural biases. However, the two perspectives differ considerably in their implications for the development of implicit cognition. Devine (1989) assumed that early exposure to, and repeated activation of, cultural biases leads to biased mental representations that are established early and grow stronger with repeated activation and ultimately become highly accessible associations within the individual mind. From this perspective, implicit bias should increase with age based on frequency of activation. This assumption underpins the typical interpretation of implicit measures as reflecting individual concept accessibility as a direct indicator of individual concept availability (i.e., when the IAT is introduced as a measure of the strength of associations). Following this rationale, observed age invariance would suggest that children have already acquired and over-learned (i.e., automatized) cultural bias by the age of the first measurement (Dunham et al., 2008).

In contrast, the BoC proposes that bias accessibility stems from both inter- and extra-personal sources, such that an individual measurement score cannot be unambiguously interpreted as reflecting either one or the other. Thus, cross-sectional evidence of age invariance implies that cultural biases may be equally accessible in children and adults alike. So far, the BoC account does not discuss potential developmental constraints for situational accessibility of intergroup bias. For example, in order to be influenced by context-dependent cultural biases, children may need to (a) possess at least a rudimentary representation of the culturally relevant social categories (e.g., it seems to be culturally relevant to distinguish girls from boys but not to distinguish people who can or cannot wiggle their ears), (b) be able to distinguish relevant features and categorize individuals as members versus non-members of different categories, and (c) be inclined to spontaneously apply this ability to categorize to encountered individuals. None of these preconditions are trivial and they are all subject to developmental distinctions and

constraints (e.g. Bigler & Liben, 2006). For example, children seem to use different perceptual information for racial categorizations than adults (Dunham, Stepanova, Dotsch, & Todorov, 2014; Dunham, Dotsch, Clark, & Stepanova, 2016). Furthermore, in order for situational accessibility effects to occur, some rudimentary associations between social categories and cultural biases would seem to need to be represented in long-term memory – which, in turn, suggests that some basic level of intra-individual bias availability is required for cultural biases to pass through children's minds. Is there a minimal threshold of availability (in terms of associative strength) required for the situational accessibility effects presumed inn the BoC to occur? By what learning processes is this threshold reached? Are there any developmental constraints on these learning processes? The BoC is certainly a promising account of implicit cognition, but these (and, likely, other) development-related questions must be answered before it can constitute a comprehensive theory. Accordingly, integrating the BoC account with theorizing about the formation and development of automatic intergroup bias (e.g. Devine, 1989; Bigler & Liben, 2006/7; Dunham et al., 2008) appears highly promising and suggests directions for future theorizing and research into the extent to which the formation and development of implicit bias is contingent upon environmental factors, and under which developmental conditions and environmental circumstances implicit bias measures reveal something about the individual versus their context.

Implications, Recommendations, and Future Directions

In this article, we have highlighted a number of challenges to the dominant interpretation of age invariance in implicit bias, which is that ingroup preferences form as soon as children acquire the most basic social category knowledge and associated ingroup memberships, and are immediately represented in memory as strong and highly accessible associations that can be

automatically activated but may remain below children's conscious awareness. At this point in time, we know too little about the developmental trajectories of implicit bias, or about age-related differences in category- versus exemplar-based bias, ingroup versus outgroup evaluation, automatic versus controlled contributions to implicit bias, or the correspondence between implicit bias and behavior. We therefore argue that this dominant perspective on implicit bias should be viewed as one of many possibilities, rather than as a core tenet of social cognitive theory.

That said, the goal of this article is not to discredit the valuable results observed in studies using implicit measures with children. Instead, by raising alternative interpretations and highlighting issues that remain unresolved, our aim is to encourage conceptual improvements in theorizing and research on implicit bias formation. The issues we discuss here stand in the way of better understanding the basic psychological processes and mechanisms underlying the formation and development of intergroup attitudes. A more careful consideration of the specific characteristics of implicit measures and their impacts on the measurement procedure (i.e., small-scale theories; Degner, Wentura, & Rothermund, 2006) will enhance understanding of age invariance in implicit bias, as well as help to develop better theories on implicit cognition in general.

More Validation is Necessary

On a related point, the domain of social cognition would benefit from more systematic validation research, and this issue is especially relevant in the developmental context. Previously, most studies of implicit cognition in children employed variants of implicit measures originally developed in adult research with pragmatic child-friendly adaptations, such as pictorial and auditory stimulus presentations, reduced trial numbers, different timing parameters or response

options, which are reflected in the ch-IAT (e.g., Baron & Banaji, 2006; Cvencek et al., 2011), the ch-AMP (Williams, Steele, & Lipman, 2016) or a child-friendly variant of an evaluative priming procedure (e.g., Degner & Wentura, 2010). However, there is little to no systematic research investigating the equivalence and comparability of these measurement procedures for different age groups. Furthermore, there has been no systematic exploration of the extent to which these procedural changes affect the interpretability of the outcome. To just name one example, the target categories in some studies are represented by pictures of children (e.g., Baron & Banaji, 2006; Williams & Steele, 2019), but others use pictures of adults (e.g., Degner & Wentura, 2010). There is some evidence that adults apply dominant racial attitudes to pictures of children and adults alike (Todd, Thiem, & Neel, 2016), although racial bias may be stronger for adult targets versus child targets (e.g., Thiem, Neel, Simpson, & Todd, 2019). To date, no such evidence exists in developmental research. Consequently, the possibility remains that children's implicit bias reflects entirely different representations, with different behavioral consequences, when the implicit measure consists of pictures of children versus adults. Validation studies need to investigate this.

Similarly, no systematic research exists yet into whether recommended best-practices for data reduction that were developed on adult samples can be validly applied to children's data. For example, reaction-time analyses usually require corrections of outliers to normalize the distribution of response times, which can be achieved through trimming or transformations (e.g., Ratcliff, 1993). However, the extent to which current conventions regarding trimming criteria (e.g., Koppehele-Gossel, Hoffmann, Banse, & Gawrosnki, 2020) or transformations like the D-scoring algorithm, Greenwald et al., 2003) are appropriate for children of different age groups that differ in overall response speed and response latency variance remains an open question (see

also Blanton, Jaccard, & Burrows, 2015). This critique also applies to MPT models, which require validation to determine whether the parameters reflect the same cognitive processes across age groups. To be sure, such systematic research requires time, effort, and resources, which may go unrewarded if the validation evidence supports initial and/or dominant assumptions. However, with changing scientific norms (e.g., pre-registration), hopefully such validation research will be valued for its contribution to a more solid foundation upon which theory can be built.

Conclusion

This article was motivated by a desire to strengthen the theoretical and methodological links between social cognition and developmental research, which would in turn benefit broader theory development on the processes underlying the formation and development of implicit intergroup cognition. Current research does not yet tap the full potential, but increasing the exchange of theoretical and methodological perspectives between social cognition and developmental research, as well as a culture of more active collaboration between subdisciplines, would help to identify essential research questions and the proper methodological approaches to investigate these questions, all in the service of advancing understanding of the development of intergroup attitudes.

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Footnotes

[1] Note that single-group scores in priming measures must be interpreted with caution because they are often tainted by main effects of prime group or target valence. For example, a difference score based on responses to positive vs. negative targets following Black primes cannot be interpreted as pure (i.e., non-relative) index of attitudes towards Black people because there typically are response biases, such as faster responses to positive vs. negative targets, or faster responses with the dominant than the non-dominant hand, etc.