6 The gendered self-concept

How implicit gender stereotypes and attitudes shape self-definition

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Background

> If women are expected to do the same work as men, we must teach them the same things.
>
> Aristotle

As the quote above suggests, the debate over the fundamental similarities and differences between women and men extends at least as far back as Aristotle and underscores the pervasiveness with which the psychological representation of gender as a social category provides a lens through which we perceive others and define ourselves. Across cultures, the development of children's conception of gender is rapid and outpaces their understanding of other locally significant categories including those based on language groups, race, ethnicity, religion, nationality and castes (Bigler & Liben, 2006, 2007; see also, Levy & Killen, 2008; Martin & Ruble, 2004; Martin et al., 2002). Indeed, gender is among the earliest social group distinctions young children make, and soon after children learn to categorize others based on gender, they begin to associate different traits and attitudes with male and female. Once entrenched in long-term memory, these associations can be easily and implicitly activated in the minds of perceivers or targets, acting as an unseen force, pushing and pulling the levers of behaviour to subtly steer men and women to different roles and activities (Croft et al., 2013; Davies et al., 2005; Steele et al., 2002). Existing divisions of behaviour inform developing gender cognitions which then recreate gender differences in behaviour as children develop into adults (Eagly & Steffen, 1984).

The societal costs of persistent gender biases among adults underscore the need to chart its developmental trajectory. Furthermore, advances in social cognition over the past two decades have revealed that implicit associative biases are governed by and thus likely to develop in ways that are distinct from explicit beliefs. The primary goal of the present chapter is to introduce recent evidence from our labs concerning the origins of implicit gender bias in childhood and to demonstrate how data on the developmental trajectory of implicit gender stereotypes and attitudes can inform our theories for the causes and consequences of such biases for a child's developing conception of him or herself. This work will also provide

a novel framework for conceptualizing the development of the implicit associative system and highlight new directions for future research.

The benefits of examining the development of gendered cognition at the implicit level

An expanding body of research on young adults reveals the social and cognitive forces that work in concert to carve deep trenches of gender-typical behaviour that get written into our system of cognitive associations. Research reveals the ways in which gender biases disadvantage women from being selected for certain jobs (e.g. Goldin & Rouse, 2000; Moss-Racusin et al., 2012) and influence how men behave toward women during professional interactions (Logel et al., 2009). Furthermore, when women themselves are simply reminded that these gender stereotypes exist, they can show impaired attentional focus and performance resulting from the added concern that their actions might confirm negative stereotypes about their group (Mrazek et al., 2011; Schmader & Johns, 2003; Schmader et al., 2008; Spencer et al., 1999).

Given that these effects of gender biases occur despite explicitly held values for gender equality (Pew Research, 2010), we argue that the implicit processes at work merit special attention and study. In other words, people have cognitive associations linking gender categories with different traits and attitudes and these *implicit associations* are likely to be learned early, unrelated to explicitly endorsed stereotypes and attitudes, and can be activated automatically in ways that bias perception and behaviour. For example, men with stronger implicit stereotypes about women behave in a more dominant and flirtatious way during a professional interaction with a woman (Logel et al., 2009), and women with a stronger implicit association of men with mathematics exhibit poorer performance in mathematics, even among those who are majoring in mathematics-intensive fields (Nosek et al., 2002). From a developmental perspective, then, it is important to consider when and how the implicit associations that underlie these biases develop and how they shape a child's emerging sense of self-definition. Recently, suitable measures of *implicit* processing in young samples have been developed (Baron & Banaji, 2006, 2009; Cvencek et al., 2011a; Dunham et al., 2008; Newheiser & Olson, 2012; Rutland et al., 2005), providing a unique opportunity to examine the developmental trajectory of unconscious cognitions. Understanding when these associations form will speak directly to pathways by which such cognitions can be changed to establish greater gender equality.

The advent of implicit measures avoids several methodological challenges in examining the development of gender bias in childhood. First, compared with their explicit counterparts, measures of implicit associations are generally less susceptible to self-presentational concerns (Banaji, 2001; Nosek, 2007) and avoid some of the interpretive challenges inherent in testing the cognitions of young children (Baron & Banaji, 2006; Dunham et al., 2008). Although measures of explicit gender beliefs can reveal substantial information, these assessment tools also become increasingly susceptible to social desirability as children grow older and become

more attuned to the cultural norms for expressing egalitarian attitudes, beliefs and behaviour (e.g. Rutland et al., 2005). For example, whereas children in middle childhood express awareness of mathematics–gender stereotypes (Cvencek et al., 2011b), these children often simultaneously deny endorsing these beliefs (see also Schmader et al., 2004, for evidence with adults). However, it is quite possible that older children and adults possess negative gender stereotypes and attitudes, even if they are reluctant to express them to the interviewer because doing so would be socially inappropriate. By contrast, implicit cognitive measures are relatively free from such social desirability concerns.

In addition, the level of processing that underlies implicit social cognition appears to be continuous across development and thus can be examined independently of an individual's stage of cognitive and language development. The same is simply not the case for explicit processes where at earlier stages of development there are added concerns about whether young children have sufficient introspective access to provide reliable verbal report on what might constitute an attitude or stereotype, not to mention concern as to whether explicit reasoning is even available to such young minds. Children's difficulty with introspection coupled with evidence of preverbal processing of gender categories (Bahrick et al., 1998; Quinn et al., 2002) underscores the need to utilize methods that can assess the more automatic thoughts and associations children hold. As such, the focus on implicit processes provides a broader population to examine.

A third and perhaps most important reason for our focus on implicit associations is that they inform our theories of children's developing sense of themselves seen through the lens of gender. Highlighting an important theoretical distinction between self-reportable *explicit* representations and introspectively inaccessible *implicit* representations (Banaji, 2001; Devine, 1989; Gawronski & Bodenhausen, 2006; Greenwald & Banaji, 1995), research with adults has demonstrated that implicitly held gender attitudes and stereotypes can have a profound influence in daily life, uniquely affecting friendship choices, hiring and voting decisions, and jury verdicts (for a review see Greenwald et al., 2009; for additional evidence of the relationship between implicit processes and behaviour see Nock & Banaji, 2007). These data clearly suggest that implicit cognitions shape behaviour in ways that are independent of the effects of explicit attitudes and beliefs, underscoring the need to understand their developmental trajectory. Indeed, efforts to reduce the deleterious consequences of gender bias among adults will likely require revising the implicit associations that take hold of the developing mind. While there is a vibrant debate in the field concerning the representational nature of implicit and explicit constructs (e.g. Blanton & Jaccard, 2006; Gawronski & Bodenhausen, 2006; Karpinski & Hilton, 2001), the outcome of that debate does not directly bear on the importance of understanding the developmental issues raised here.

The data that we introduce in this chapter examines the development of implicit gender stereotypes and attitudes and provides an emerging framework for understanding how implicit cognitions more generally are shaped by cultural and cognitive forces. We will first consider how implicit associations are learned in general. We will then focus specifically on the development of implicit gender

stereotypes about mathematics and science and the development of implicit gender attitudes. We will also examine the ways in which the developing mind may strive to achieve cognitive–affective balance among gender stereotypes and the self-concept (and among gender attitudes and self-esteem). Finally, we will discuss the implications of these findings for theories of the acquisition and development of implicit social cognition more generally, including the timing and method of efforts aimed at *changing* such cognitions.

Theoretical perspectives on the trajectory of implicit associations

The conventional view is that implicit associations are the product of a domain-general computational mechanism that detects patterns of covariation, establishing an implicit association that may be stereotypic (e.g. male = mathematical) or evaluative (e.g. male = good). By virtue of the claim that the learning mechanism is domain-general, it is hypothesized that all associations are learned via the same basic process, regardless of whether they concern stereotypes or attitudes or whether they are in reference to social groups or to non-social categories (Bigler & Liben, 2007; Greenwald & Banaji, 1995). Domain-general associative learning processes can similarly shape associations between the concept gender and children's emerging concept of the self. For example, a child who is praised for learning to count or for demonstrating success with numerical operations might develop an association between the self and numbers/mathematics. Such an association may form directly when one receives praise (linking self with positive performance in the domain of mathematics – '*you are good at mathematics*') as well as from actively noticing one's selective engagement with mathematics activities (e.g. spending more time engaged with mathematics exercises, feeling positive about the self during this engagement, awareness of one's own preference to spend time on mathematics-related activities).

Associations between the self and particular activities (e.g. I can do mathematics) and between the concept gender and those same activities (e.g. girls can do mathematics) can form via independent processes, but they are also importantly linked in one's broader associative network of cognitions. These shared linkages might also influence the magnitude and direction of implicit associations as the developing mind seeks to achieve cognitive balance among associated constructs (Festinger, 1954; Greenwald et al., 2002; Heider, 1946). Within the theoretical framework of balance theory (Heider, 1946), the associations among concepts tend to self-organize on principles of consistency. Thus, if I like John, and John likes Peter, then I will also be inclined to like Peter. Based on Heider's (1946) theory, Greenwald et al. (2002) provided a rigorous statistical approach to test for *balanced identity* among implicit constructs related to the self (Balanced Identity Theory, BIT). The theoretical expectation is that, if a balanced configuration exists among three constructs, any one of the three constructs should be predictable from the multiplicative product of measures of the other two constructs (Greenwald et al., 2002). In other words, when two concepts are associated with the same third concept, the association between those two concepts should strengthen.

Initial evidence of BIT comes from the adult literature. Nosek et al. (2002) showed that among female college students, a balanced configuration of implicit mathematics–gender stereotypes, gender identity and mathematics self-concepts is associated with their negative attitudes towards mathematics and lower performance on the mathematical portion of the Scholastic Aptitude Test. Interestingly, these balanced associations were found even among women majoring in mathematics-intensive fields, pointing to the ways in which these implicit cognitions operate despite more consciously motivated career pursuits. Such findings are informative when found with adults, but only a thorough developmental analysis can reveal whether principles of balance operate across implicit associations (e.g. attitudes, stereotypes and self-identity) from the point of their initial acquisition or whether successful balance among these constructs reflects a major cognitive achievement on the part of the developing child (Cvencek et al., 2011b; Dunham et al., 2007).

With respect to mathematics stereotypes, the idea is that the following set of cognitions forms to create psychological balance: I am female (gender identity), and females in my culture do not do mathematics (a cultural stereotype), then I will not do mathematics (a self-concept). Cvencek et al. (2011b) outlined two ways that cognitions of the self might achieve balance as they are first developing: 1) one's concept of the self with respect to a given domain and given group might shape and inform the development of a broader concept of one's group in that domain, or 2) group stereotypes may be acquired first and subsequently influence mathematics self-concepts for a given domain. The first holds that with a strong gender identity and a given level of self-identification with mathematics (mathematics self-concept), children might generalize/project their own mathematics identification to others of their own gender (mathematics–gender stereotype; for a similar analysis among explicit intergroup attitudes see Patterson et al., 2010). This developmental sequence can be expressed as: Me = Girl; Me ≠ Mathematics; *therefore* Girls ≠ Mathematics.

An alternative proposal is that children who strongly identify with their gender (strong gender identity) are more likely to internalize cultural stereotypes about their gender (mathematics–gender stereotypes), which in turn influences their mathematics self-concepts. Considered from the perspective of girls, this developmental sequence can be expressed as: Me = Girl; Girls ≠ Mathematics; *therefore* Me ≠ Mathematics. Children who do not strongly associate self with either male or female might show weaker development of gender-based self-concepts through either mechanism. Evidence for when each leg of this triangle in children's implicit associative network emerges and how they relate to one another will likely speak to the causal processes that result in implicit self-identification with mathematics and its relationship to associated stereotypes and attitudes. Moreover, an examination of principles of cognitive balance among these concepts in children from an Asian culture, in which collectivist societal norms are more salient than the norms for individual cognitions about the self, may also reveal whether or not cognitive balance is a culturally universal mechanism for developmental change in children's social cognition (Cvencek et al., 2013b). In

the sections that follow, we will present new evidence from our labs supporting the theoretical claim that cognitive balance in the development of children's stereotypes toward and attitudes about gender groups represents an early emerging and perhaps culturally universal accomplishment that shapes the developmental trajectory of such associations by the eighth year of life.

Evidence for the emergence of implicit gender stereotypes and cognitive balance

Studying the interplay among mathematics–gender stereotypes, mathematics self-concepts and mathematics achievement can help shed light on how the culture's prevailing stereotypes about mathematics ability influences children's emerging mathematics self-concepts and performance. A meta-analysis of gender differences in explicit self-views about mathematics reveals that girls rate their mathematics ability lower than boys do across various cultural contexts (Else-Quest et al., 2010), despite young boys and girls exhibiting similar performance on objective measures of mathematics and science abilities. Thus, the sex differences in explicit mathematics self-concepts observed among older children and adults appear to *precede* rather than follow actual differences in mathematics achievement. The implication of such findings is that, once ingrained, these mathematics self-concepts may exert a developmental influence on children's interest and effort, leading to the gender gap in mathematics-intensive fields such as engineering or computer science that is apparent among adults. If girls develop a lower self-concept of their mathematics ability before they actually underperform in mathematics, the implication is that gender stereotypes affect in some way *how* the self-concept in mathematics first forms. While it is possible that an internalization of cultural stereotypes into children's explicit views of themselves might lead to performance differences in mathematics as children grow older, it is also possible that these performance differences are better explained by changes in gendered cognitions at the implicit level.

Bringing current data to bear on these issues, two of our co-authors conducted two studies with 419 elementary-school children in the US and Singapore that tested the presence of implicit stereotypes about gender, mathematics and the self. Each child completed implicit measures of gender self-concept, mathematics–gender stereotype and mathematics self-concept (Cvencek et al., 2011b, 2013b). Implicit associations were measured using a child-friendly version of the Implicit Association Test (IAT, Greenwald et al., 1998) that measures reaction time during a categorization task to provide an index of the relative association strength among select concepts.

Typical IATs pit two concepts against one another (e.g. gender and self) during which participants are asked to rapidly classify words and or images into their respective categories (e.g. male/female and self/other) using two response keys. For the gender self-concept task this involved categorizing words as either self-related (e.g. me, my, I) or other-related (they, them, their) using separate keys. Further, participants were asked to use those same keys to concurrently classify

words as belonging to the category male (e.g. Mike, John, David) or female (e.g. Sarah, Emily, Jen). For half the trials the self-related words and male words shared a single response key (with female and other-related words sharing the second key). For the remaining half of the trials those pairings were reversed such that male and other shared a single response key (while female and self shared the second key). The assumption of this procedure is that the stronger the association among concepts, the faster and more accurate participants should be to categorize them when they share a single response key (e.g. self + male) compared with when they share different response keys (e.g. other + male). For the mathematics self-concept IAT, children were asked to categorize self/other words alongside categorizing words as either mathematics oriented (e.g. numbers, calculator, addition) or reading oriented (e.g. book, literature, library). For the mathematics–gender stereotype IAT, participants were instructed to classify words as either male or female *or* belonging to the category mathematics or reading. The order of these tasks was counterbalanced.

The data show that by eight years of age, children exhibit evidence of implicit gender identity, mathematics-stereotypes and implicit self-beliefs, with boys and girls associating mathematics more with males than females and with boys more strongly associating their concept of self with mathematics than do girls (Cvencek et al., 2011b). In other words, both boys and girls were faster and more accurate in classifying words related to mathematics and words related to male when they shared a single response key. Thus, around the same time that girls begin to exhibit more negative explicit beliefs about their own mathematics ability, they also develop more negative implicit associations of girls with mathematics and a weaker association of self with mathematics, despite no observable differences in performance or ability at this young age. Recent findings demonstrate similar relationships among elementary-school children from Singapore, a country in which girls excel in mathematics (Cvencek et al., 2013b).

This evidence suggests that implicit self-construals, similar to their explicit counterparts, are shaped by the prevailing cultural stereotypes in early childhood. Furthermore, it is noteworthy that mathematics–gender stereotypes were demonstrated in Singaporean culture (Cvencek et al., 2013b), where mathematics performance overall is substantially higher among Singaporean children compared with their American counterparts. In fact, in Else-Quest's cross-national comparison of mathematics performance among 14–16 year old children, boys slightly outperformed girls in the US whereas girls tended to outperform boys in Singapore (Else-Quest et al., 2010). Yet, in spite of these relatively better mathematics outcomes for Singaporean girls, children sampled in our recent study in Singapore exhibited implicit gender stereotypes about gender and mathematics in the same direction as those observed among American youth (mathematics = male), albeit of a somewhat smaller magnitude.

Speaking to issues of cognitive balance among these implicit representations, the results showed that the stronger children identified with their own gender and the stronger they identified their gender with mathematics, then the stronger the association between self and mathematics. Interestingly, the strength of cognitive

balance among implicit associations was positively associated with age, suggesting that balance may represent an important accomplishment of the developing mind. This was true in Western individualist cultures and East Asian collectivist ones alike (Cvencek et al., 2013b), and when coupled with similar evidence of cognitive balance found in other domains (e.g. race, Dunham et al., 2007), supports a broader conclusion that the underlying principles of cognitive balance in children's representations of their social–cognitive world may be culturally universal. Whereas cultures may differ on which stereotypes are prominent, the intrapersonal motivation for cognitive balance may apply regardless of the content of the beliefs.

Development of gender stereotypes can impair performance

In addition to illustrating how the development of implicit stereotypes can affect the development of children's self-concept for mathematics, recent evidence also links these implicit stereotypes to actual performance. For example, although recent meta-analyses do not reveal an overall gender gap in mathematics performance among elementary-school-aged children, this gap is more pronounced in some countries than in others (Else-Quest et al., 2010). Moreover, the variation in the gender gap corresponds to variation in children's implicit mathematics stereotypes. In a cross-national comparison of thirty-four countries, country-level measures of mathematics–gender stereotypes predicted country-level gender gaps in eighth-grade mathematics achievement – stronger societal stereotypes against females doing mathematics were correlated with larger gaps between boys' and girls' actual mathematics performance (Nosek et al., 2009).

The relationship between gender stereotypes and a gender gap in mathematics performance is not only found across cultures; it has also recently been shown to exist within cultures as well, as evident by studies of American and German middle-school children and adults. Steffens and colleagues (2010) found that implicit mathematics–gender stereotypes predicted German adolescent girls' (but not boys') mathematics achievement and enrolment preferences in related disciplines. Nosek et al. (2002) found the same relationship among US college students. Taken together, the findings from samples in the US and Germany all show that culturally shared implicit mathematics–gender stereotypes might play a part in creating gender differences in mathematics achievement and mathematics participation, relationships that emerge early in elementary school.

New insights for understanding mathematics achievement gaps

One avenue for future research is to more clearly isolate the process by which implicit gender stereotypes affect girls' mathematics achievement. Specifically, future research is needed to test at least two possible pathways. On the one hand, applying Eccles' expectancy-value hypothesis (Eccles et al., 1983, 1984), these stereotypes decrease young girls' interest and engagement in mathematics because the stereotypes lower their self-confidence and the value they place

on that domain. For example, Steffens et al. (2010) found that stronger implicit mathematics–gender stereotypes were particularly predictive of lower achievement among low-achieving girls. They speculated that holding a stereotype that 'mathematics is for boys' plays a role in determining the amount of time girls spend studying mathematics. They observed that if a girl holds a strong mathematics–gender stereotype that girls don't do mathematics, then she may feel that it is not needed, culturally expected or even possible for her to excel in mathematics. From this perspective, implicit gender stereotypes decrease girls' motivation and lead them to avoid mathematics-related pursuits.

Alternatively, the awareness of stereotypes that associate mathematics with male more than female sets the stage for children to experience stereotype threat. Stereotype threat occurs when the concern that one might confirm negative stereotypes about oneself or one's group disrupts performance (Steele & Aronson, 1995). For example, in a recent study of middle-school-aged children, girls evaluated themselves less confidently in mathematics than boys did, despite having equal performance (Muzzatti & Agnoli, 2007). However, when these 10-year-old girls were reminded that females are under-represented in mathematics, the performance of the girls dropped precipitously to become lower than that of boys. Other research has also shown that gender stereotypes about mathematics, if activated, have the potential to create a gender gap in performance (Ambady et al., 2001). The adult literature suggests that these performance impairments induced by bringing stereotypes to mind result from an interrelated set of processes including physiological signs of stress, meta-cognitive monitoring of performance, efforts to regulate emotion and problems of attentional control (Schmader et al., 2008). However, an assumption of stereotype threat theory is that these cognitive impairments stemming from a concern about confirming the stereotype are greatest among those most motivated to do well in the domain. It is not yet known whether any or all of these mechanisms reviewed by Schmader et al. (2008) account for performance impairments that young girls experience when gender stereotypes are primed.

Research is needed to adjudicate between these two possible mechanisms by which implicit gender stereotypes may lead to lower mathematics performance among girls. The first implicates motivational variables like avoidance of mathematics-related tasks and activities as contributing to underperformance. The second implicates impairments in cognitive processing that occur when one is particularly motivated to excel in the domain as a means of disconfirming the stereotype. Although research on the gender gap in mathematics performance among young adults has separately examined each of these mechanisms (Diekman et al., 2010; Forbes & Schmader, 2010; Jamieson & Harkins, 2007), no research has tried to parse the separate effects of motivation versus cognitive interference, especially as predicted by implicit associations among children. Developmentally, the fear of confirming a negative stereotype and the cognitive interference it can create may occur relatively early in development. Indeed, children as young as 3 years of age show a tendency to conform to behaviours stereotypical of their gender (Weinraub et al., 1984), and a motivation to disconfirm negative stereotypes may

similarly guide children's behaviours around this period in development. On the other hand, it is not until children are older that they manifest more flexibility in approaching or avoiding mathematics classes and activities. As a result, any motivational differences might not reveal themselves until children experience greater control over their time. The degree to which gender stereotypes shape motivation and induce cognitive interference at younger ages is yet to be examined.

Such research could also explore how manipulating the content of implicit associations uniquely affects these processes. For example, in a series of experiments with undergraduate women, one of our coauthors demonstrated that retraining an implicit association of 'liking' with mathematics led women (but not men) to exert more effort at a mathematics task, especially when gender stereotypes were primed or made salient (Forbes & Schmader, 2010). However, this strengthened tendency to like mathematics did not improve working memory capacity or mathematics performance. Instead, retraining an implicit association of women with mathematics led women to exhibit higher working memory capacity and perform better on a mathematics exam even in the context of stereotype threat cues. Such findings suggest that one's attitude toward a domain might be a stronger predictor of whether one approaches or avoids a task in that domain but that positive stereotypes about your group can specifically shape performance by facilitating more fluid cognition.

Although studies seeking to shape implicit associations have not been done with younger age groups, such data would certainly speak to the causal role that cultural stereotypes about mathematics and gender play in shaping the observed gender differences in performance. We suggest that intervention programmes aimed at targeting such stereotypes before they become engrained might be best aimed at children as young as age six or seven, the earliest ages where evidence of the internalization of cultural stereotypes about gender and ability are observed and prior to the reported developmental increase in strength of cognitive balance among related self-constructs. We return to this general point about changing implicit gendered cognitions later in the chapter.

Evidence for the emergence of implicit gender attitudes

Our recent research demonstrates how the abilities and domains that children come to implicitly associate with males and females might shape their emerging perceptions of the self in or around early childhood. Stepping back we realize that the complex web of gender cognitions extends beyond the relationship between stereotypes and self-definition to include the attitudes, positive and negative, children form toward males and females. In fact, developmentally, gender attitudes emerge prior to gender stereotypes and the awareness of one's own gender identity (Martin et al., 2002). If similar principles of cognitive balance can be applied to the implicit attitudes one develops toward their gender group and themselves, then an examination of implicit gender attitudes could provide an important opportunity to better understand how principles of cognitive–affective balance begin to take hold at even earlier stages of the developing mind. For

example, a child's emerging attitude toward the self might be partly shaped by the pressures of cognitive balance stemming from learned attitude associations with his or her gender group. Just as with the insights gained from research on implicit stereotypes, our research has also recently examined the developmental trajectory of implicit gender attitudes to highlight potential pathways and timing for attitude change.

Before presenting our data on the developmental trajectory of implicit gender attitudes, we first summarize alternative hypotheses one might have about how and when these attitudes develop. We will then show how our developmental data has constrained theory building in this domain. First, it might be expected that boys and girls from a young age will simply exhibit a preference for their own gender group. In two classic experiments, Sherif et al. (1961) and Turner et al. (1979) demonstrated that a mere preference for one's in-group may be an automatic consequence of self-categorization processes – once you categorize yourself in a group and identify with that group label you can't help but feel positivity toward it. There is now a wealth of data showing that children and adults tend to prefer the in-group based on sharing the same race or ethnicity (Aboud, 1988), religion (Heiphetz et al., in press), nationality (Barrett, 2007), or language (Kinzler et al., 2007). Indeed, both children and adults even show preferences for previously unfamiliar social groups to which they have been randomly assigned (e.g. Baron & Dunham, 2013; Bigler et al., 1997; Brewer, 1979; Dunham et al., 2011; Greenwald et al., 2002; Nesdale & Flesser, 2001; Nesdale et al., 2003, 2007; Spielman, 2000). Consistent with these findings, Yee and Brown (1994) report that 2 year olds verbally express an own gender preference on explicit attitude measures; little boys like boys and little girls like girls. As such, it might be predicted that boys and girls will exhibit similar levels of implicit own gender positivity once they attain an awareness of their gender identity and associate the self with that gender group. Provided a child's gender identity doesn't change, this own gender preference should be observed across development.

Another possibility, however, is that at an early age, gender labels do not represent abstract categories of males and females in general but rather map on more directly to a child's most salient male and female exemplars (e.g. mum and dad). If this is the case, then we might expect boys and girls to form positive attitudes toward the gender of their primary caregiver. Indeed, research with infants shows that boys and girls illustrate a preference to look at faces of individuals who are matched in gender to their primary caregiver (Quinn et al., 2002). Thus, children raised primarily by their mother show a preference for female faces and those raised primarily by their father show a preference for male faces. Despite improvements in gender equality in the division of labour at home and in the office, women continue to perform the lion's share of child-rearing duties (Croft et al., 2013) and thus it may be expected that a preference for female will similarly shape the gender attitudes of both boys and girls. As such, a role for maternal attachment implicates early-emerging female positivity in both males and females as positive attitudes toward one's mother generalize to positive attitudes toward women in general.

Of course, a preference for one's in-group and a preference for the gender of one's primary caregiver can both exert some combinatory influence over the development of gender attitudes, albeit differently for boys and girls. For girls, both mechanisms would reinforce a strong own gender preference (female = good). For boys, these two forces should act in opposing directions, provided the primary caregiver is female. In this case it might be expected that boys will exhibit a weaker own gender preference relative to females (male = a little good), a significant but weaker preference for female (female = a little good) or the two effects could cancel each other out producing no clear gender preference. This tension for boys should be evident early in development given preverbal children's sensitivity to the gender of their primary caregiver (Quinn et al., 2002) and the fact that the primary caregiver is more prominent in the life experiences of young children.

At a young age, children's developing concepts of 'male' and 'female' can also be shaped by observations that in books and media, males and females often enact different behaviours or embody differentially valenced roles. For example, Rudman and colleagues (Rudman & Goodwin, 2004; Rudman et al., 2007) highlight a tendency to associate men more than women with violence. Although Rudman and colleagues speculate that children might not develop a fear of male violence until adolescence, when a higher propensity for male violence reaches a peak (United States Department of Health and Human Services, 2001), even quite young children are exposed to the potential threat of males through indirect mediums such as television programming where villains are frequently male (Gerbner et al., 1978; Sternglanz & Serbin, 1974; Tedesco, 1974). The salience of such negative and fear inducing imagery might enable a relatively early but strong association of male = bad. For example, studies have shown that even preschoolers have a tendency to assume that males respond to ambiguous situations with more anger than do females (Parmley & Cunningham, 2008). Such information, whether learned directly or indirectly, might simply exacerbate a tendency among girls to prefer their own gender (female = good and male = bad), while again mitigating, cancelling out or even reversing an own group positivity bias among boys.

New empirical insights into the development of gender attitudes

Thus far we have detailed several alternative hypotheses for the development of implicit gender attitudes, depending on different mechanisms that could be involved. Importantly, while each mechanism supports different predictions about the emergence and ontogenesis of implicit gender attitudes among boys and girls, it is certainly possible that multiple mechanisms operate concurrently or even independently across development. Clearly, developmental data is crucial in adjudicating among these contrasting theoretical positions. We next turn to evidence from our labs on the actual developmental trajectory of implicit gender attitudes to provide new insight into which mechanisms shape these attitudes and when during development that influence is exerted.

The earliest developmental examination of implicit gender attitudes to date focused on 4–5 year olds using the Preschool IAT (PSIAT), a child-friendly

adaptation of the adult IAT (Cvencek et al., 2011a). Here, children were tasked with categorizing images of boys and girls into their respective categories using either a large green or orange response button connected to the computer. Concurrently, children heard (and saw) affectively positive words (e.g. good, nice) and affectively negative words (e.g. bad, mad) and were similarly asked to classify these words into their respective categories (good or bad) using the same two response buttons. Once again, the average reaction time and error rate to categorize male + good (and female + bad) using the same response key was compared with the average reaction time and error rate to categorize female + good (and male + bad) using the same response key. If children exhibit an implicit preference for their own gender group, then they should be faster and more accurate to categorize images of same gender when those pictures are paired with the same response button used to simultaneously categorize positive words.

Turning to the data, we observed that girls exhibited a strikingly strong implicit preference for female over male, whereas boys exhibited a marginally significant preference for their own gender group (Cvencek et al., 2011a). Thus, children generally exhibited evidence of own gender bias, but this bias was significantly stronger for girls than boys. Even if an own group positivity bias influences implicit gender attitudes at this young age, it appears that other factors could be mitigating the strength of the own gender preference among boys. This discovery of a weaker preference among 4-year-old boys toward their own gender group may reflect an internalization of positive attitudes toward the gender of their primary caregiver (who is most often female). It may also reflect an internalization of a male = violent/angry stereotype. One way to tease these possibilities apart is to collect data on children's primary caregiver and to measure children's implicit gender stereotypes about violence and aggression and examine what role these variables play in shaping implicit gender attitudes at this age.

Moving to an examination of gender attitudes among school-aged children with a specific focus on documenting age and gender differences in attitude, we recently measured the implicit gender attitudes among children aged 5–17 (Dunham et al., 2013). This procedure followed a similar IAT design reported in the preschool study above, whereby children were asked to categorize images of boys and girls into their respective categories along with affectively positive and negative words presented acoustically through headphones into the categories *good* and *bad*. We tested nearly 500 children across this age range with an equal distribution of males and females at each age. As such, we achieved much better power at detecting age and gender related differences in the magnitude and direction of these implicit gender cognitions compared with the prior study by Cvencek and colleagues.

The youngest girls in our sample exhibited an implicit pro-female bias and the magnitude of this bias did not change across the age range studied. This is a remarkable degree of stability in own gender bias for girls throughout childhood and adolescence, seemingly uninfluenced by puberty where notions of masculinity and femininity might be expected to change dramatically. This study also found that boys at the youngest ages in the sample reported a significant implicit

own gender preference. This finding provides stronger statistical support for the general conclusion reached by Cvencek et al. (2011a) that males also implicitly evaluate their own gender positively. Moreover, as in Cvencek et al.'s study of preschoolers, the magnitude of this bias was substantially weaker than that shown by their female counterparts. In other words, young girls associated female with good more than young boys associated male with good, even though both showed a significant attitudinal preference for their own gender over the other.

One unique aspect of the Dunham et al. study of implicit attitudes across childhood is the ability to use process dissociation analyses to distinguish between an association of in-group = good and out-group = bad, a distinction that should further disentangle the unique hypotheses raised earlier (Batchelder & Riefer, 1999; Conrey et al., 2005; Sherman et al., 2008). Using these analyses, Dunham and colleagues reveal that a female = good and a male = bad association was observed among girls and the relative strength of each association did not change with age. In contrast, boys only showed evidence of a male = good association that gradually weakens across childhood until no gender preference is observed in or around adolescence. Thus, at no point in development did boys exhibit a female = bad association.

Together, these data are among the first and most convincing to suggest an early emerging role for own group positivity among both boys and girls perhaps in combination with a fear of male violence bias that might model a more negative association with men. Interestingly, our data seem to suggest that girls may learn this male = bad association early on and this association remains stable across development. Among boys, in contrast, their disappearing preference for their own group around puberty hints at the possibility that greater direct exposure to male aggression may help undo this own gender preference. It is also possible that own group positivity bias may operate alongside a maternal attachment bias, thereby increasing positivity toward women. These new findings may explain why males failed to show an out-group = bad association across development. It will be especially important for further research to build off these early findings to evaluate the impact of the male = bad association for males and females at different points during development. Such research could begin to examine the development of implicit gender stereotypes about violence and whether there is evidence of balance among such stereotypes, self-concept and attitudes at some point during development.

Emergence of cognitive balance among gender
attitudes, self-concepts and behaviour

Our recent findings suggest that gender biases emerge by the fifth year of life and are largely stable in magnitude across development, at least for girls. We next consider how these emerging biases toward gender concepts interact with a developing sense of self, given the principles of cognitive balance discussed earlier. Recall, according to BIT (Greenwald et al., 2002), people with *high* self-esteem should display stronger in-group bias. This is because people strive to

maintain consistent attitudes toward the self and toward their in-groups. Thus, developmentally, BIT allows for a) either self-esteem or in-group bias to precede the other in development or b) for both to develop concurrently. Current research provides both the framework, as well as the methodology, that will allow for a much closer empirical investigation of the developmental course of the interrelationship among these implicit constructs.

Cvencek et al. (2013a) examined evidence of balance among implicit gender self-concept, self-esteem and gender attitudes among 5-year-old children. Once again, they employed a modified version of the PSIAT to measure implicit self-concepts and self-esteem with preschool children. They observed theoretically expected principles of affective–cognitive consistency (Greenwald et al., 2002) operating in children as young as 5 years of age, such that children who had positive self-esteem and strong gender self-concepts also displayed greater positivity toward their own gender. These results now contribute to a growing body of research documenting evidence for principles of cognitive balance operating in children as young as 5 years of age (Cvencek et al., 2011b; Dunham et al., 2007). It is interesting to note that balance among these attitudinal constructs occurs a full three years before documented evidence of balance among the implicit gender stereotypes discussed earlier. Such a finding suggests that the failure to detect balance among younger kids in the domain of gender stereotypes is not the result of a cognitive limitation of the mind in establishing balance, but rather those constructs may take longer to form interconnections. Finally, although implicit self-esteem and in-group positivity appear to be present and developing concurrently by age 5, it is possible that one precedes the other during development. Once more, no studies have examined balance among these constructs with younger samples to date, leaving this an area of considerable interest for further research.

Although the relationship among implicit gender attitudes, explicit gender attitudes and observable behaviour has only recently received developmental examination, there is suggestive evidence of balance among these constructs as well. For example, in the study of preschool children's implicit gender attitudes reported above, Cvencek et al. (2011a) examined the relationship between implicit and explicit gender attitudes and children's gendered play activities. Implicit attitudes were measured using a variant of the PSIAT. Explicit attitudes were measured using a forced-choice preference measure where participants had to choose (across several trials) which gender individual they liked more. Finally, to measure gendered play preference, parents were asked to indicate how frequently during the past month their children played with gender typical toys, engaged in stereotypical activities and exhibited gender typical behaviours.

According to Cvencek et al. (2011a) implicit and explicit measures of gender attitudes correlated significantly with one another, such that the more children implicitly preferred their own gender group, the more they reported an explicit preference for people of that gender. Moreover, both measures predicted variance in parents' reports of their children's gendered play activities. Thus, the more children implicitly preferred one gender over the other, the more likely their parent reported that their child engaged in behaviours typical of that preferred gender.

Pointing to the unique role played by implicit processes in predicting behaviour, children's implicit gender attitudes predicted their play preferences over and above the role played by children's explicit attitudes toward gender groups.

Thus, similar to the developmental emergence of implicit gender stereotypes, children's implicit gender attitudes are shown here to emerge early in development – by the fourth or fifth year of life, and are bound, in some part, by principles of cognitive–affective balance from a young age. These findings in the gender domain parallel recent reports on the early emergence and developmental stability of implicit race attitudes (Baron & Banaji, 2006, 2009; Dunham et al., 2008), underscoring potentially broad signatures of how implicit associations form and develop. While there is considerable research to be pursued, some of which we have outlined here, the evidence is building in support of the important role cognitive balance plays in children's emerging network of associations. Such findings, across measures of gender stereotype, attitude, identity and behaviour, highlight the importance of targeting a vast web of constructs from an early age if one wants to affect positive change for the implicit associations that contribute to gender differences in behaviour and well-being more generally.

A roadmap for change: insights from developmental investigations

Sociocultural learning theories stress the importance of the environment in shaping children's beliefs and attitudes toward social groups. Most learning theories are quite broad, emphasizing the general importance of both direct and indirect experiences. The very nature of these learning mechanisms means individuals will sometimes acquire negative attitudes and stereotypic attributes about themselves and their groups. As such, understanding how to change these implicit associations has received considerable attention, focusing on contact with out-group members as well as direct and indirect forms of exposure to counter-stereotypical and counter-attitudinal information (Dovidio & Gaertner, 1999; Dovidio et al., 2002, 2004; Gaertner & Dovidio, 2005; Gaertner et al., 1999; Gregg et al., 2006; Olsson, et al., 2005; Pettigrew & Tropp, 2006; Tropp & Pettigrew, 2005). Unfortunately, much of this work has revealed that while change is possible, it is also surprisingly difficult to achieve. While many studies share this general conclusion, it is worth noting that all of these examinations have exclusively focused on adult samples. However, recent data on the early emergence of implicit stereotypes, attitudes and cognitive–affective balance from our labs and others discussed here highlights the importance of bringing developmental data to bear on understanding the malleability of implicit associations.

Looking forward, developmental analysis will play a crucial role in understanding when across the lifespan implicit associations are most amenable to change and may help shed light on the challenges faced in changing the minds' of adults. For example, several existing theoretical models produce strikingly different predictions concerning the developmental trajectory of implicit intergroup cognition with implications for when such cognitions would be most flexible.

Only developmental evidence will help adjudicate among these alternatives. On one view, intergroup stereotypes and attitudes are acquired slowly, the result of accumulated experience over the lifespan (Bigler & Liben, 2006; Devine, 1989; Greenwald & Banaji, 1995). This view supports the hypothesis a) that change will become increasingly more difficult with age as there will be a longer period of reinforcement to overcome.

A second view, motivated by the literature on executive function development, suggests that with age comes a global increase in the flexibility of children's thought (Aboud, 1988; Bigler & Liben, 2006; Davidson et al., 2006; Jones et al., 2003; Piaget, 1929; Piaget et al., 1971). Accordingly, this view supports the hypothesis b) that efforts to change implicit associations will be more successful later in development (i.e. adolescence) as the capacity to revise earlier thoughts improves. Both hypotheses predict a gradual change in the flexibility of implicit intergroup cognition across development, albeit in opposite directions.

On a third view, implicit associations are particularly influenced by early life experiences, perhaps akin to a sensitive period, whereby first impressions become particularly difficult to modify. Such a view supports the hypothesis c) that the optimal period to affect change occurs in early childhood at the time these associations first take root (Rudman, 2004; Rudman et al., 2007), with no specific predictions about age-related differences in the capacity for change after this period. The converging evidence from our labs on implicit gender stereotype and attitude development that we have summarized here supports the idea of a sensitive period for the development of implicit associations. Specifically, these studies reveal that such associations are learned surprisingly early during development, and that there is very little change in the magnitude of such associations from age 5 onward. These findings not only parallel what has been observed in the domain of race (Baron & Banaji, 2006; Dunham et al., 2008), but they also underscore the generality of our earlier claims that such associations form early and quickly, relatively unaffected by the wealth of learning opportunities that await the developing mind later in childhood and adolescence. Indeed, given the general stability of these implicit associations across development as well as our presented evidence of cognitive–affective balance that only strengthens over time among school-aged children, we believe that a sensitive period of acquisition appears to take place before or around ages 4–5 for gender attitudes and by age 7–8 for gender stereotypes about mathematics and science (at least among Western societies where formal schooling in these disciplines occurs).

One important implication of our speculation of a sensitive period in the formation of these implicit cognitions is that efforts to change an individual's gender stereotypes or attitudes may be most effective by reaching the child at the very point during development when these associations first take root in the mind. Such a claim runs contrary to the current research focus of investigating adult populations. Examining developmental constraints on the malleability of implicit social cognition can focus on changing the content of the cognition (e.g. we should be instilling that girls do science just as well!) and, based on our findings of cognitive balance, might also minimize the strength of association between self and gender

(thereby reducing the likelihood that girls will internalize the stereotype that science isn't for 'me' and that boys will internalize the attitude that 'I' am bad).

One way to approach these questions is to design an experiment with participants who range in age from childhood through adolescence. An initial assessment of an implicit attitude or stereotype should be assessed, followed by a targeted intervention (e.g. direct contact with a counter-attitudinal or stereotypical exemplar such as a female), and then a measure of the implicit association following the intervention period. Age-related differences in how much that initial association changes based on the controlled experience will begin to shed light on the proposals raised earlier.

Other efforts could focus on manipulating the length, quality and type of exposure to counter-attitudinal and stereotypical information. For example, research with young adults has seen some success in predicting weaker implicit gender stereotypes after both short-term and long-term exposure to successful female role models (Stout et al., 2011), but such interventions might be stronger and more long lasting when conducted with young children. One suggestion would be to expose children to early examples of women excelling in mathematics. This could take the form of reading children's books about famous female scholars in the field. Another possibility is to ensure that summer camps and after-school programmes that have mathematics-centred classes for young children have a gender parity requirement. While parents might be subtly influenced by their own gender biases and sign up boys more so than girls for such programmes, the result is that parents' own gender biases reinforce different skills in boys and girls. Another suggestion would be for mothers and fathers to supervise gender atypical courses for their children. Thus, in the case of mathematics and science courses, mums would make more of a concerted effort to review this work with their children while dads focused on other subjects such as reading and writing. This practice would provide children with evidence that counters the prevailing cultural stereotypes. Effects on developing implicit associations of mathematics with gender categories and the self would inform best practices and timing for interventions. Surprisingly, we aren't familiar with any other research focusing exclusively on interventions with young children designed to change implicit gender associations.

Of course, it should also be recognized that our evidence for the stability of implicit gender attitudes and stereotypes from childhood to adulthood does not imply that these associations cannot be changed at later ages. Indeed, while the magnitude of the associations we examined appears fairly stable across development, features of the environment (cultural attitudes and beliefs) are also fairly stable. As such, it is still possible that systematic changes in the cultural messages people receive can lead to changes of various degrees across development in the magnitude of the corresponding implicit associations. Examining this possibility will surely be another important avenue for future research.

Final thoughts on promoting gender equality

In this chapter, we have summarized recent evidence for the early development and ongoing stability of implicit gender biases. We have also argued that an

understanding of how gender associations shape children's developing views of themselves points to the need for early intervention for effective change. The findings presented here with elementary-school children reveal that gender-linked academic stereotypes exert an influence on children's mathematics self-concepts much earlier than previously thought. Intervention programmes aimed at changing the ideas of students about gender and mathematics might profitably be directed at very early stages in development. Specifically, interventions based on implicit measurement techniques can be of particular benefit to elementary-school students: by changing young girls' implicit attitudes, stereotypes and self-concepts about mathematics and science, their performance and interest in these domains might also increase. Importantly, exerting such change does not require students to complete a specific curriculum. Implicit measures can also be used to provide diagnostic information about the prevalence of stereotypic biases among students and the effectiveness of approaches that attempt to mitigate these biases. Implicit measures are easily administered, psychometrically sound and sensitive to individual differences. If the lower mathematics achievement in girls can be partially accounted for by those girls' internalization of the cultural stereotype that mathematics is for boys, a method to measure those stereotypes at an early age will provide a useful tool for teachers in assessing their students and designing appropriate intervention strategies.

The developmental trajectory of implicit gender attitudes reported here also raises concern for children's exposure to another cultural association, the male = violent stereotype. The internalization of this association may be diminishing boys' ability to maintain a positive own group preference and fuelling a male = bad association among females. If this causal relationship is borne out through further research, then new consideration must be given to the content of children's (and adults') television programming, especially given evidence of the interrelationship among implicit constructs such as gender identity, gender attitudes and self-esteem. Indeed, the far reach of implicit gender attitudes, shaping attitudes toward the self and one's gender identity through principles of cognitive balance, underscores the need to address this issue quite early in development (Cvencek et al., 2013a).

Gender identity is a foundational way in which we define ourselves. As a result, the associations with gender categories in a child's environment are learned and internalized quite easily. Efforts at reducing gender bias then needs to focus on how environments shape broader cultural information about gender that becomes imprinted onto the minds' of bodies just a few years removed from nappies. Such a conclusion might only be reached from a careful analysis of the developmental trajectory of these implicit associations. Without such enquiry, the window within which such associations form and are considered most malleable would still be wrongly attributed to a period much later in development. We hope researchers who traditionally study the gender cognitions of adults or who focus only on explicit measures of gendered cognitions will increasingly see the value of developmental enquiry in constraining theories of acquisition and change by examining implicit social cognition starting from very early ages.

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