Failure Feedback and The Transmission of Gendered Beliefs about Ability

Maxine Iannuccilli

A Thesis
In the Department of Psychology

Presented in Partial Fulfillment of the
Requirements For the Degree of
Doctor of Philosophy at
Concordia University
Montreal, Quebec, Canada

August, 2024

CONCORDIA UNIVERSITY
SCHOOL OF GRADUATE STUDIES

This is to certify that the thesis prepared

By: Maxine Iannuccilli

Entitled: Failure Feedback and The Transmission of Gendered Beliefs about Ability

and submitted in partial fulfillment of the requirements for the degree of

Doctor Of Philosophy

complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Signed by the final examining committee:

Rosemary Reily — Chair

Andrei Cimpian — External Examiner

Erin Barker — Arm's Length Examiner

Holly Recchia — Examiner

William Bukowski — Examiner

Kristen Dunfield — Thesis Supervisor (s)

Approved by

Andrey Ryder or Andrew Chapman
Chair of Department or Graduate Program Director

August 8th, 2024
Date of Defence

Dean,

Abstract

Failure Feedback and The Transmission of Gendered Beliefs about Ability

Maxine Iannuccilli, Ph.D.

Concordia University, 2024

The Brilliance Stereotype associates raw, innate high intellectual ability to men, but not women (Leslie et al., 2015). Such gender stereotyped beliefs about intellectual abilities emerge early (by the age of 6, e.g., Bian et al., 2017), extend into adulthood (e.g., Storage et al., 2020) and can have pernicious effects on behaviour (e.g., Bian et al., 2018; Master et al., 2016). Yet, the sources of development of the brilliance stereotype are seldom investigated. The present research explores the feedback children receive from their parents in response to failure as a potential source of gendered information about intellectual ability.

Across two empirical studies, feedback provided by parents to their 5- and 6-year-old children (N_{Study1} = 136; N_{Study2} = 114) was recorded as they made their way through a challenging puzzle activity (Study One and Two) described as being for "really really smart kids" (Study Two). Parental feedback was recorded and categorized using a coding scheme I developed based on previous research (e.g., Haimovitz & Dweck, 2016). Feedback utterances were coded as either person-oriented (fixed messages, e.g., "this is too hard for you"), process-oriented (growth messages, e.g., "you need practice"), or other messages (e.g., instructions, statements, questions, product messages). Moreover, parents' mindsets and gender stereotyping attitudes were examined to assess their influence on the feedback provided and their relation to children's mindsets.

Overall, results from both studies suggest that, in the face of setbacks, parents provide more growth-related messages to boys compared to girls. Specifically, boys received more strategy- and help-focused messages (Study One), as well as more pedagogical questions, product

feedback, and instructions (Study Two). In contrast, girls received less growth-related encouragement in response to failure, which may imply that their efforts are perceived as futile, reinforcing the brilliance stereotype that boys are inherently smarter. Additionally, parents' mindsets were related to their stereotypical beliefs, yet were not predictive of feedback provided nor did they correlate with children's implicit beliefs about ability. The findings provide valuable insights about how messages about intellectual ability are communicated within parent-child dynamics, highlighting the potential role of failure feedback in the development of children's gender stereotypes.

Acknowledgements

I am deeply grateful to all those who have supported and encouraged me throughout my doctoral dissertation journey.

First, I extend my deepest appreciation to my supervisor, Dr. Kristen Dunfield. Your trust and encouragement have been instrumental in my academic journey. Your enthusiasm for my work has been truly motivating, and your support has been invaluable. I am thankful for your mentorship and for believing in my potential.

To my friends, you have played a more significant role in my journey than you may realize. Your friendship, advice, and shared experiences have been a source of strength and inspiration. Thank you for being there through the highs and lows.

My family, your unwavering genuine belief in my abilities has been a cornerstone of my perseverance. Knowing that I can count on your support in all my endeavors has given me the confidence to pursue and achieve this goal.

I would also like to give a shout out to myself. Taking on this challenge, seeing it through, and witnessing my own growth along the way has been a rewarding experience. Just as my research explores the concept of growth mindsets, this journey has reaffirmed the value of embracing challenges and continuous learning in my personal and professional development.

Last but certainly not least, a heartfelt thanks to Bruce for his companionship and unconditional love.

Thank you to everyone who has been a part of this everlasting experience.

Contribution of Authors

Chapter 1: Introduction

I am the primary author of this chapter, with contributions from my supervisor, K.A. Dunfield.

Chapter 2 & 3: The transmission of gendered beliefs about intelligence (Studies 1 & 2)

A version of these chapters combined is being prepared for submission to a journal for publication: Iannuccilli, M., Dunfield, K.A. Failure Feedback and The Transmission of Children's Gendered Beliefs about Intelligence.

I am the primary author of this work including the design of the studies, data collection, data analyses and interpretation. K.A. Dunfield contributed to study design and preparation of the manuscript. Research assistants, Cameron Hines, Sarah Kalaouze, Sabrina Gallant, GardeniaJane Duverger Sorroche, Ephrathah Hagdu, Julianna Bressan, and Radu Urian helped with participant recruitment and data collection. Nicolas Alessandroni helped with planning of data analysis. Both authors contributed to the editing of the manuscript.

Chapter 4: General Discussion

I am the primary author of this chapter, with contributions from my supervisor, K.A. Dunfield.

The research presented in this dissertation was approved by Concordia University's Human Research Ethics Committee under certificate number 30012698.

The Canada Graduate Scholarships (CGS) Doctoral Scholarship awarded to M. Iannuccilli by

The Social Sciences and Humanities Research Council (SSHRC) funded this dissertation. Funds from Concordia University's Social Justice Center as well as a SSHRC IDG awarded to Katharina Nieswandt (PI) further served to support the primary author throughout the creation of this work.

Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction

Despite significant progress in dismantling traditional gender roles over the last decades (see Friedman, 2015; United Nations, 2021; World Bank, 2012) it would be a mistake to think of gender inequities as a relic of the past (Statistics Canada, 2023; World Economic Forum, 2020). Societal biases about gender persist, often manifesting in subtle yet pervasive ways (e.g., attributions of status and value to men over women, Mandalaywala et al., 2020; Roper, 2019; Storage et al., 2020). From an early age, children acquire societal stereotypes perpetuated by our culture, such as the belief that men are inherently intellectually superior to women (Bian et al., 2017), and these stereotypes shape individuals' behaviours, constraining opportunities and reinforcing gender norms (Bian et al., 2018; Maranges et al., 2023a). This dissertation takes a developmental approach to the acquisition of gender stereotypes, with a specific focus on implicit beliefs about intellectual ability, to get at the source of these consequential beliefs. The purpose of this dissertation is to provide insight into the origins of gender disparities related to stereotypes about ability in the aim of working toward informing effective ways of intervening on these beliefs, and ultimately preventing the perpetual transmission of societal gender biases. The theoretical lens guiding this exploration is rooted in socialization processes, elucidating how societal norms and expectations shape individuals' gendered experiences and perceptions. I will present two papers that explore how gendered messages about intellectual ability are transmitted from parents to children. The following introductory chapter will provide an overview of gender stereotypes about intellectual ability – specifically, gendered perceptions of high intellectual ability, i.e., brilliance – and associated societal implications, then elaborate on the social development of mindsets (i.e., implicit beliefs about ability) and how they relate to gendered beliefs about intelligence.

From the outset, it is important to note that sex and gender are not equivalent. Sex relates to one's biological makeup, while gender is a social construct that is associated with an array of norms and expectations (Wood & Eagly, 2002). Neither are dichotomous. Sex exists beyond the typical chromosomal dichotomy (i.e., typically male XY pair and female XX pair). In terms of gender, individuals can identify with a wide variety of expressions along and beyond a continuum (e.g., non-binary, agender, transgender, two-spirit, pangender) (see Hyde et al., 2019). The following work focuses on gender and will mostly employ reference to dichotomous terminology (e.g., men and women, boys and girls). By no means is the intention to downplay or disregard the value of expansive gender identities (see Morgenroth & Ryan, 2021; Rubin et al., 2020), nor undermine the crucial need to continue widening the scope of psychological research on gender. In contrast, the following work names the gender binary in the aim of addressing the very limitations of its boundaries. I aim to better understand the construction of the prominent social categories of gender (i.e., men and women). The dichotomized approach serves to capture the socialized experience of the majority of participants who identify within it, but also speaks to the barriers such a system imposes on the populations that fall beyond it. Indeed, the present work does not focus on individual differences based on gender, but instead examines the environmental and social factors that contribute to such perceived differences, helping to highlight their potential impact on everyone navigating within them.

1.1 Research Problem and Motivation

In general, the ability to categorize is a fundamental aspect of human cognition that serves to manage information and make rapid cognitive assessments (Macrae & Bodenhausen, 2000; Sloutsky & Fisher, 2012). Within social cognition, this ability becomes especially consequential. Social categorization reflects humans' proclivity to organize their social

environment, operating as a cognitive shortcut that allows individuals to efficiently process and interpret a myriad of social stimuli (Rhodes & Baron, 2019). By grouping individuals into categories based on shared characteristics such as gender, race, or age, social categorization enables individuals to streamline interpersonal interactions and decision-making processes by identifying perceived commonalities and differences among people (Gelman & Markman, 1986) – an ability which can be particularly useful in situations where cognitive resources are limited. Beyond its cognitive benefits however, the formation of social categories can give rise to pernicious social outcomes, particularly when said categories are viewed to reflect inherently meaningful, essentialized boundaries between fundamentally different groups of people (Hirschfield, 1996; Gil-White, 2001). Social essentialism exaggerates similarities within social groups and heightens perceived differences between groups (Diesendruck & Menahem, 2015; Miller & Prentice, 1999; Yzerbyt et al., 2001). Unsurprisingly, essentialist thinking about social categories has been consistently associated to stereotyping (Bastian & Haslam, 2006), intergroup bias and prejudice (Leyens et al., 2001; Pehrson et al., 2009). That is, people who view category membership as fixed and immutable are more likely to endorse stereotypes as meaningful truths that are innately determined compared to people who view categories as malleable and dynamic (Levy et al., 1998). Accordingly, such a cognitive mechanism holds profound implications for social attitudes and behaviors, and stresses the weight carried by perceptually significant social cues such as gender.

Gender is one of the most salient, early emerging, social cues in children's environments. Gender structures children's school and home environments (e.g., Maccoby & Jacklin, 1987), influences how adults and peers interact with them (Brown et al., 2020; see also Martin, Fabes, & Hanish, 2014), and is used to inform what characteristics are (stereo)typical of one's own gender (see Martin et al., 2002). Children are highly sensitive to gender cues (Martin & Ruble, 2004),

and readily learn society's categorical definitions of gender through the vast input of gendered information available in their social environment (Bem, 1983). Indeed, early in development, individuals notice and attend to perceptual differences, and use such markers to begin constructing social categories; in infancy, humans are already able to categorize gendered faces (e.g., 3-month-olds show preference for faces that match the gender of their primary caregivers, see Quinn & Macrae, 2011; Quinn et al., 2019). With age, gender garners more meaning as a social category and gender stereotyping becomes more sophisticated (Rogers & Meltzoff, 2017). By mid-childhood, children have amassed a whole array of stereotypical beliefs about gender: gender stereotypes about play for example (e.g., that girls play with dolls and boys play with trucks, see Berenbaum et al., 2008), social roles and occupations (e.g., children perceive women to be better and make more money at feminine-typed jobs (secretary) and men at masculine-typed ones (pilot); Levy et al., 2000), personality traits (e.g., girls are less likely to be viewed as leaders, i.e., being "in charge"; Mandalaywala et al., 2020), and ability (e.g., math is for boys, Cvencek et al., 2011; boys are geniuses, Storage et al., 2020).

In general, stereotypical beliefs about gender have meaningful impacts on behavior and social outcomes. Among others, some of the most well-studied social consequences relate to gender stereotypes in STEM fields (i.e., Science, Technology, Engineering, and Mathematics). Specifically, gendered STEM beliefs influence individuals' interests and motivation toward fields (e.g., the belief that girls do not belong in fields like mathematics and computer science, Master et al., 2016; Muenks et al., 2020) and persistently serve gatekeeping roles (Cheryan et al., 2015). For example, studies assessing children's gender stereotype about math using both implicit (e.g., IAT) and explicit (e.g., self-report questionnaires) tests reveal that elementary school children endorse that math is "not for girls" (Cvencek et al., 2011; Del Río & Strasser, 2013; Muzzatti & Agnoli, 2007; Passolunghi et al., 2014). Math-gender stereotypes accordingly

influence children's self-concepts (Ambady et al., 2001; Cvencek et al., 2011, 2014) and contribute to stereotypically affirming behaviours and attitudes (Ambady et al., 2001; Master et al., 2017; Muzzatti & Agnoli, 2007). Simply activating children's gender identity has been shown to significantly impede girl's math performance or stray them away from math-related challenges or opportunities (Ambady et al., 2001). These disparities in access to opportunity then extend to indirect gatekeeping. That is, children will choose boys over girls as leaders (Mandalaywala et al., 2020) and teammates for "really really smart" games (Bian et al., 2018). Similarly, adults are more likely to recommend men as candidates for positions emphasizing high intellectual ability, and women for jobs requiring hard work (Bian et al., 2018). Such discrepancies reveal the real-world impact of gendered beliefs about intelligence.

1.1.1 Gender Stereotyping Intellectual Ability

The Brilliance stereotype is the belief that brilliance – or high intellectual ability – is more often associated to men than to women (Leslie et al., 2015; Meyer et al., 2015; Storage et al., 2020). Precisely, the belief that innately superior levels of intelligence are more often linked to men (i.e., a male trait), perhaps particularly white men (Jaxon et al., 2019), and that women are simply not as naturally gifted (Tiedemann, 2000; Upson & Friedman, 2012). Embedded in this stereotype is the notion that women *inherently* lack the natural giftedness and intellectual acumen attributed to men. Such a belief in the essential cognitive disparities between genders finds roots in historical contexts and continues to shape contemporary perceptions of intellectual ability.

The brilliance stereotype underlies a gendered narrative about intellectual ability that has permeated culture over centuries. Philosophers like Descartes and Rousseau wrote about the innate differences in intelligence between men and women, reflecting the natural hierarchy of men's superior intellect over women (e.g., Rousseau, 1987). Aristotle and the father of evolution

himself, Charles Darwin contributed to the narrative that the male is naturally intellectually superior, “in whatever he takes up (...) whether requiring deep thought, reason or imagination” than the female (Darwin, 1872; see Saini, 2017). Such cultural sentiments have trickled into contemporary perceptions; one example comes from the former vice-president of Harvard, now sitting board member of OpenAI, Larry Summers’ reference to innate differences in intellectual abilities when asked to comment on the reasons for the problematic university gender gaps in science and engineering (Dillon, 2005). Indeed, the cultural permeation of the brilliance stereotype is evident in various societal institutions and practices. Educational systems as well as media and popular culture continue to perpetuate the rhetoric that men’s intellect is inherently superior to women’s (e.g., Gálvez et al., 2019; Storage et al., 2016). For instance, an analysis of half a century’s worth of Western film content revealed that language reflecting brilliant cognitive ability (e.g., “genius”, “bright”, “clever”) was more often associated to representations of men compared to women (Gálvez et al., 2019). Considering the prevalence of such culturally embedded sentiments, it is unsurprising that the development of the brilliance stereotype has become of interest in the research literature.

Empirical investigations confirm that the *Brilliance-is-Mal*e stereotype continues to pervade lay societal beliefs. Though explicit expressions are less common, implicit attitudes persist. Using adapted versions of Implicit Association Tests (IAT), Storage et al. (2020) demonstrate that both adults and children are more likely to implicitly associate brilliance-related concepts (e.g., genius) to men over women. Their findings reflect beliefs of over 3600 participants spanning seven geographic regions, speaking to the prevalence of the stereotype across age and location. The stereotypical belief shows up in many spheres of children’s lives; parents are more likely to google whether their sons are geniuses (Furnham et al., 2002; Stephens-Davidowitz, 2014), and teachers underrate girls’ intellectual competence compared to

boys' (Gunderson et al., 2012; Robinson-Cimpian et al., 2014). Among the more striking findings, Bian et al. (2017) demonstrate the endorsement of the stereotype in children as young as six. When asked to identify "really really smart" people between representations of girls and boys or men and women, six-year-old girls identified boys and men over members of their own gender as more intellectually brilliant. This belief among children holds despite acknowledging that girls are in fact outperforming boys in school (Bian, 2017; Jaxon et al., 2019). The stereotype not only takes root early, but also intersects with race (e.g., associating brilliance with White but not Black men (vs. White and Black women), Jaxon et al., 2019), and continues to develop into elementary school years (Zhao et al., 2022). Such a growing body of research motivates the need to better understand the development of the brilliance stereotype and its role in perpetuating problematic gender gaps in contexts highlighting intellectual prowess.

1.1.2 Implications for Education, Workplace and Society

Most modern societies today are still far from gender equality. Early learned beliefs about intelligence influence interests and motivation, which in turn can lead to divergent academic and career paths. In childhood, girls begin displaying reduced interest toward brilliance-typed activities in general (e.g., girls are less interested in games described as being for "really really smart kids", Bian et al., 2017), arguably starting to pave a path leading stereotyped groups away from such domains. By high school, girls do not feel like they belong in fields like computer science, resulting in reduced interest for enrolling in STEM courses (e.g., Master et al., 2016). The negative effects of gender typed beliefs about intellectual ability extend into adulthood and continue to undermine women in a variety of domains associated with brilliance (Deiglmayr et al., 2019; Leslie et al., 2015; Maranges et al., 2023b; Meyer et al., 2015). Women are less likely to major or hold university degrees in such fields (NSERC, 2017; Leslie et al., 2015). Maranges and colleagues (2023) investigated the inverse gender gap between philosophy and psychology –

two fields that have much overlap in their history and content, but one (philosophy) is perceived to require brilliance to succeed while the other (psychology) is not. Brilliance beliefs were found to influence undergraduates' choice of major, specifically women who viewed themselves as less brilliant were less likely to major in philosophy (typically perceived to require more brilliance than psychology). Clearly, such early learned stereotypical beliefs about brilliance could ultimately contribute to the persistent gender gaps still observed in society.

The underrepresentation of women in brilliant-typed fields is apparent not only in university degrees obtained, but also in employment. Indeed, the gender gap in science, technology, engineering, and math (STEM) is still strikingly large (Leslie et al., 2015). For example, data from the United States National Science Foundation's 2018 report of women in the STEM-workforce states that women hold only 18% of the occupations in STEM (NSF, 2023). Similar statistics have been reported by the National Sciences and Engineering Research Council (NSERC) of Canada's 2017 analysis of gender distribution in STEM fields based on Statistics Canada survey data. The proportion of women employed across STEM fields reached a mere 20% in 2016 (Meyer et al., 2015; NSERC, 2017). In addition to holding fewer positions in the workforce, women are also getting paid considerably less than their male counterparts (NSERC, 2017), and occupy fewer leadership and decision-making roles (only 20% of seats on boards of directors within corporations and government business enterprises across Canada are held by women, Statistics Canada, 2023). The disparity is only exacerbated when gender's intersection with race is considered (e.g., Black and Indigenous women earn even less than white women for every dollar earned by white men). It is clear that despite progressive social movements emphasizing diversity and inclusion, the representation of women across academic and work fields and in influential positions is still way below men's, and gender parity issues remain a societal concern that deserves our attention and continues to motivate this type of work.

The tangible implications of the brilliance stereotype underscore the importance of better understanding the way children learn to think about intellectual ability. Although research on how children acquire brilliance beliefs is relatively new, existing studies on intelligence beliefs in general provide valuable insights that can inform our understanding in this area.

1.1.3 The Role of Mindsets

Mindsets are implicit beliefs about the instability and malleability of ability. Specifically, mindsets reflect a set of beliefs about whether abilities remain stable or can change over time, and whether said abilities are malleable through exertion of effort (Dweck, 1999, 2006). Mindsets play an influential role in people's goals and achievement-related behaviour and resilience (Aronson et al., 2002; Blackwell et al., 2007; Dweck, 2006; Dweck & Leggett, 1988.; Hong et al., 1999). The following expands on the nature and implications of mindsets and considers them in the context of gender stereotypes.

The degree of one's belief about the stability and malleability of abilities varies along a continuum (Yeager & Dweck, 2020). At one end, growth mindsets refer to the implicit beliefs that abilities are highly adaptable and responsive to effort. Individuals who endorse growth views believe that dedication and persistence can significantly develop one's skill. People who fundamentally understand that ability is flexible and malleable prioritize effort as a valuable tool in their growth (Dweck, 1999), view challenges as informative rather than discouraging (Dweck & Legget, 1988), and in turn are more likely to sustain persistence in the face of setbacks (Lucca et al., 2019; Nussbaum & Dweck, 2008; Yeager et al., 2016). At the other end of this continuum, fixed mindsets reflect implicit beliefs that abilities are rigidly static and unchanging (Dweck, 1999). Individuals who endorse fixed views hold steadfast convictions that we are born with a set level of competence that remains constant throughout life. Moreover, people who believe that ability is fixed view setbacks as revealing a lack of inherent ability or talent rather than an

opportunity for growth, and in turn avoid challenges and give up more easily in the face of obstacles (Dweck & Leggett, 1988; Haimovitz et al., 2011; Snyder et al., 2014). Much of the research literature has focused on mindsets in older children, adolescents, and into adulthood, with a gap in understanding the development of mindsets in early childhood. Results are mixed as to whether young children tend to start off with positive growth views toward change and theoretically develop fixed views in response to environmental ability cues (e.g., school grades and performance assessments) or whether growth views are more likely to develop with age (Muradoglu et al., 2022; Pomerantz & Saxon, 2001).

Between the two extremes (i.e., growth versus fixed), individuals can hold nuanced positions regarding the extent to which any given ability can be developed or remain static. Such variability in mindsets can apply across dimensions (i.e., domains, Malespina et al., 2022; Kalender et al., 2022). That is, individuals' beliefs about stability and malleability can be different for different abilities. For example, individuals can hold differing beliefs about physics than they do about intelligence (Makkonen et al., 2019; Scherr et al., 2017). As such, growth and fixed views can be held simultaneously; people might endorse a growth mindset concerning a particular ability while maintaining a fixed mindset about another (e.g., Scherr et al., 2017). The complexity in endorsement of distinct mindsets not only applies to how one reasons about specific domains or abilities, but also to whether people's beliefs about mindsets apply consistently to all individuals or groups of people universally. In other words, a universal mindset refers to the belief that *everyone* can achieve higher levels of ability, whereas a nonuniversal mindset assigns such potential for growth only to a select few (Rattan, Savani, et al., 2012). Such varying complexities in mindsets are important to consider because they operate in the real world; growth and fixed mindsets profoundly influence people's attitudes towards learning, achievement, and resilience.

Like brilliance beliefs, individuals' mindsets are notably related to motivation and achievement contexts (e.g., Aronson et al., 2002; Blackwell et al., 2007; Haimovitz et al., 2011; Paunesku et al., 2015). Growth mindsets and universal mindsets alike have been empirically linked to various adaptive outcomes; numerous intervention studies demonstrate the beneficial effects of growth beliefs, particularly among negatively stereotyped or underperforming groups (Blackwell et al., 2007; Claro et al., 2016; Good et al., 2003; Lin-Siegler et al., 2016; Paunesku et al., 2015; Rattan et al., 2015; Smith et al., 2013; Yeager et al., 2016; but see, Macnamara & Burgoyne, 2023; Sisk et al., 2018). To illustrate, Blackwell et al. (2007) administered a growth mindset intervention protocol on teenage students and longitudinally monitored students' resulting math motivation and performance. The protocol included lessons on the malleability of intellectual ability in tandem with discussions about the pitfalls of stereotyping. Students' math grades notably increased, and their motivation improved, especially among students who started off with more fixed views of intelligence. Similar effects of growth beliefs have been shown to be especially beneficial for women compared to men (e.g., Degol et al., 2018) and minoritized groups (e.g., Good et al., 2003). Relatedly, universal mindsets foster support for more egalitarian social policies and distribution of resources (Rattan et al., 2012), as well as a stronger sense of belonging for underrepresented groups in STEM (Rattan et al., 2015). As such, we often turn to growth mindsets and often-cited growth mindset interventions (e.g., Blackwell et al., 2007) in attempts to mitigate the pernicious effects of negative stereotyping.

Early evidence holds that while mindsets and brilliance beliefs are linked, they are not the same (Limeri et al., 2023; Maranges et al., 2023a; Muradoglu et al., 2024; Rattan, Savani, et al., 2012). Despite the overlap between outcomes in the context of achievement (e.g., academic goals and performance), a distinct pattern emerges between mindsets and brilliance beliefs

(Limeri et al., 2023). For example, in addition to undergraduates' stereotyped brilliance beliefs, Maranges et al. (2023) also looked at whether students' beliefs about intellectual ability in general influenced their choice of major. Although mindsets did not directly predict major, they did play a role in influencing the likelihood of holding brilliance beliefs. That is, students' who held more fixed views of intelligence in general were more likely to endorse brilliance beliefs, which in turn directly affected choice of major. Such findings echo the link between fixed mindsets and endorsement of stereotypes as meaningful truths (Bastian & Haslam, 2006; Levy et al., 1998). Evidence to date alludes to an intricate relationship between mindsets and beliefs about brilliance, encouraging the investigation of both in tandem in the context of gendered beliefs about intelligence.

1.2 Research Objective & Structure of the Thesis

The present research contributes to our understanding of the development of gender stereotypes regarding intellectual ability alongside broader beliefs about intelligence. Research to date has largely informed how such beliefs relate to one another, yet minimally informs our knowledge about the development of mindsets in early childhood, and even less so that of the brilliance stereotype. The following section engages with our current understanding of how children's gendered beliefs about intellectual abilities are socialized. The present work builds from here in the objective of furthering early efforts to address the sources of the development of said beliefs.

1.2.1 The Development of Children's Implicit Beliefs about Intellectual Ability

Early socialization is thought to shape the development of children's beliefs about ability. As primary agents in children's early environment (Maccoby, 1992), parents play a vital role in the transmission of children's mindsets (e.g., Haimovitz & Dweck, 2016; Tiedemann, 2000). Past

investigations of the transmission of mindsets have largely focused on praise as a potential source of information about the nature of intellectual ability. Person praise focuses on the inherent qualities or attributes the person possesses (e.g., “you are so smart”). In contrast, process praise emphasizes the process of learning, growing, and improving skills and abilities rather than innate qualities (e.g., “you worked so hard”). Years of research has established that praising children’s innate intelligence tends to foster helpless responses to challenges in line with fixed mindsets, while praising effort or strategies encourages mastery-oriented approaches to difficulty which align with growth beliefs (Gunderson et al., 2013, 2018; Kamins & Dweck, 1999.; Mueller & Dweck, 1998). For example, college students who received process praise after working on a given task reported higher intrinsic motivation and perceived competence after a subsequent failure situation compared to students who had received person praise (Haimovitz & Corpus, 2011). Based on such findings, it was assumed that adults inevitably transmit their implicit growth or fixed beliefs to children through praise.

Yet, research shows little to no correlation between adults' mindsets and those of the children they influence (Gunderson et al., 2013; Haimovitz & Dweck, 2016; Park et al., 2016). Many parents and teachers who endorse a growth mindset do not effectively pass it on to children because adults’ visible actions are not necessarily in line with their abstract beliefs about ability. In other words, parents with growth mindsets about intelligence are not necessarily more likely to provide process praise (e.g., Gunderson et al., 2013). Accordingly, parents’ mindsets are not correlated with their children’s mindsets; children of parents with growth mindsets do not necessarily hold growth beliefs themselves (Dweck, 2017; Haimovitz & Dweck, 2016). Instead, the way adults respond to failure provides much more concrete information about their beliefs about intellectual ability. Haimovitz and Dweck (2016) manipulated parents’ implicit beliefs about failure and then asked parents to provide hypothetical feedback in response to an imagined

situation in which their children failed a math test. That is, parents were either exposed to messages about failure as debilitating or enhancing: describing failure as an obstacle versus an opportunity for learning. The parents who held debilitating views of failure were more likely to respond to their children's hypothetical setbacks with person-oriented (i.e., fixed) messages emphasizing performance, e.g., "my child is just not that good at math". Parents' enhancing views of failure, on the other hand, were linked to more process-oriented (i.e., growth) responses that focused on learning, e.g., "the important thing we need to do is try to understand the concepts behind the problems" (Haimovitz & Dweck, 2016). In turn, children's resulting mindsets about intelligence were in line with their parents' failure beliefs – suggesting that the messages children hear in response to failure might be more influential in the development of their own beliefs about ability than the messages they receive in response to their successes.

It is important however to note the hypothetical nature of these studies and the associated limitations. Parenting is multifaceted and children are likely getting a variety of feedback messages (e.g., Leonard et al., 2021; Zentall & Morris, 2010). This leads us to posit that what parents report they *would* say to their children in response to failure (e.g., "I'd encourage my child to tell me what she learned from doing poorly on the quiz", Haimovitz & Dweck, 2016) does not reflect the reality of common parenting practices. For example, in one study examining the type of praise parents use in naturalistic settings (recorded at home during routine daily activities), Gunderson et al. (2013) report that utterances like "good job" were used far more often than the more eloquent exemplars of process praise often reported in experimental studies (e.g., "it is ok to make mistakes and fail sometimes, because that's how people learn", Haimovitz & Dweck, 2016). Plus, a considerable bulk of the feedback children receive in the face of challenges are not as clearly categorizable as either person versus process, but rather composed of an assortment of messages to consider (e.g., statements about the challenge itself, "this is

hard"; see also Leonard et al., 2021). Further, children may be getting a mixed bag of messages (e.g., an inconsistent mix of person and process feedback), which can potentially have different effects on the development of children's own beliefs and behaviour. In a study looking at praise, inconsistency in types of praise received (e.g., "good job, you're so smart", i.e., simultaneously emphasizing both the process that is external to oneself (the job in this example) and praising an internal trait of the person (one's smartness here) led to differential effects on children's persistence and perceptions of self-competence (Zentall & Morris, 2010): for example, even a minimal amount of process praise amidst mostly person-oriented messages may be enough to encourage positive self-evaluations. In consideration of the potential gaps between parents' responses to failure in hypothetical versus real-world contexts, the present research fulfills a need to explore the actual messages about intellectual ability parents provide to their children in response to familiar failure situations and how such messages interact with gender.

It is essential to recognize that parental socialization does not occur in a vacuum but operates within the broader cultural context. Gender stereotypes about ability are deeply ingrained in society (Bem, 1983) and influence the way parents interact with their children (e.g., Crowley et al., 2001; Furnham et al., 2002; Tenenbaum & Leaper, 2003; Tiedemann, 2000). For instance, parents underestimate their daughters' science-related competence compared to their sons (e.g., Frome & Eccles, 1998); even despite the lack of a difference between girls' and boys' performance in physics, parents had lower expectations for their daughters' interest and ability and relatedly used more "teaching talk" (e.g., causal explanations, conceptual questions, scientific vocabulary) in interactions with their sons compared to their daughters around physics (Tenenbaum & Leaper, 2003). Hence, while research on the developmental socialization of the brilliance stereotype is in its infancy, we can reasonably expect there to be a difference between the messages girls and boys hear about intellectual ability.

People will intuitively explain behaviours that match stereotypes (e.g., boys who are good at math) as inherently determined, and explain away stereotypically inconsistent behaviours (e.g., girls excelling at math) as externally driven (Hammond & Cimpian, 2017; Kiefer & Shih, 2006; Robinson-Cimpian et al., 2014; Yee & Eccles, 1988). As such, parents may inadvertently reinforce gendered beliefs about intelligence by praising boys for their stereotypically innate brilliance while attributing girls' successes to their effort or hard work (Chestnut et al., 2021; Chestnut & Markman, 2018; Dweck et al., 1978; Elmore & Luna-Lucero, 2017; Vial & Cimpian, 2020; Yee & Eccles, 1988). Such differential evaluative feedback can play a role in shaping children's beliefs about intellectual ability and foster the development of related gender stereotypes. Here, I aim to characterize failure feedback in a familiar parent-child setting to explore whether children's gender influences the type of feedback parents provide.

1.2.2 Overview of the Chapters

The present work aims to further our understanding of the intersection between parental socialization, children's mindsets, and gender stereotypes about ability. Investigating the actual messages children are receiving about ability can provide valuable insights into the mechanisms through which socialization influences the development of children's mindsets and their susceptibility to gender stereotypes.

Following this introduction, the thesis unfolds in three chapters, consisting of two main empirical studies presented in manuscript style followed by an overall discussion. Study One (Chapter Two) presents an initial exploration of whether the feedback parents provide to their five- and six-year-old children in the face of challenging tasks differs based on children's gender. To this end, I observed the amount of person-oriented versus process-oriented messages about intellectual ability children received from their parents in response to failure as children attempted a series of difficult puzzles. Research highlighting the early onset of gendered beliefs

about ability provide compelling grounds to speculate that children might receive disparate messages about ability at a young age based on their gender. Moreover, in addition to examining parents' feedback messages, the study investigates the relationship between parents' intelligence and failure mindsets, as well as explores parents' gender role attitudes and explicit gender stereotyping.

Study Two (Chapter Three) builds upon the methodology employed in Study One, further probing the trending pattern of parent's gendered failure feedback messages provided to children in a context emphasizing high intellectual ability. Specifically, Study Two explicitly emphasizes intellectual brilliance as a requirement for success in the challenging puzzle activity, given that negative beliefs about intellectual ability and their behavioral consequences tend to emerge in such brilliance-typed situations. The study additionally seeks to nuance the assessment of parents' mindsets, plus measures children's own implicit beliefs about ability.

A review of the relevant literature specific to each study will be included in the subsequent chapters as well as the according methodology, respective results, and discussion of the findings. The final chapter concludes with implications for theory and practice, covers certain limitations of the work, and invites avenues for future research.

Chapter 2: Study One

2.1 Introduction

The following chapter delves into the brilliance stereotype and draws parallel insights from the research literature on the development of children's implicit beliefs about intellectual ability (i.e., mindsets). Study One is my first attempt at exploring the messages children receive from their parents about intellectual ability in response to failure.

2.1.1 The Brilliance Stereotype

The Brilliance Stereotype associates brilliance with men (Leslie et al., 2015; Meyer et al., 2015; Storage et al., 2020). That is, we have a commonly held belief that high-level cognitive abilities such as brilliance, genius, and giftedness are stereotypical characteristics of men (Meyer et al., 2015; Upson & Friedman, 2012). Over 3600 participants across seven geographic regions completed an implicit association test (IAT) assessing people's beliefs about gender and intelligence. Overall, people associate raw, innate, superior intelligence (i.e., brilliance) to men; adults are more likely to believe that men are more brilliant than women and so do 9- and 10year-old children (Storage et al., 2020). Further, when you ask children who they believe is "really really smart" between girls and boys or men and women, six-year-olds are already less likely to believe that girls in general are brilliant – despite acknowledging that girls are in fact outperforming boys in school (Bian et al., 2017; Jaxon et al., 2019). Not only is the stereotype acquired early, but the strength of the implicit gendered belief likely increases with age throughout elementary school years (Zhao et al., 2022).

Such early learned stereotypes reveal considerable obstacles for children that could significantly deter or deprive them from valuable opportunities (Boston & Cimpian, 2018;

Storage et al., 2016). In line with their personal beliefs about gendered intelligence, six-year-old girls start to avoid games that are for "really really smart" children (versus games for children who "try really really hard") (Bian, 2017). By elementary school, girls show reduced interest toward areas that are believed to require high intellectual ability (e.g., computer science and engineering; Master et al., 2016, 2021). Based solely on gender, teachers are less likely to refer girls for gifted programs (Bianco et al., 2011). In parent-child interactions about science, parents are less likely to use intellectually challenging language with their daughters compared to their sons (Tenenbaum & Leaper, 2003). Among peers, when children are asked to choose teammates for a novel game that is "for children who are really really smart", they are less likely to choose girls compared to boys. Unsurprisingly, adults make similar decisions in parallel contexts: when asked to provide recommendations for an ideal job candidate emphasizing high natural intellectual ability and superior reasoning (vs. motivation and hard work), participants are much less likely to recommend women (Bian et al., 2018; Moss-Racusin et al., 2012). Relatedly, fewer women make up the members of fields that are perceived as requiring brilliance for success (e.g., STEM, Leslie et al., 2015; philosophy, Maranges et al., 2023). Such findings highlight some of the ways in which gender stereotyped beliefs about intelligence influence problematic societal gender gaps that continue to persist.

Evidenced consequences of gendered beliefs about intellectual abilities highlight the importance of understanding the developmental sources of such beliefs. Research on children's acquisition of the brilliance stereotype is in its infancy, yet we can gain valuable insights from extensive research on the development of beliefs about intelligence more generally.

2.1.2 Intelligence Mindsets

Implicit theories of intelligence – or intelligence mindsets – refer to one's personal beliefs about intellectual abilities. That is, beliefs as to whether intellectual abilities are stable and

inherent (fixed mindsets), or malleable and a function of effort (growth mindsets) (Dweck, 2006). Individuals differ in their implicit theories; people who hold fixed mindsets believe that we are born with a given level of ability (e.g., intelligence) and cannot do much to change it, whereas people who hold growth mindsets endorse the belief that no matter the amount of intelligence, anyone can work toward developing, or growing their ability (Dweck, 1999, 2006). Fixed mindsets portray ability as a reflection of the person, while growth mindsets depict ability as the outcome of a process. Whether gender differences exist in mindsets remains unclear; the literature is not only mixed on whether a gender difference exists or not (Tucker-Drob et al., 2016; Yan et al., 2014), but also on its hypothesized direction. Certain *theoretical* accounts hypothesize that women are more likely to hold fixed mindsets (e.g., Dweck, 2007; Nix et al., 2015), while *empirical* findings suggest the opposite pattern to be true; that women are more likely to hold growth mindsets compared to men (e.g., Macnamara & Rupani, 2017). Despite the mixed evidence on gender differences in mindsets, findings for the behavioural consequences associated with mindsets are rather consistent, and such consequences vary by gender.

Intelligence mindsets play an important role in many aspects of development including achievement (Aronson et al., 2002; Blackwell et al., 2007), motivation (Haimovitz et al., 2011), perseverance (Paunesku et al., 2015), and self-worth (Kamins & Dweck, 1999). Growth mindset interventions have been demonstrated as particularly beneficial for stereotyped groups (e.g., Degol et al., 2018; Good et al., 2012), low performing groups (e.g., Lin-Siegler et al., 2016; Paunesku et al., 2015; Porter et al., 2022), and for individuals who start off with stronger fixed beliefs about ability (Blackwell et al., 2007). For example, teaching students about the malleability of intelligence led to improved math and reading scores overall, but most notable was the increase in math scores among girls (Good et al., 2003). Inversely, fixed messages about ability can be especially detrimental for stereotyped groups, related to women being less likely to

major in fields that emphasize brilliance (e.g., philosophy, Maranges et al., 2023), and demonstrate more self-handicapping behaviour (e.g., Snyder et al., 2014) in such contexts. Findings of the like highlight the reason growth mindsets are often proposed as viable strategies for inoculating against negative gender stereotypes about ability.

The underlying rationale for growth mindset interventions is to inform beliefs about intelligence as a skill that is malleable. The well-intended aim of such interventions is to motivate individuals by emphasizing learning and development, valuing improvement, and providing opportunities and resources for growth (Yeager & Dweck, 2020). The research focus is often placed on negatively stereotyped or underperforming groups (e.g., Blackwell et al., 2007; Degol et al., 2018; Good et al., 2012; Yeager et al., 2016). However, children do not develop in a vacuum and the context in which beliefs about intelligence are being transmitted matters (Vygotsky & Cole, 1978). Conveying the message that intellectual abilities develop with effort to certain groups while maintaining the rhetoric that intelligence is natural with other groups perpetuates the belief that "trying hard isn't natural" (Amemiya & Wang, 2018; Boston & Cimpian, 2018; Smith et al., 2013). For example, parents and educators are more likely to attribute and praise girls' successes to effort and boys' to innate genius (e.g., Tiedemann, 2000; Yee & Eccles, 1988), which inadvertently communicates that boys are the naturally superior intellectual group and reinforces the idea that girls need to invest the effort to be *just as smart* as boys (e.g., Boston & Cimpian, 2018; Chestnut et al., 2021; Chestnut & Markman, 2018; Robinson-Cimpian et al., 2014). Language holds much power in communicating beliefs about the nature of intellectual abilities (Lucca et al., 2019; Rhodes & Baron, 2019; Tsay & Banaji, 2011), and influences related attitudes, motivation, and interests (Cimpian et al., 2007; Lei et al., 2019).

2.1.3 Socialization of Intelligence Mindsets

Early socialization is thought to shape the development of children's beliefs about ability. As primary agents in children's early environment (Maccoby, 1992), parents play a vital role in the construction of children's mindsets (e.g., Haimovitz & Dweck, 2016; Tiedemann, 2000). While it has long been believed that children inevitably develop beliefs about intelligence endorsed by their parents, it turns out that such beliefs are not so obvious to children without direct instruction. Indeed, many parents with a growth mindset are not passing it along to their children (Haimovitz & Dweck, 2017), and many students of teachers with growth mindsets are not developing similar growth beliefs (Park et al., 2016; Sun, 2019). The exception is found among children who receive (explicit) growth feedback and opportunities to revise their own mistakes (Boaler et al., 2021; Sun, 2015).

In contrast, adults' responses to *failure* provide much more visible cues and relevant information about abilities. Parents who implicitly believe failure is debilitating tend to provide person-oriented feedback in response to their children's hypothetical setbacks, e.g., "my child is just not that good at math", while parents who view failure as enhancing are more likely to offer process-oriented feedback focused on learning, e.g., "the important thing we need to do is try to understand the concepts behind the problems" (Haimovitz & Dweck, 2016). While such findings provide valuable insight into possible ways through which intelligence mindsets are transmitted to children, we must consider that parents' responses to failure in hypothetical contexts may not reflect common parenting practices in natural settings. For example, Leonard et al. (2021) demonstrate that person- and process-oriented messages actually make up the minority of the feedback parents provide to their children in the face of challenges. Here, I further investigate the actual messages children receive about ability, as I build on findings that identify failure as a context ripe with opportunity for the development of children's beliefs about intelligence.

The interplay between how beliefs about intellectual ability are socialized and the development of gender stereotypes about intelligence is seldom investigated. We have good reason to believe that children are receiving different messages about ability early in development when descriptive stereotypes are considered (e.g., Bian et al., 2017). Yet, just as the evidence for gender differences in mindsets is mixed, so are the hypothesized directions as to how gender influences such messages about ability. The theoretical argument that women are more likely to hold fixed mindsets about intelligence suggests that we criticize girls for a lack of natural ability in situations of failure (e.g., "girls just aren't good at math") (Dweck, 2007). Researchers observed evaluative feedback provided to students in elementary classrooms, and found that teachers are more likely to call into question girls' intellectual competence when making failure attributions, compared to attributing boys' failure to lack of motivation and dismissal of rules (Dweck et al., 1978). Inversely, in line with the brilliance stereotype, men are perceived as "effortlessly enlightened" in terms of intellect while women are expected to expend effort for success and genius (Elmore & Luna-Lucero, 2017). Accordingly, when behaviours are consistent with cultural stereotypes (e.g., men performing well in math), feedback tends to emphasize natural ability (person-oriented, e.g., "you are so good at math"), whereas behaviours that do not match stereotypes (e.g., girls performing well in math) receive more effort-centered praise (process-oriented, e.g., "you worked so hard") (see Vial & Cimpian, 2020). We can expect that feedback provided by parents differs as a function of children's gender and the gendertyping of a given context. Yet, how gender influences the actual messages received about their intellectual abilities and how such feedback intersects with cultural stereotypes remains unclear.

2.1.4 The Current Study

The present study examines whether the feedback parents provide to their children in the face of challenging tasks differs based on child's gender. Specifically, I explore the amount of

person-oriented versus process-oriented responses children receive in response to failure. The hypotheses are exploratory in nature given research investigating gender differences in the socialization of children's beliefs about intellectual abilities is in its infancy. We can expect different results based on separate yet related background literature investigating 1) the general development of intelligence mindsets and 2) the development of gender stereotypes about intellectual ability. Research on mindsets presents little evidence to suggest consistent gender differences in children's beliefs about the fixed versus growth nature of intellectual ability. As such, we may expect that there will be no difference in failure feedback provided to children (i.e., no effect of gender). In contrast, findings highlighting the early onset of gendered beliefs about intelligence (e.g., Bian et al., 2017) offer good reason to believe that children do receive different messages about intellectual ability at a young age based on their gender identification.

Further, I investigate parents' intelligence and failure mindsets and how they relate to their explicit gender stereotyping and gender role attitudes, as well as to the type of feedback parents provide in response to failure. The hypothesis here, based on previous findings associating fixed views with more stereotyping (e.g., Levy et al., 1998), is that parents' fixed mindsets will be associated with stronger endorsement of the brilliance stereotype and more traditional views of gender. In line with Haimovitz and Dweck (2016), I also hypothesize that parents' failure mindsets, but not their intelligence mindsets, will predict the type of feedback provided, in that debilitating views of failure will relate to person-oriented feedback messages whereas enhancing views of failure will be associated with process-oriented failure feedback.

2.2 Study One – Method

In Study 1, I recorded parent-child interactions as children attempted a series of difficult puzzles. The goal was to determine whether there is a difference in the type of failure feedback

parents provided to children based on child's gender and on the gender typing of the activity. A pre-registered data collection and analysis plan will be available on the Open Science Framework upon publication (https://osf.io/94shc/).

2.2.1 Participants

136 parent-child dyads participated. An a priori power analysis was conducted based on an ANOVA to suggest an estimated sample size of 155 for 80% Power, yet in consideration of the resulting nature of our outcome variable (i.e., count data) a Poisson GLM was used for the main analysis (see Analysis Plan). The children were 5 and 6 years of age (M_{age} = 6.00, SD_{age} = 0.6 years) and included an equal number of girls (66, M_{age} = 6.04, SD_{age} = 0.63 years) and boys (70, M_{age} = 5.96, SD_{age} = 0.57 years). The parents (125 mothers, 11 fathers) were recruited in different ways: through Concordia University's infant database, the Children's Helping Science Website, and through social media platforms (e.g., Facebook). Due to the global COVID-19 pandemic, participation was entirely remote. Consent information was sent by email prior to the virtual meeting, and parents' verbal consent and children's assent was video and audio recorded at the start of the Zoom meetings. An additional 12 children were tested but excluded from analysis for the following reasons: attempting to complete less than one test puzzle (n = 9), technical difficulties (n = 1), or sibling interference during testing (n = 1).

Prior to the Zoom meeting, parents were emailed a survey link which allowed us to collect valuable demographic information. Of the 116 parents (M_{age} = 37.74 years, SD_{age} = 5.32 years) who submitted demographics survey responses, the majority N = 89 (76.7%) were white, 8 (6.9%) were of West Central Asian or Middle Eastern origin, 6 (5.2%) were of East or Southeast Asian origin, 6 (5.2%) were of Latin, Central or South American origin, 5 (4.3%) were Black, 2 (0.9%) of South Asian origin, and 2 (0.9%) Indigenous Peoples. Parents were primarily

mothers (92.2%), living in Canada (110, 96.5% in Quebec), and married (105, 90.5%). For 33 (28.7%) of the participating families, annual household income exceeded $150,000, 32 (27.8%) families' annual income ranged between $100,000 and $150,000, 19 (16.5%) reported earning between $75,000 and $100,00, seven (6.1%) between $50,000 and $75,000, only 10% received under $50,000, and 12 families (10.4%) preferred not to disclose this information. Most parents held University degrees (83, 71.6%; 58 Bachelor's, 18 Master's, 6 Doctoral, 1 Associate), 16 (13.8%) obtained a CEGEP degree, 15 (12.9%) high school diplomas or less, and 2 (1.5%) held a professional degree.

In addition to parent and household information, the questionnaire also prompted parents to report about their children. Our child sample was made up of an equal number of monolingual children (56, 49.1%) and bilingual children (58, 50.9%, i.e., knowledge of two or more languages, Grosjean, 2010). All parents reported a minimum 6/10 level of proficiency in English for all children who participated, with the majority (77.9%) scoring a 10 out of 10. The children in our sample were either enrolled in daycare (23), preschool (14), primary school (71), homeschooled (4), or had not yet received any form of formal schooling (2). For the 116 child participants whose parents submitted the demographics questionnaire, almost all of them (110) had one or more sibling. Finally, parents were asked to rate their children's experience with puzzles and the use of electronic devices. The majority of children 79 (58.1%) were reported to have "lots of experience" with puzzles, 35 (25.7%) had "minimal experience". Children also "more regularly used" touchscreen tablets compared to desktop computers (54.4% compared to 11.8%). For 33 (24.3%) participants, they had never used a desktop computer before, or seldomly (65, 47.8%).

2.2.2 Procedure

Participants were invited to take part in an online study about the development of children's beliefs about intelligence. Prior to the virtual meeting, parents filled out an online questionnaire which included a battery of demographic questions as well as different scales that assessed their intelligence and failure mindsets, their beliefs about gender roles and brilliance (see Measures). Each parent-child dyad was tested over the Zoom video call platform, guided through the experiment with the visual aid of presentation slides inspired by the Social Learning Lab at Stanford University (Xi Jia Zhou & Hyora, 2020).

The experimenter sent participants a link to a tangram website created by members of the CSCD lab. Participants were asked to share their screen which allowed us to record their behavior in parallel to their activity on the website. Once on the tangram website, participants were given the opportunity to practice manipulating the puzzle pieces (i.e., moving and turning) and completing some easy practice puzzles. After the practice puzzles, participants were cued to start the test puzzles; participants were informed that the puzzles would be hard, and that they would only have two minutes to complete each of the four test puzzles. The puzzles were selected to be hard enough that children would experience setbacks and likely fail to complete them within the given timeframe. Parents were encouraged to engage and interact with their children as they would naturally throughout the experiment, unaware of the fact that our research interest lied in their failure feedback.

After completion of the tangram puzzles, participants were redirected to the Zoom presentation slides and debriefed. The debrief session informed participants that the tangram puzzles were purposely selected to be challenging and were not a measure of ability. The debrief information revealed our interest in the feedback parents provided to their children throughout the challenging puzzles. Finally, participants were sent a link to a set of fun age-appropriate

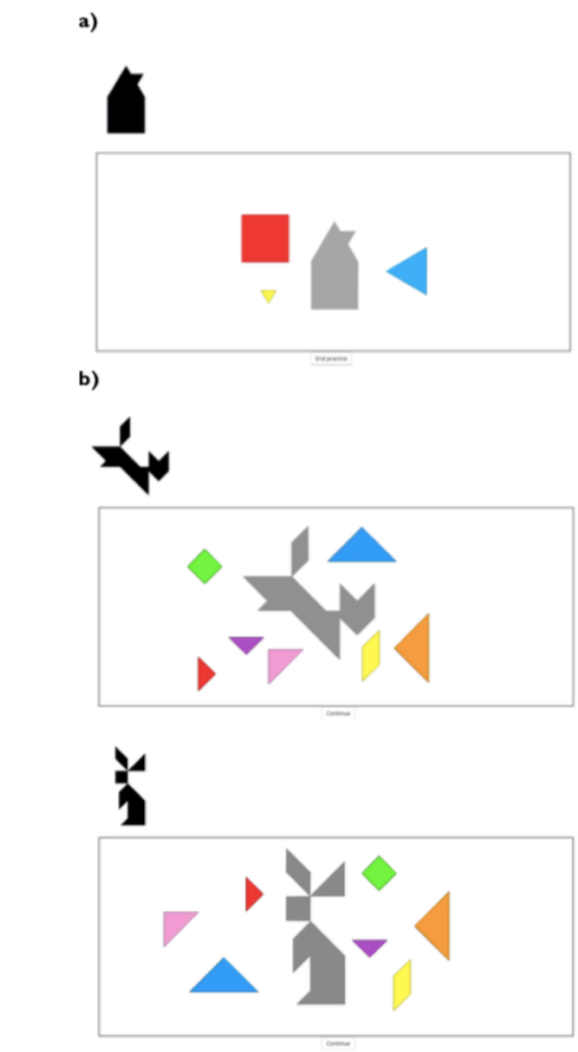
puzzles to ensure that children ended the session positively. Following the Zoom meeting, participants received an email with supporting debrief information, as well as links to related research, and a certificate of completion to thank them for their participation. The full preregistered experimental protocol including stimuli will be available on the Open Science Framework upon publication (https://osf.io/94shc/).

2.2.3 Measures

Tangram puzzles. The tangram website was hosted on the Pavlovia platform and was compatible with desktop and laptop computers. The puzzle pieces could be moved with a mouse or trackpad and rotated with the spacebar. The four tangram puzzles were created to be challenging enough to ensure that children experience setbacks and likely fail to complete the puzzles within the given two-minute timeframe. We manipulated the colour of the tangram puzzle to create three stereotypically gender typed sets of puzzles: a pink set (feminine-typed), a blue set (masculinetyped), and a multicoloured set (gender-neutral). Beside color, the four tangram puzzles and their order of presentation remained identical for each set (see Figure 1 for examples of the tangram puzzles).

Figure 1

Tangram Puzzle Examples



Note. Screenshot examples of tangram a) practice trials, and b) neutral test trials (2/4 test puzzles)

Parents' feedback. Trained coders transcribed and coded parents' feedback utterances from videos of the participants attempting the tangram puzzles (25% double-coded, ICC > 0.80 for every feedback category: ICC_{person} = 0.88; $ICC_{process}$ = 0.80; $ICC_{product}$ = 0.89; ICC_{other} = 0.88, see Hallgren, 2012). See Appendix C for the ICCs for the individual feedback subcategories. Every unique sentence or phrase uttered by the parent in response to the puzzle activity during the test phase was counted as one utterance. We coded the count of utterances into types of failure feedback, based primarily on Haimovitz and Dweck's (2016) coding scheme: personoriented, process-oriented utterances (Haimovitz & Dweck, 2016; Pomerantz & Kempner, 2013; Rattan, Good, et al., 2012; Rhodes et al., 2018), as well as product and other feedback (Gunderson et al., 2013; Haimovitz & Dweck, 2016; Henderlong Corpus & Lepper, 2007; Leonard et al., 2021). The person-oriented category of feedback included five subtypes of utterances: judgments of ability (e.g., "it's too hard for you"), comfort for lack of ability (e.g., "it's ok, you can do something easier"), contingent self-worth (e.g., "I'm impressed at how good you are"), pity for lack of ability (not applicable), performance as a goal (e.g., "you have to finish in time"), social comparison (e.g., "*I* can't even do that"), and generic language (e.g., "good girl"). In parallel, the process oriented category of feedback included judgments of effort (e.g., "you need to practice"), strategies (general, e.g., "you can try different ways" ; and specific to the puzzle activity, e.g., "maybe start with the big pieces"), help seeking (e.g., "you can ask for help"), mastery as the goal (e.g., "you are getting the hang of it"), interest (e.g., "this is a fun challenge"), failure as enhancing (e.g., "it's ok to get it wrong, you can learn"), and specific language (e.g., "you are doing good", "good job", versus you *are* good). See Appendix B for complementary definitions of the feedback subcategories.

I also included a false growth feedback category based on Dweck's considerations related to the common misapplication of the growth mindset theory throughout the years. Merely telling

children to "just keep trying" without providing concrete solutions for learning conveys a fixed message, ("something must be wrong with me if I keep trying [the same way] and keep failing", Dweck, 2015). The false growth feedback utterances were not counted as either person or process, and instead coded as its own independent category. Beyond the person and process categories of interest, we coded for product feedback (i.e., utterances in response to children's actions such as moving a puzzle piece, e.g., "there you go", Gunderson et al., 2013). Finally, five categories were grouped as other feedback: statements (e.g., "it looks like a lion") and questions directed at the child (e.g., "where do you think that goes?") that do not allude to either person- or process-oriented feedback, technical instructions (e.g., "hold and press"), direct instructions as of what to do (e.g., "move that piece there"), and statements of encouragement (e.g., "let's do the next one!"). See Table 1 for examples and Appendix B for the complete coding manual.

Parents' mindsets. Parents' intelligence mindsets were assessed with three items from Dweck (1999) (e.g., "People can learn new things, but they can't really change their basic intelligence") rated from 1 = *strongly disagree* to 6 = *strongly agree* ($\alpha = 0.80$). Parents' failure mindsets were assessed with three items from Haimovitz and Dweck (2016) (e.g., "Experiencing failure debilitates performance and productivity"), rated from 1 = *strongly disagree* to 6 = *strongly agree* ($\alpha = 0.64$). Higher scores on the intelligence and failure mindset scales respectively indicated more agreement with a fixed (vs. growth) view of intelligence and more debilitating (vs. enhancing) view of failure. See Appendices C and D for full reporting of mindset items.

Parents' beliefs about brilliance. Parents' endorsement of the Brilliance stereotype was assessed using Bian et al.'s (2018) Explicit Gender-Brilliance Stereotype Endorsement and Awareness Scale. The scale includes a total of eight items related to beliefs about gender differences in intellectual ability (e.g., "Even though it's not true of everyone, males are generally born with

greater raw intelligence than females") and gender differences more broadly (e.g., "Males' and females' biology has an effect on their cognitive ability, even though the differences might be small") ($\alpha = 0.85$). Parents rated their agreement with each item from 1 = *strongly disagree* to 6 = *strongly agree*. Higher scores indicated stronger endorsement of gender-brilliance stereotyping (i.e., more likely to associate high intellectual ability to men). See Appendix F for all items.

Parents' beliefs about gender roles. Parents' attitudes about men's and women's social roles were assessed using items from the Questionnaire on Normative Gender Role Attitudes (NGRO; (Athenstaedt et al., 2004; see Kollmayer et al., 2018). Our adapted version of the questionnaire includes 16 items on a 7-point Likert scale that measure whether parents hold more traditional versus egalitarian views of gender (e.g., "For some professions, men are better qualified than women") ($\alpha = 0.87$). Higher scores indicated more traditional (vs. egalitarian) views of gender roles. See Appendix G for the complete list of items.

2.2.4 Analysis Plan

First, descriptive statistics, including means and standard deviations for each feedback category were computed to summarize the data. For the primary analysis, a Generalized Linear Model (GLM) with Poisson regression was used to model the amount of feedback utterances provided by parents (i.e., count data), with child's gender (boy, girl) and gender-typing of the puzzles (masculine-typed, feminine-typed, gender-neutral) as our predictor variables. To account for exposure, we incorporated the number of attempted puzzles as an offset (i.e., exposure) variable into the regression model. Statistical significance was determined using an alpha level of 0.05, and the results were interpreted in terms of incidence rate ratios (IRRs), providing an indication of the effect sizes. A series of Poisson regressions followed significant effects of gender on the total amount of person- and process-oriented feedback, to explore gender's

influence on the amount of specific subtypes of feedback. Additionally, Spearman correlations were conducted between the different subtypes of person- and process-oriented feedback.

Next, one sample t-tests were conducted to examine parents' reported scores on the intelligence and failure mindset scales, and brilliance stereotyping and gender role questionnaires against midpoint. Pearson correlation analyses were then performed to investigate the relationships between the different survey scales. Further, parents' intelligence and failure mindset scores, were added to the primary GLM Poisson model as continuous predictors to examine their predictive effects on the amount of person- and process-oriented failure feedback utterances provided. In line with Haimovitz and Dweck's (2016) findings, I expect parents' failure mindsets but not their intelligence mindsets to relate to their failure feedback. Lastly, parents' implicit beliefs about intelligence and failure, as well as their brilliance beliefs and gender role attitudes were examined in interaction with children's gender as predictors of parents' feedback.

2.3 Results

Parents' feedback. The means and standard deviations for the total overall amount of feedback provided to boys and girls were calculated (i.e., count of total utterances), as well as the total amount of person- and process-oriented failure feedback, and product and other utterances. In line with similar empirical investigations (e.g., Leonard et al., 2021), other utterances made up the majority of the feedback provided to children. See Table 1 for a complete reporting of the means and standard deviations of the different types of feedback utterances. Note that the means in Table 1 do not account for the fact that number of puzzles attempted varied across children, and so the opportunity for parents to provide feedback varied. For 106 parents, children attempted all four test puzzles ($N_{boys} = 50$; $N_{girls} = 56$) and person-oriented feedback was

provided at a rate of 0.63 (the mean number of person utterances was 2.52, SD = 2.77) and process-oriented feedback at a rate of 1.17 (M = 4.67, SD = 3.85), 12 parents observed 3 puzzles (person feedback was provided at a rate of 0.64, M = 1.92, SD = 2.75; and process at a rate of 0.72, M = 2.17, SD = 2.69), 15 two (person at a rate of 1.30, M = 2.60, SD = 2.61; process 1.14, M = 2.27, SD = 1.94), and three parents only one puzzle (M_{person} = 0.33, SD = 0.58; $M_{process}$ = 2.33, SD = 3.21). To account for exposure, we incorporated the number of attempted puzzles as an offset (i.e., exposure) variable into the regression model (see Hilbe, 2007). A Poisson GLM with mixed effects from the lme4 package (Bates et al., 2015) in R (R version 4.3.1, R Core Team, 2023) was conducted to predict failure feedback utterances (i.e., count data) from child's gender and gender-typed color of the puzzle, with number of attempted puzzles (out of 4) included as an offset variable: glmer(Total_PP ~ gender + color + offset(log(completion)) + (1|ID), family = "poisson", data=). Figures were created using ggplot2 (Version 3.3.5; Wickham, 2016).

Table 1

Study One Examples and Descriptive Statistics of Failure Feedback

Failure Feedback	Examples	Girls	Boys	Total
Process	You need to practice (*effort*) You can try different ways (*strategy*) You can ask for help (*help*)	3.70 (3.52)	4.54 (3.85)	4.13 (3.70)
Person	It's too hard for you (*ability*) You have to finish in time (*performance*) *I* can't even do that (*social comparison*)	2.21 (2.29)	2.63 (3.08)	2.43 (2.72)
Product	Nice There you go That doesn't fit	7.52 (6.03)	7.13 (5.92)	7.32 (5.96)
Other	Hold and press (*technical instruction*) Move that piece there (*direct instruction*) It looks like a lion (*statement*) Where do you think that goes? (*question*) Let's go! (*encouragement*)	27.30 (17.80)	24.40 (17.40)	25.80 (17.60)
Total		40.70 (23.00)	38.70 (23.70)	39.70 (23.30)

Note. Means(standard deviations) of the number of utterances provided by parents.

The overall model was significant (χ^2 = 4.49, p = 0.034); child's gender predicted the amount of total person- and process-oriented feedback utterances parents provided to children (IRR = 0.76, 95% CI = 0.57 – 0.99, p = 0.048). Girls are receiving 0.76 times the amount of overall person and process feedback compared to boys. Puzzle color (i.e., gender-typing of the tangrams) did not predict feedback and was dropped from further analyses and subsequent investigations. When looking at the different types of failure feedback, gender did not predict the amount of person-oriented feedback provided (IRR = 0.81, 95% CI = 0.55 – 1.20, p = 0.30), but did predict process-oriented feedback (IRR = 0.73, 95% CI = 0.55 – 0.97, p = 0.032). That is, girls received 0.73 times the amount of process feedback compared to boys. Specifically, parents provided significantly more strategy utterances (e.g., "try moving the pieces around in different ways", "a good way to start is by moving all the pieces out of the way to see the big picture") (M_{boys} = 2.76; M_{girls} = 2.09, IRR = 0.67, CI = 0.47 – 0.97, p = 0.033) to boys. Parents also provided more, albeit nonsignificant, help seeking messages (e.g., "ask for help when you need it", "let me know if you need help") to boys compared to girls (M_{boys} = 1.06; M_{girls} = 0.56, IRR = 0.56, CI = 0.29 – 1.08, p = 0.082). Gender did not predict the amount of false growth feedback (M_{boys} = 0.90; M_{girls} = 0.89, IRR = 0.93, CI = 0.58 – 1.50, p = 0.763), analyzed separately. Further, children's gender did not predict the amount of other feedback utterances provided by parents, IRR = 1.06, 95% CI = 0.81 – 1.40, p = 0.65, nor overall total amount of utterances, IRR = 0.99, 95% CI = 0.78 – 1.27, p = 0.96.

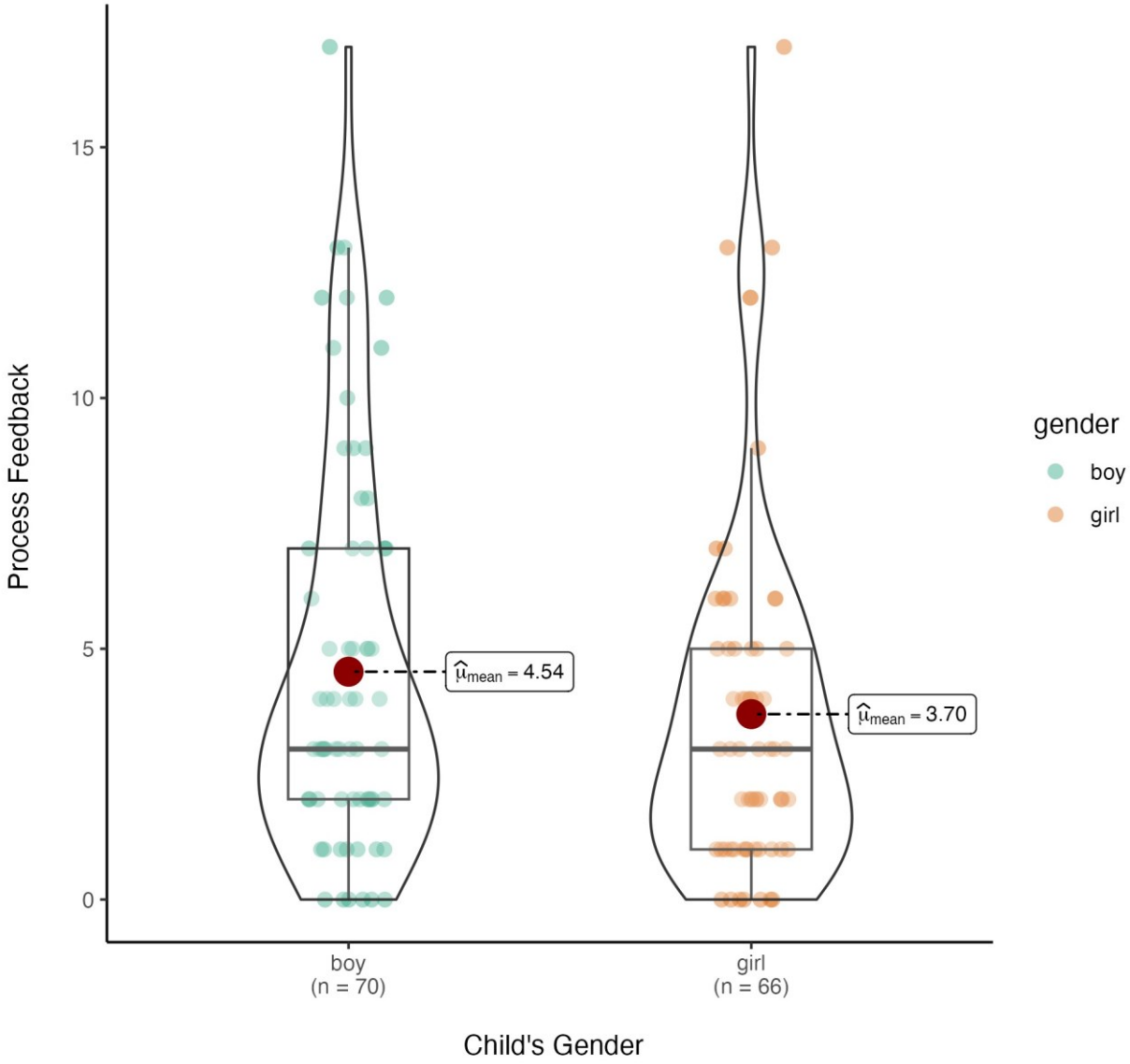
Table 2

Study One Poisson GLM predicting Process Feedback by Gender

	Process Feedback		
Predictors	*Incidence Rate Ratios*	*CI*	*p*
(Intercept)	1.07	0.87 – 1.31	0.542
Gender [girls]	0.73	0.55 – 0.97	**0.032**

Figure 2

Study One Process Feedback by Children's Gender

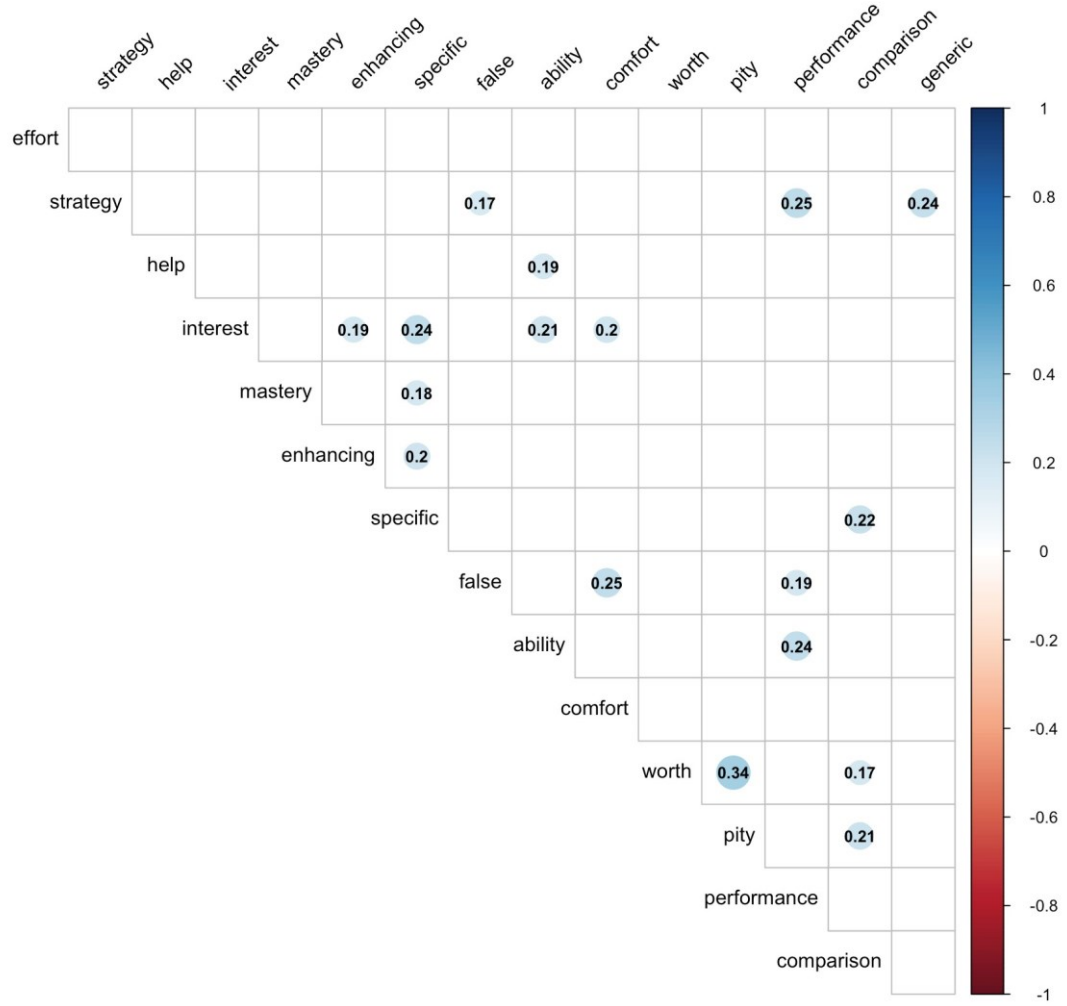


Note. Observed means and total amounts of process feedback utterances provided by parents, plotted by children's gender (boy, girl). Error bars represent confidence intervals.

In addition to the GLM, Spearman correlations were conducted between the different types of person- and process-oriented feedback to better understand how these feedback types are associated with one another and identify any patterns in how parents deliver feedback. Intercorrelations among person-oriented subcategories of feedback were found (e.g., judgments of ability and performance as a goal, $r(13) = 0.24$, $p = 0.004$), as well as among process-oriented subcategories (e.g., interest and specific language, $r(13) = 0.24$, $p = 0.005$). Interestingly however, certain process-oriented feedback types were positively associated with personoriented messages. Strategy utterances were associated with performance messages ($r(13) = 0.25$, $p = 0.003$), generic language ($r(13) = 0.24$, $p = 0.004$), and false growth feedback utterances ($r(13) = 0.17$, $p = 0.05$). Interest was also associated with ability ($r(13) = 0.21$, $p = 0.02$) and comfort ($r(13) = 0.20$, $p = 0.02$) (see Figure 3).

Figure 3

Study One Spearman Correlations between Failure Feedback Messages



Note. Spearman rank order correlations between the different type of person- and process-oriented feedback messages provided by parents. Statistical significance ($p < 0.05$) is indicated, with the size and color saturation of the circles representing the strength of the relationships.

Parents' mindsets, beliefs about brilliance and gender roles. Parents' mindset scores and brilliance stereotyping and gender role attitudes reported on the survey scales were compared against midpoint and examined in relation to each other**.** On average, parents held more growth mindsets about intelligence, $t(112) = -12.38$, $p < .001$, 95% CI [2.22, 2.58] and stronger enhancing views of failure, $t(112) = -20.26$, $p < .001$, 95% CI [1.82, 2.12]. Parents were also less likely to explicitly endorse the gender-brilliance stereotype, $t(112) = -19.16$, $p < .001$, 95% CI [1.89, 2.19] and traditional roles of gender , $t(111) = -23.61$, $p < .001$, 95% CI [2.01, 2.32]. Pearson correlations revealed that, in line with Haimovitz & Dweck (2016, S1), parents' implicit beliefs about intelligence correlated with their own beliefs about failure. Further, parents' mindsets were positively related to gender-typed beliefs about brilliance and social roles; more fixed views of intelligence and debilitating views of failure were related to stronger endorsement of gender-brilliance stereotyping and more traditional views of gender roles. Further, gendered beliefs about brilliance and social roles were strongly related; stronger brilliance beliefs were associated with stronger traditional (vs. egalitarian) beliefs about gender. See Table 3 for means, standard deviations, and correlations.

Table 3

Study One Means, Standard Deviations, and Intercorrelations for Survey scales

Variable		*N*	*M*	*SD*	Pearson correlations 1	2	3	4
Parent scales								
1.	Parents' intelligence mindset	113	2.40	0.95	—			
2.	Parents' failure mindset	113	1.97	0.80	.200*	—		
3.	Parents' brilliance stereotype	113	2.04	0.81	.329**	.393**	—	
4.	Parents' gender-role beliefs	112	2.15	0.82	.336**	.440**	.755**	—

Note. **p*. < .05 ***p*. < .001. Parents' intelligence mindset, failure mindset, and brilliance stereotype scores were on a 6-point Likert scale from strongly disagree to strongly agree (the midpoint is 3.5). Parents' gender-role beliefs were on a 7-point Likert-scale from *strongly disagree* to *strongly agree* (the midpoint is 4, neither agree nor disagree).

I also ran a series of regressions to explore whether parents' mindsets, their gender brilliance stereotyping, and gender role attitudes predicted the feedback they provided their children, and whether the predictive effects differed by children's gender.

First, parents' intelligence mindsets and failure mindsets survey responses were examined as continuous predictors of feedback provided by parents, added to the GLM Poisson model. Neither parents' intelligence mindsets (IRR = 1.11, 95% CI [0.99, 1.23], p = 0.35) nor parents' failure mindsets (IRR = 0.89, 95% 95% CI [0.73, 1.08], p = 0.23) predicted the overall amount of person and process feedback provided in our sample. There was no statistically significant difference in amount of person (IRR = 011, p = 0.32) or process (IRR = 1.06, p = 0.49) feedback between parents with different implicit beliefs about intelligence. Similarly, there was no statistically significant difference in amount of person-oriented feedback (IRR = 0.01, p = 0.96) based on parents' failure mindsets, yet a somewhat marginal, albeit non statistically significant, difference emerged in the amount of process-oriented feedback predicted by parents' failure mindsets, IRR = 0.84, 95% CI [0.68, 1.03], p = 0.09. This trend would suggest that with each one-unit increase in parent failure mindset (i.e., endorsing a more debilitating view of failure), the expected count of process feedback decreases by a factor of 0.84.

Next, I added interaction terms to a supplementary series of regressions to explore whether the effects of parents' mindsets differed as a function of children's gender in predicting the amount of failure feedback provided (i.e., whether parents' implicit beliefs interacted with gender to influence their feedback) (glmer(Total_PP ~ gender * mindset + offset(log(completion)) + (1|ID), family = "poisson", data=). Gender did not significantly interact with parents' intelligence mindsets (IRR = 1.12, 95% CI [0.80, 1.57], p = 0.51) nor with parents' failure mindsets (IRR = 1.00, 95% CI [0.67, 1.47], p = 0.98) to influence the amount of overall

person-process feedback parents provide to their children. Specifically, intelligence mindsets did not interact with gender to predict person (IRR = 0.95, 95% CI [0.59, 1.52], p = 0.83) nor process (IRR = 1.20, 95% CI [0.84, 1.73], p = 0.32) feedback, and neither did failure mindsets interact with gender to predict person (IRR = 0.93, 95% CI [0.54, 1.59], p = 0.78) nor process (IRR = 1.02, 95% CI [0.67, 1.56], p = 0.92) messages. The added complexity to the model and the redistribution of variance could be accounting for the noted loss of marginal significance of the predictive main effect of parents' failure mindsets on the amount of process feedback provided.

Finally, parents' beliefs about brilliance and beliefs about gender roles were also examined in interaction with gender as predictors of the types of feedback provided. Brilliance beliefs and gender did not interact to predict overall person-process feedback (IRR = 1.05, 95% CI [0.72, 1.54], p = 0.80). No significant predictive interaction effect was found for person (IRR = 0.89, 95% CI [0.52, 1.52], p = 0.68) or process (IRR = 1.13, 95% CI [0.74, 1.71], p = 0.57) feedback specifically. Parents' attitudes about men's and women's social roles similarly did not interact with children's gender to predict person (IRR = 0.99, 95% CI [0.57, 1.70], p = 0.96) or process (IRR = 1.15, 95% CI [0.75, 1.76], p = 0.52) feedback (overall person-process, IRR = 1.10, p = 0.62).

2.4 Discussion

Study One explored whether parents provided gendered feedback messages to their 5- and 6-year-old children in the context of failure (i.e., a challenging puzzle task). Overall, parents spoke an equal amount to their children regardless of gender, but surprisingly provided more process-oriented feedback to boys than to girls. Specifically, parents provided more strategy focused (e.g., "you can try the piece in other ways", "start by moving pieces out of the way") feedback to boys. Interestingly, such strategy messages were associated with person-oriented

messages of performance and ability (e.g., “you have to hurry to finish in two minutes”), as well as with false growth feedback messages (e.g., “just keep trying”). That is, parents who provided children with more process strategies were also more likely to stress performance and highlight fixed aspects of ability in response to the challenging puzzles. Note, person- and process-oriented messages were among the least provided feedback to children overall. In line with similar empirical investigations (e.g., Leonard et al., 2021), most of the feedback recorded was product (e.g., “there you go”), general statements about the puzzles (e.g., “it looks like a lion”), and questions (e.g., “what’s next?”).

The overlap between person- and process-oriented feedback messages begs the question as to whether the feedback provided to boys, while delivered in growth language (i.e., process-oriented), may convey underlying fixed performance beliefs. Decades of research demonstrating the beneficial effects of growth mindsets has found its way into homes and classrooms (Yettick et al., 2016), with both parents and teachers explicitly endorsing the growth mindset theory (e.g., Haimovitz & Dweck, 2016; Park et al., 2016). Reflected in our findings, parents reported more growth intelligence mindsets and enhancing views of failure overall. Over the years however, a growing concern underscores a potential disparity between self-reported agreement with growth mindset theory and its practical application (Barger et al., 2022; Dweck, 2015).

False growth mindsets are fundamental misconceptions of growth mindsets by which adults fail to truly embrace the effort required for personal growth and the challenges and setbacks that come with it, despite endorsing easy-to-agree-with statements typically used in mindset assessments (e.g., “No matter how much intelligence you have, you can always change it quite a bit”, Dweck, 1999). In the context of the present study, false growth mindsets could be explaining the difference in process-oriented messages provided to children: parents could be providing boys with more fixed messages about ability cloaked in more socially acceptable

growth language (e.g., proposing strategies in the aim of pressuring performance). Parallel to the social decline in explicit expressions of gender stereotyping – evidenced here by parents being less likely to explicitly endorse traditional gender role attitudes and gender stereotyping – adults may be transmitting fixed messages about intellectual ability in subtler ways. In the context of our results, boys may be receiving more covert messages about ability that underscore a fixed nature of intelligence, in line with the stereotypic belief that brilliance is an innately male trait. Relatedly, a lack of nuance in self-reported assessments of adults' mindsets may be leading us to overlook suggested (Haimovitz & Dweck, 2016) associations between parents' mindsets and feedback provided. Our findings reveal that parents' intelligence and failure mindsets were related to one another and to gender stereotyping attitudes but were not predictive of the feedback provided to children. Echoing the cautionary tales of false growth mindsets and recent calls for more nuanced assessments of mindsets (e.g., Barger et al., 2022; Malespina et al., 2022), Study Two aims to get a better idea of parents' mindsets which could provide a more representative understanding of the factors that influence how adults transmit beliefs about intellectual ability.

An alternative explanation for the gender difference in amount of process feedback provided considers the context of failure more closely. Decades of research on the development of mindsets has focused primarily on praise (see Haimovitz & Dweck, 2017 for a review). In line with the brilliance stereotype, men are more likely to receive praise for their innate intellectual ability in contexts of success. That is, men's successful performances are attributed to a natural genius essence, consistent with cultural stereotypes (see Vial & Cimpian, 2020). In contrast, when women succeed, their success is attributed to hard work (e.g., Tiedemann, 2000; Yee & Eccles, 1988). Only recently has the focus shifted from contexts of success to contexts of failure to identify the transmission of adults' implicit beliefs about intelligence to children. Indeed, it

turns out that the way adults respond to children in the face of setbacks, compared to responses to success, affords more concrete information regarding the nature of intellectual ability (Haimovitz & Dweck, 2017). Among the few studies examining evaluative feedback in naturalistic contexts of failure, gender differences are revealed in support of the present findings. Girls are not praised for their intelligence but are criticized for their lack of it. Boys, on the other hand, are more likely to be praised for their brilliance, but when they fail – they are criticized for lack of hard work and dedication (e.g., Dweck, 1978). Such findings can also help explain children's juxtaposing beliefs that boys are more brilliant than girls while also being cognisant of the fact that girls are outperforming boys in school (e.g., Bian et al., 2017). That is, one can maintain the brilliance is male stereotype by discounting boys' shortcomings to lack of effort or dismissal of the rules, in contrast to girls whose failures reveal a lack of natural intellectual ability since they are typically perceived to already be trying their best. This reasoning likely draws on the intersection of additional societal gender biases (e.g., "boys will be boys", Skipper & Fox, 2022) and highlights the need to continue investigating the socialization of individual beliefs about intelligence in tandem with the development of gender stereotypes.

A further consideration in the investigation of gender stereotyped beliefs about intelligence is the distinction between intellectual ability in general versus the far end of that ability (i.e., brilliance). Individuals' implicit beliefs about ability vary along a continuum (i.e., view abilities as more or less fixed versus malleable), but also across separable dimensions (i.e., domains, e.g., physics, Kalender et al., 2022; Malespina et al., 2022), and people can hold both growth and fixed views simultaneously (e.g., Scherr et al., 2017). In the present context, one's intelligence mindsets may differ from their brilliance mindsets; one may hold growth beliefs about intelligence in general but fixed views about genius levels of intellect. In Study One, parents provided feedback to their children in response to a series of challenging puzzles – a

familiar parenting context that encourages parents to reveal their beliefs about the nature of intelligence to their children (Haimovitz & Dweck, 2016). Based on past empirical findings revealing gender bias in contexts that highlight *high* intellectual ability (e.g., Bian et al., 2018, Storage et al., 2020), Study Two builds off the present methodology by emphasizing brilliance in similar parent-child interactions to further our understanding of the transmission of gendered beliefs about brilliance specifically.

Chapter 3: Study Two

3.1 Introduction

Study One investigated parental feedback provided to children within the context of a challenging puzzle task, and uncovered gender differences in the type of feedback provided. Study One revealed that parents offered more process-oriented feedback to boys compared to girls. Interestingly, process-oriented messages were associated with certain person-oriented messages, specifically performance focused feedback. Overall, most feedback utterances provided by parents fell beyond the person or process categories. The present study attempts to replicate Study One's trending pattern of results. The following chapter delves into the conceptual distinction between intelligence in general and brilliance in particular, by situating the puzzle task in a context of *high* intellectual ability, in addition to considering the subtle yet potentially significant nuances in how we measure mindsets, including false growth beliefs.

3.1.1 The Far End of Intellectual Ability

In a similar way that one's physics mindsets can differ from their intelligence mindsets (see Malespina et al., 2022; Marshman et al., 2018), one's beliefs about intelligence may also be different from how one thinks about giftedness (Makkonen et al., 2019). It would be possible that someone believes that intelligence is changeable, whereas brilliance is more of a fixed trait. That is, anyone can work toward getting smarter, but only few born with the innate capacity can truly be really really smart, i.e., brilliant (Rattan, Savani, et al., 2012). Such a case would suggest that brilliance is an attribute reserved for a select few; implying that not everyone can attain such levels of intellect, no matter how hard they work (Rattan et al., 2012). The distinction between general intellectual ability and brilliance (i.e., the far end of that ability) is an important conceptual consideration in the investigation of gendered beliefs about intelligence. Brilliance

beliefs and intelligence mindsets are indeed separate yet related concepts. People who endorse fixed views about ability are more likely to adopt stereotypical beliefs in general (Bastian & Haslam, 2006; Levy et al., 1998). Indeed, in Study One, parents who held stronger fixed mindsets were also more likely to endorse brilliance stereotypes and more traditional views about gender roles. Relatedly, Maranges et al. (2023) investigated how mindsets and brilliance beliefs influence students' choice of major and found that undergraduates who hold fixed mindsets about (intellectual) abilities are more likely to endorse the belief that innate genius ability (i.e., brilliance) is a prerequisite for success in certain fields. However, it was students' brilliance beliefs that were shown to directly affect choice of major, not their intelligence mindsets. Specifically, while women who held fixed mindsets were more likely to perceive philosophy as requiring brilliance for success, it was whether they held limiting brilliance beliefs that ultimately predicted avoiding majoring in said brilliant-typed fields (Maranges et al., 2023a; see also Deiglmayr et al., 2019). Such findings highlight the need to consider brilliance beliefs together with people's mindsets to better understand how stereotypes about high intellectual ability are being transmitted.

Parents play an important role in the socialization of both children's mindsets (Haimovitz & Dweck, 2016) and brilliance stereotypes (Zhao et al., 2022), yet it remains unclear which aspects of parent-child interactions influence the development of children's gendered beliefs about brilliance. While explicit expressions of gender stereotypes are less common than they once were, stereotypical beliefs about intellectual abilities are nonetheless still being acquired by children (Bian et al., 2017). Subtle uses of language indirectly convey gendered messages about ability (e.g., "girls are just as smart as boys", Chestnut et al., 2021; Chestnut & Markman, 2018), and the context in which such messages are being transmitted matters. In contexts of success, girls are often praised for their effort and hard work whereas boys are praised for their natural

intelligence (e.g., Elmore & Luna-Lucero, 2017; Yee & Eccles, 1988; see also Vial & Cimpian, 2020). In Study One, the opposite pattern is revealed in a context of failure: process-oriented feedback is provided to boys more than girls in response to setbacks (see also Dweck, 1978). This inverted pattern of evaluative feedback highlights a potential breeding ground for the development of gendered brilliance beliefs. That is, the association of women's high effort with low ability in contexts of success under the pretense that "trying isn't natural" (Kiefer & Shih, 2006; Smith et al., 2013; Tsay & Banaji, 2011), and the attribution of women's failures to a lack of ability because women are assumed to already be trying their (limited) best. In contrast, boys' success is portrayed as a clear indication of natural ability whereas their failures are attributed to a lack of effort as a means to justify their poor, otherwise brilliant, performance. Here, I further the examination of how messages about ability are being transmitted to children in contexts of failure that highlight brilliance (see Haimovitz & Dweck, 2016, 2017).

3.1.2 True Growth Beliefs

Years of research showcasing the positive impact of growth beliefs have started permeating culture (Rattan et al., 2015). A growing number of parents and educators actively embrace the theoretical components of growth mindsets, evidenced in implementations in classrooms, home environments, and even business sectors (Murphy & Reeves, 2019; Park et al., 2016; Puente-Díaz & Cavazos-Arroyo, 2017; Yettick et al., 2016). Accordingly, in Study One, parents self-reported more growth than fixed beliefs about ability overall. However, parents' mindsets were not predictive of the process-oriented (i.e., growth) and person-oriented (i.e., fixed) feedback they provided to their children. That is, parents who reported endorsing growth views were not necessarily more likely to provide more growth (vs. fixed) messages to their children. Plus, certain feedback delivered in growth language (e.g., strategy-focused messages)

was actually associated with certain fixed feedback, notably performance-focused messages (e.g., "you won't finish in two minutes"). Such overlap highlights a potential gap between the self-reported nature of mindset beliefs and their application in practice. Here, I further investigate the nuanced ways parents may be transmitting implicit beliefs about ability to their children.

Growth mindsets refer to the implicit beliefs that abilities are highly adaptable and responsive to effort. Individuals may claim to possess a growth mindset but lack a genuine understanding of the concept or fail to implement it effectively. At surface level, it can be easy to explicitly agree with statements that emphasize effort to foster growth (Barger et al., 2022), typically used in self-report assessments of adult mindsets (e.g., "No matter how much intelligence you have, you can always change it quite a bit", Dweck, 1999, 2006). Yet, proponents of growth mindset theory have come to caution against distilling growth beliefs down to mere effort, neglecting the learning process itself (Dweck, 2015, 2017). An educator may support growth mindsets because they believe in promoting effort over ability but have difficulty incorporating the broader tenets of growth mindset theory – the instability and malleability of ability (Yeager & Dweck, 2020) – into their instructional practices (e.g., Patrick & Joshi, 2019). The gap between assessment and practical application suggests that agreement with explicit growth statements may not necessarily equate to meaningful comprehension of the deeper aspects of growth mindsets. That is, truly believing and embracing effort, challenges, and setbacks as necessary for growth and learning. The misunderstanding of growth mindsets can in turn result in ineffective application and unfavourable consequences. For example, merely emphasizing effort without linking it to progress or strategies can inadvertently perpetuate fixed messages about ability (e.g., Patrick & Joshi, 2019; Sun, 2019). Disparity between proclaimed growth mindset beliefs and their practical implementation can ultimately hinder true adoption of a growth mindset.

Attempts at addressing the potential discrepancy between belief and practice of growth theory have called for more accurate and nuanced understanding of mindsets. Barger and colleagues (2022) propose an alternative assessment tool of mindsets to better understand adults' personal theories of ability. The scale incorporates alternative measures that expand on participants' beliefs about the stability and malleability of ability. The measures compare participants' perceptions about the role of effort and natural ability and their predictions regarding the potential for change over time. Using this scale, Barger et al., (2022) identified a significant proportion of adults with false growth mindsets: individuals who reported endorsing growth beliefs using traditional mindset items but held underlying beliefs that were more in line with fixed mindsets (e.g., attributed a greater percentage of intelligence to natural ability over effort). In Study One, a possible explanation for the lack of association between parents' selfreported growth beliefs and amount of actual growth feedback provided to children could be that the traditional measures of mindsets overestimated parents' true growth views. In such a case, some of the feedback provided by parents would more likely align with underlying fixed beliefs, in contrast to falsely claimed growth views. Here, I include a nuanced assessment of participants' growth beliefs for a more accurate representation of parents' implicit beliefs about ability, and further elucidate the lack of evidence for the transmission of adults' growth mindsets to their children (see Haimovitz & Dweck, 2016, 2017).

To further investigate the transmission of parental beliefs to their children, we must also consider children's own developing mindsets. Mindsets have long been understudied in early childhood because it was believed that cognitive limitations prevented children from reasoning about ability and effort distinctly, thus making children unable to hold mindsets (Nicholls, 1984; Parsons & Ruble, 1977). While subsequent research offers evidence in support of children's cognitive capacity to endorse mindsets (Dweck, 2002; Heyman & Compton, 2006; Muradoglu &

Cimpian, 2020), attempts to assess children's implicit beliefs about ability remain scarce, often conflate related concepts (e.g., motivation, Gunderson et al., 2013; achievement, Ruzek et al., 2020), and tend to show low internal reliability. The *Growth Mindset Scale for Children* (GM-C) addresses past limitations in its design to assess mindsets about intellectual ability in children as young as four (Muradoglu et al., 2022). In parallel to Barger et al.'s (2022) adult measure, the GM-C measures young children's beliefs about the stability and malleability of ability. Children are presented with vignettes of different child characters who are unskilled in a particular domain and asked about the characters' potential for change. In their study, Muradoglu et al. (2022) found that older children (6-year-olds compared to 5-year-olds) and girls (compared to boys) held stronger growth views. Here, I use the GM-C to assess children's intelligence mindsets and investigate how they relate to their parents' implicit beliefs.

3.1.3 The Current Study

The goals of Study Two are to (1) further explore the trending pattern of gendered failure feedback provided to children from Study One in a context emphasizing high intellectual ability (i.e., brilliance), (2) obtain a more nuanced measure of parents' mindsets, and (3) assess children's mindsets about intellectual ability (GM-C) and how they relate to their parents' mindsets. As in Study One, the hypotheses are exploratory in nature, yet I expect to replicate the trending pattern from Study One that boys receive more process-oriented feedback in response to failure compared to girls. As in Study One, I expect parents' fixed beliefs about intelligence and debilitating views of failure to be positively associated with stronger endorsement of the brilliance stereotype, traditional gender-role attitudes, as well as with fixed beliefs about brilliance (Levy et al., 1998; Maranges et al., 2023). I further assessed parents' growth beliefs utilizing Barger et al.'s (2022) alternative mindset scales in conjunction with the traditional

mindset measures to examine whether parents who report endorsing growth theories are indeed more likely to attribute success to effort (which would suggest true growth beliefs), or instead attribute success to ability (suggesting underlying fixed beliefs). As proposed by Haimovitz and Dweck (2016) and in line with the marginal predictive effect of parents' failure mindsets on amount of process feedback in Study One, I expect that parents' failure mindsets but not their intelligence mindsets will be associated with their children's mindsets and will be predictive of the amount of process-oriented messages provided to their children. As in Study One, the predictive effects of parents' implicit beliefs about ability, brilliance stereotypes, and gendered social roles were also explored in interaction with children's gender. Finally, in line with Muradoglu et al.'s (2022) initial investigation of children's mindsets using the GM-C, I hypothesize that girls will report stronger growth (vs. fixed) beliefs about ability compared to boys.

3.2 Study Two – Method

Study Two builds off methodology used in Study One to further explore the pattern of parents' failure feedback messages. Here, brilliance was explicitly emphasized as a requirement for success for the challenging puzzle activity because negative beliefs about intellectual ability and their behavioural consequences tend to emerge in such brilliance-typed contexts (e.g., Bian et al., 2017, 2018; Muradoglu et al., 2023; Storage et al., 2016). I further investigate parents' mindsets with more nuanced measures and assess children's own implicit beliefs about intelligence.

3.2.1 Participants

I ran a simulation analysis to estimate Power based on the data from Study One. For an effect size comparable to S1 with a 95% confidence interval, we would need 300 participants for 85% Power (81.56, 88.02). The aim here was not confirm or reject a hypothesis, but instead to explore the type of feedback parents provide to their children and inform future research of potential sources of gendered messages about intellectual ability that may be worth further investigation. After careful consideration of feasibility and the exploratory nature of the present study, I aimed to collect a sample size between 100 and 150 which would allow to detect a 0.28 effect size with 54.67% power, 95% CI [46.34, 62.80]). A total of 114 children (M_{age} = 5.97, SD_{age} = 0.56 years; N_{girls}= 55) and their parents (M_{age} = 39.94, SD_{age} = 5.15 years; 107 mothers, 7 fathers) participated in the puzzle task. Parents' verbal consent and children's assent was audio and video recorded over Zoom prior to participation. An additional 13 participants were excluded due to unmet language requirements (i.e., parents providing feedback in a language other than English or French, n = 9), technical difficulties (n = 2), and because they did not attempt a minimum requirement of one test puzzle (n = 2). As in Study One, I highlight trending patterns in the data, complemented with correlation analyses.

Out of the 114 Zoom participants, 85 parents (M_{age} = 39.94, SD_{age} = 5.15 years; 74 mothers, 11 fathers) completed the online questionnaire prior to their Zoom participation. Of them, N = 51 (60%) were white, 9 (11%) were Black, 8 (9.4%) Indigenous Peoples, 6 (7.1%) were of Latin, Central or South American origin, 5 (5.9%) of South Asian origin, 1 (1.2%) of East or Southeast Asian origin, and 1 (1.2%) originating from Oceania. The majority of parents were married (69, 81.2%), and the annual household income for 29 (34.1%) participating families exceeded $150,000, 23 (27%) ranged between $100,000 and $150,000, eight (9.4%) between $75,000 and $100,00, eight (9.4%) between $50,000 and $75,000, 11.8% reported under

$50,000, and 8 families preferred not to disclose income. Highest levels of education attained ranged from university degrees (71, 83.5%: 37 Bachelor's, 23 Master's, 6 Doctorate, 1 Associate, 4 professional), CEGEP degree (13, 15.3%), and high school diplomas (2, 2.4%).

Of the children of the 85 parents who submitted the demographics questionnaire, child participants were mostly bilingual (N = 57, 67%) and proficient in English, with the majority (70%) scoring a 10 out of 10. Children were either enrolled in daycare (11), kindergarten (66), preschool (1), primary school (4), or had not yet received any form of formal schooling (2). The majority of child participants had one or more sibling (72). Finally, 67% (57) of children were reported to have "lots of experience" with puzzles and 32.9% (28) had "minimal experience".

A total of 98 children (47 girls, *M*age = 5.98, *SD* = 0.59) attempted the Children Mindset questionnaire (GM-C). An additional four were excluded from the analysis because their parents interfered with participation (e.g., reformulated the questions for the child, n = 2), or because of experimenter error (n = 2). 12 children who did the test puzzles did not want to attempt the "story activity" GM-C questionnaire.

3.2.2 Procedure

As in Study One, parent-child pairs were welcomed to take part in a study over Zoom about children's beliefs about intelligence. Parents were asked to fill out an updated version of Study One's online questionnaire prior to the meeting. The experimental procedure from the start of the Zoom meeting up to the completion of the tangram puzzles was similar to Study One, with the addition of the brilliance manipulation. That is, in addition to informing participants that the puzzles would be hard, and that they would only have two minutes to complete each of the four test puzzles, they were also told that the puzzles were "for really really smart kids [and that] only really really smart kids could do the next puzzles". This cue was provided after the practice puzzles, prior to starting the test puzzles.

After completion of the tangram puzzles, the child participants were introduced to a story activity (i.e., The Children's Mindset Scale, see Measures) before being debriefed. The experimenter told the participants that they would hear stories about different kids and would be asked some questions about those kids. To help maintain children's attention throughout the questionnaire, I incorporated a child-friendly tracker. The experimenter introduced an image of a school bus on a presentation slide, and after every story the image of the bus advanced one stop forward regardless of children's answers. Children and their parents were debriefed after completion of the questionnaire. The debrief session was similar to Study One with an added mention of brilliance.

3.2.3 Measures

Tangram puzzles. The tangram puzzles were the same used in Study One. Here, the color of the tangrams was not manipulated because I did not find an effect of colour in Study One and dropped it from our model. All parent-child pairs attempted the identical set of four multicoloured (neutral-typed) tangram puzzles. The brilliance manipulation cue was also added to the tangram website in text on the page prior to the first test puzzle (see Appendix A).

Parents' feedback. Trained coders transcribed and coded parents' feedback utterances from the video and audio recordings (25% double-coded, ICC > 0.90 for every feedback category: $ICC_{person} = 0.96$; $ICC_{process} = 0.93$; $ICC_{product} = 0.94$; $ICC_{other} = 0.99$, see Hallgren, 2012). See Appendix C for the ICCs for individual feedback subcategories. I used the same coding manual developed for Study One (see Appendix B), with one addition. Informed by Leonard et al.'s (2021) findings highlighting the prevalence of pedagogical questions in feedback provided to children, I subdivided our question category into two subcategories: general questions (i.e., "where is the cursor?") and pedagogical questions specific to the puzzles (i.e., "where do you think that goes?").

Parents' mindsets. Four items from Dweck (1999) were included to assess parents' intelligence mindsets (e.g., "People can learn new things, but they can't really change their basic intelligence", see Appendix D) (α = 0.76). Six items from Haimovitz and Dweck (2016) were used to assess their failure mindsets (e.g., "Experiencing failure debilitates performance and productivity", see Appendix E) (α = 0.68). Both intelligence and failure mindsets were scored on a 6-point Likert scale (1 = *strongly disagree* to 6 = *strongly agree*). Growth items were reverse scored, so that resulting higher average scores respectively indicated more fixed (vs. growth) views of intelligence and debilitating (vs. enhancing) views of failure. I further included 3 items to assess parents' brilliance mindsets on a 7-point Likert-scale (1 = *strongly disagree*, 3 = neither agree nor disagree, 6 = *strongly agree*), adapted from traditional intelligence mindset scale items (α = 0.81). See Appendix H for all items of the Brilliance Mindset Scale.

Alternative measures of mindsets (Barger et al., 2022) were included in the questionnaire for a more nuanced assessment of adults' implicit beliefs. Participants were asked to indicate "What percentage of intelligence is due to effort versus natural ability" on a sliding scale from 0 to 100% natural ability (vs. effort). Scores were reversed; higher scores indicated stronger growth mindsets. Next, participants read three vignettes about different characters who received low (17/100), average (55/100), and high (92/100) scores on a test. Participants were then asked to predict a future range of scores for the characters between 0 and 100. The difference between the range of predicted scores for each character were calculated and combined into a flexibility score (α = 0.93). For example, a participant who indicated 10 as a lowest score and 50 as a highest score for Person A who received an initial low score of 17 out of 100 had a resulting flexibility score of 40 (50 - 10) for the low score vignette. This calculation was repeated for participants' predicted scores for the average and high score vignettes and averaged together.

Higher average scores also indicated stronger growth mindsets. See Appendix I for complete alternative mindset scales.

Parents' beliefs about brilliance & gender roles. As in Study One, the Explicit Gender Brilliance Stereotype Endorsement and Awareness Scale (8 items, α = 0.84) (Bian et al., 2018) and the Questionnaire on Normative Gender Role Attitudes (16 items, α = 0.79) (NGRO; Athenstaedt et al., 2004; see Kollmayer et al., 2018b) were used to assess parents' endorsement of the Brilliance stereotype and their attitudes about men's and women's social roles.

Children's mindsets. Children's mindsets were assessed using an adapted version of Muradoglu and colleagues' Children's Mindset Scale (GM-C, Muradoglu et al., 2022). The adapted scale includes a total of six vignettes of different characters who are not good at math, spelling, and drawing (see Appendix J). Two vignettes were presented for each domain: one of a girl and one of a boy. The reason I did not match the gender of the characters to the gender of the participants was to attempt accounting for gender's potential influence on children's judgments about ability, in consideration of stereotypes about math (i.e., boys are better at math than girls) and language (i.e., girls are better than boys). The presentation order of the gendered vignettes was counterbalanced in that the sequence in which the vignettes featuring boy and girl characters were shown was varied systematically among participants. Participants were asked about the characters' potential for change over time (i.e., instability beliefs) and whether they believe the characters' ability can change with practice (i.e., malleability beliefs). The internal consistencies were strong for both the instability (6 items, α = 0.81) and malleability (6 items, α = 0.92) subscales. See Appendix J for complete scoring details.

3.2.4 Analysis Plan

Means and standard deviations for each feedback category were calculated to summarize the data. I analyzed gender's predictive effect on parental feedback using a Generalized Linear

Model (GLM) with Poisson regression. The number of attempted puzzles was included in the model as an offset variable. Statistical significance was determined using an alpha level of 0.05, and the results were interpreted in terms of incidence rate ratios (IRRs), providing an indication of the effect sizes. Upon finding significant effects of gender on the total amount of feedback, follow up Poisson regressions were conducted to explore gender's influence on the specific subtypes of feedback. Plus, Spearman correlations were conducted between the different subtypes of failure feedback.

Next, one sample t-tests were conducted to examine parents' reported scores against midpoint on the intelligence, failure, and brilliance mindset scales, as well as on the brilliance stereotyping and gender role questionnaires. Pearson correlation analyses were then performed to investigate the relationships between parents' mindsets and gender beliefs, and the association between parents' growth views using the traditional and alternative measures of intelligence mindsets. Further, similarly to study 1, the predictive effects of parents' mindsets on failure feedback were analyzed using follow up Poisson regressions.

Finally, one sample t-tests were conducted to examine children's own mindsets against midpoint, and a Linear Regression model was specified to examine the effect of children's gender and order of the vignettes as predictors of children's mindset scores on the GM-C. Lastly, Pearson correlations were used to assess the relationship between parents' mindset scores (both on the traditional and alternative scales) and children's mindset scores.

3.3 Results

Means and standard deviations for the total amount of feedback provided overall, as well as for the total amount of person- and process-oriented failure feedback, and product and other feedback are reported in Table 4. Again, the majority of feedback utterances provided were

product and other utterances. Most other utterances were provided as direct instructions given to children on how to do the challenging puzzles ($M = 7.23$, $SD = 7.56$; $M_{boys} = 7.34$; $M_{girls} = 7.11$) and questions parents had for their children, specifically pedagogical questions ($M = 5.84$, $SD = 7.89$; $M_{boys} = 6.75$; $M_{girls} = 4.89$). 88 parent-child pairs attempted all four puzzles ($N_{boys} = 42$; $N_{girls} = 45$). 12 participants attempted 3 puzzles ($N_{boys} = 7$; $N_{girls} = 5$), 8 two puzzles ($N_{boys} = 5$; $N_{girls} = 3$), and 5 children attempted only one puzzle ($N_{boys} = 3$; $N_{girls} = 2$).

Table 4

Study Two Examples and Descriptive Statistics of Failure Feedback

Failure Feedback	Examples	Girls	Boys	Total
Process	You need to practice (*effort*) You can try different ways (*strategy*) You can ask for help (*help*)	2.69 (2.57)	3.20 (3.23)	2.95 (2.92)
Person	It's too hard for you (*ability*) You have to finish in time (*performance*) *I* can't even do that (*social comparison*)	1.98 (3.17)	2.16 (2.13)	2.07 (2.68)
Product	Nice There you go That doesn't fit	5.15 (4.79)	6.71 (5.79)	5.94 (5.36)
Other	Hold and press (*technical instruction*) Move that piece there (*direct instruction*) It looks like a lion (*statement*) Where do you think that goes? (*question*) Let's go! (*encouragement*)	29.60 (25.00)	38.20 (27.20)	33.98 (26.40)
Total		40.58 (31.19)	51.36 (30.77)	46.02 (31.30)

Note. Means (standard deviations) of the number of utterances provided by parents.

I conducted a Poisson GLM with mixed-effects to analyze the effect of child's gender (girl, boy) on the amount of feedback utterances (i.e., count data) provided by parents, with number of attempted puzzles (out of 4) included as an offset variable. Based on model diagnostics using the Dharma package in R (Hartig, 2022), the following model best captured stochastic variability from individuals and number of puzzles attempted (offset variable, "completion") with no overdispersion, DV = TOTAL PP, IV = GENDER + OFFSET(LOG(COMPLETION)) + (1|ID), family = "poisson", data=). The lme4 package (Bates et al., 2015) in R (R version 4.3.1, R Core Team, 2023) was used for the main analysis and figures were created using ggplot2 (Version 3.3.5; Wickham, 2016).

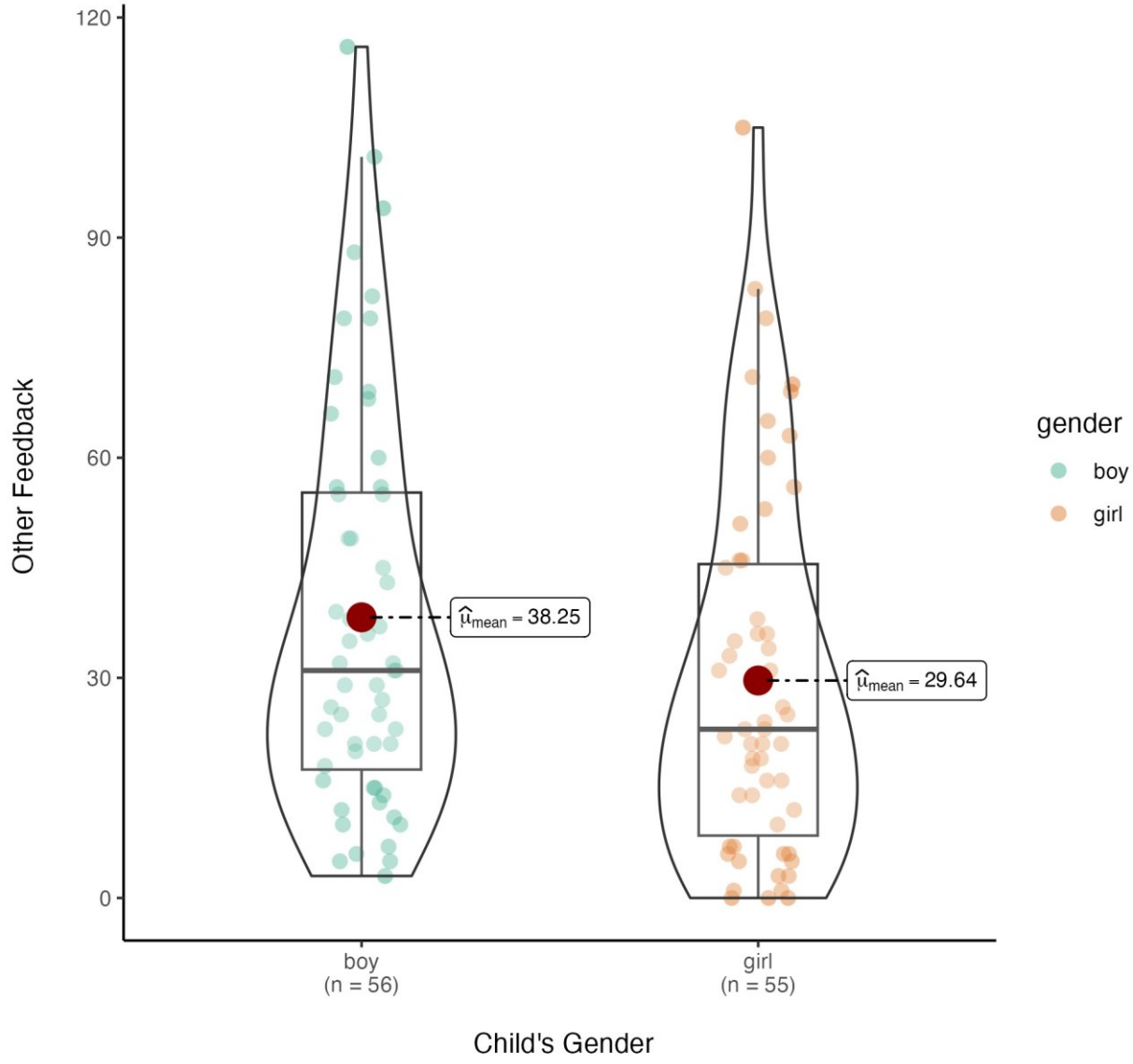
Overall, children's gender predicted the total amount of feedback utterances provided by parents (IRR = 0.40, 95% CI = 0.29 – 0.56, $p < 0.001$). That is, on average, girls receive 0.40 times the amount of total feedback compared to boys, meaning boys received approximately 2.5 times as much feedback as girls (1/IRR). Unlike Study One however, gender did not predict the total amount of feedback provided in person and process language, IRR = 0.80, 95% CI = 0.58 – 1.11, p = 0.18; there was no difference in the amount of person- (IRR = 0.68, 95% CI = 0.41 – 1.13, p = 0.14) nor process-oriented (IRR = 0.80, 95% CI = 0.53 – 1.20, p = 0.27) feedback messages provided to children based on their gender. Similarly, gender was not predictive of the amount of false growth feedback (e.g., "just keep trying"), IRR = 0.61, 95% CI = 0.27 – 1.38, p = 0.24. Instead, gender did predict the amount of product, IRR = 0.66, 95% CI = 0.45 – 0.98, p = 0.037, and other feedback messages, IRR = 0.42, 95% CI = 0.30 – 0.59, $p < 0.001$. On average, girls received 0.66 times the amount of product messages (e.g., "there you go", "well done") and 0.42 times the overall number of instructions, statements, and questions, compared to boys.

Upon further exploration of the other feedback categories, parents provided significantly more pedagogical questions (e.g., "where do you think that goes?", "what do you think is

next?"), IRR = 0.41, 95% CI = 0.24 – 0.72, p = 0.002, direct instructions (e.g., "that piece goes there", "turn that one"), IRR = 0.65, 95% CI = 0.43 – 0.99, p = 0.043, statements of encouragement (e.g., "let's go!", "you can do it!"), IRR = 0.61, 95% CI = 0.40 – 0.93, p = 0.023 to boys compared to girls, as well as more statements overall (e.g., "the puzzle looks like a lion"), IRR = 0.70, 95% CI = 0.53 – 0.94, p = 0.02. Gender did not predict the amount of technical instructions provided (e.g., "click and press"), IRR = 1.02, 95% CI = 0.71 – 1.45, p = 0.92, nor general questions, IRR = 0.60, 95% CI = 0.34 – 1.06, p = 0.08. See Figure 4 for a visual representation of total amount of other feedback utterances provided by gender.

Figure 4

Study Two Other Feedback by Children's Gender

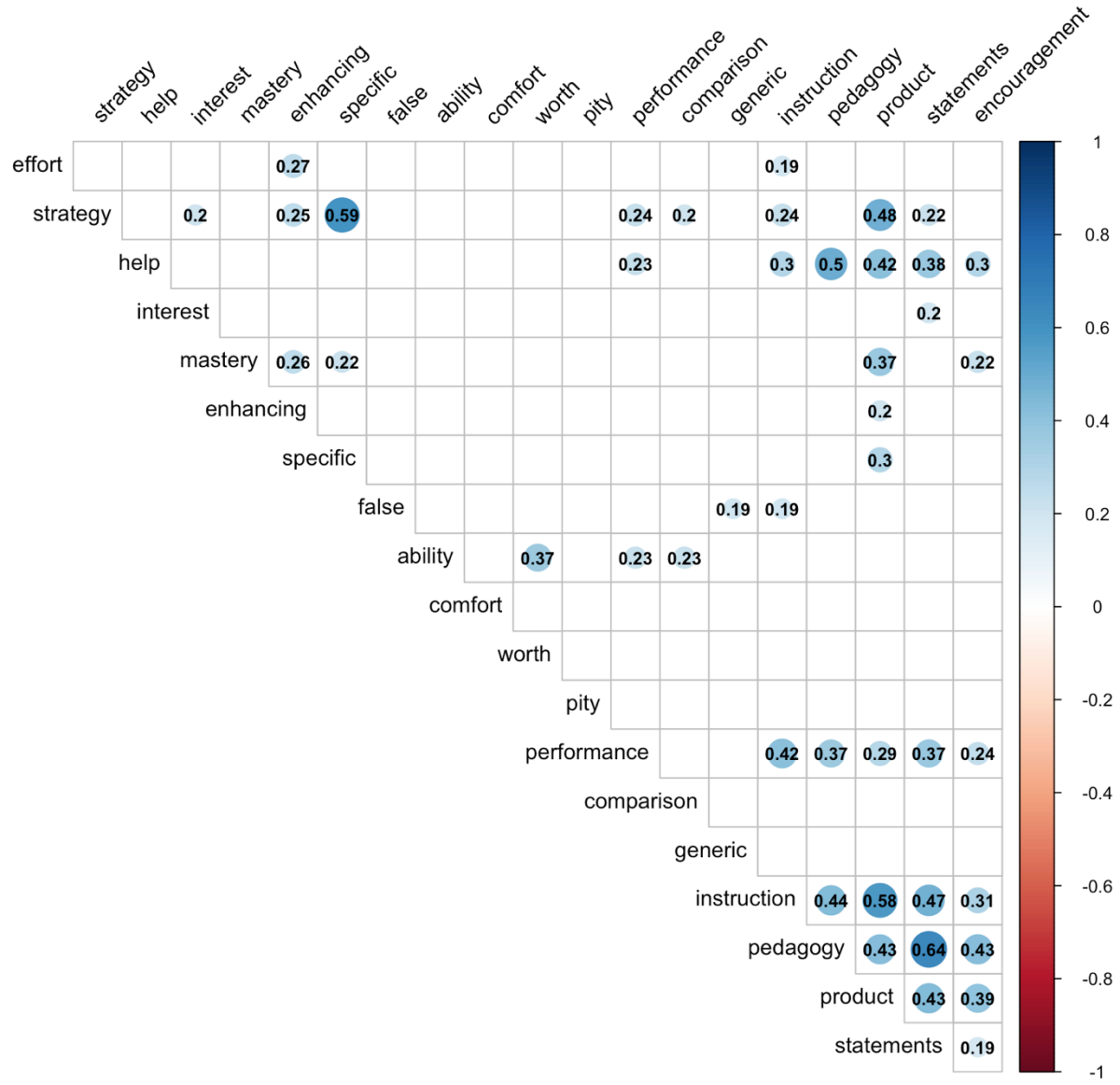


Note. Observed means and total amounts of other feedback utterances provided by parents in Study 2, plotted by children's gender (boy, girl). Error bars represent confidence intervals.

In addition to the GLM, Spearman rank-order correlations were conducted between the different types of feedback messages. I found significant intercorrelations among process oriented subcategories (e.g., strategy and specific language, $r(17) = 0.59$, $p < 0.001$), as well as associations among certain person-oriented subcategories (e.g., ability and worth, $r(17) = 0.37$, $p < 0.001$). Similarly to Study One, certain person-oriented categories were also associated to process messages – specifically, performance feedback was positively correlated with strategy messages, and help-seeking. I also examined the correlations between the person and process categories with the other feedback messages. Notably, pedagogical questions, instructions and product feedback were significantly correlated with process messages. Pedagogical questions were associated with help-seeking feedback ($r(17) = 0.50$, $p < 0.001$); direct instructions were associated with effort, strategy, and help; and product feedback was associated with strategy, help-seeking, mastery as a goal, failure as enhancing, and specific language. Interestingly, pedagogical questions, instructions and product were also associated with performance feedback. Finally, false growth messages were associated with generic language used by parents ($r(17) = 0.19$, $p = 0.04$) and instructions ($r(17) = 0.19$, $p = 0.04$). See Figure 5 for Spearman rank-order correlations.

Figure 5

Study Two Spearman Correlations between Failure Feedback Messages



Note. Spearman rank order correlations between the different type of person- and process-oriented feedback messages provided by parents. Statistical significance ($p < 0.05$) is indicated, with the size and color saturation of the circles representing the strength of the relationships.

Parents' mindsets, beliefs about brilliance and gender roles. In line with Study One, parents on average endorsed more growth intelligence mindsets, $t(78) = -8.59$, $p < .001$, 95% CI [2.50, 2.85] and enhancing views of failure $t(78) = -14.07$, $p < .001$, 95% CI [2.15, 2.48]. The Pearson correlation coefficient between parents' implicit beliefs about intelligence and failure was similar to that of Study One, yet marginally significant here, $r = 0.21$, $p = .06$. Study Two additionally assessed parents' brilliance mindsets, the mean score for which did not significantly differ from midpoint, $t(71) = 1.08$, $p = 0.28$, 95% CI [3.86, 4.47]. Parents' brilliance mindsets were significantly correlated with their intelligence mindsets; more fixed views of brilliance were related to more fixed views of intelligence, but their brilliance and failure mindsets were not related. As in Study One, parents reported low endorsement of the gender-brilliance stereotype, $t(78) = -16.76$, $p < .001$, 95% CI [1.92, 2.25] and more egalitarian (vs. traditional) roles of gender, $t(71) = -18.35$, $p < .001$, 95% CI [2.32, 2.65]. Again, scores on both measures were strongly correlated to each other and such gender-typed beliefs about brilliance and social roles were positively related to parents' mindsets: more fixed views of intelligence and brilliance, and debilitating views of failure were related to stronger endorsement of the brilliance stereotype. Debilitating views of failure were also associated to more traditional (vs. egalitarian) views of gender roles. See Table 5 for means, standard deviations, and correlations.

I further assessed parents' growth views using alternative measures of mindsets using Barger's (2022) False Growth Beliefs scales (i.e., the effort vs. ability measure and ability flexibility measure). Effort versus ability correlated with the traditional measure of intelligence mindsets and brilliance mindsets, in that more growth responses on the alternative measures were associated with lower fixed beliefs about intelligence and brilliance. The ability flexibility measure was not associated with traditional measures, and neither the effort nor flexibility

measure correlated with parents' failure mindsets, nor their stereotyping beliefs. See Table 5 for complete reporting of the correlations.

Table 5

Study Two Means, Standard Deviations, and Intercorrelations for Survey scales

Variable	*N*	*M*	*SD*	Pearson correlations 1	2	3	4	5	6
1.Intelligence mindset	79	2.66	0.87	—					
2.Failure mindset	79	2.31	0.75	.21	—				
3.Brilliance mindset	72	4.17	1.31	.66**	.18	—			
4.Brilliance stereotype	79	2.09	0.75	.34*	.28*	.31*	—		
5.Gender-role beliefs	72	2.48	0.70	.13	.33*	.19	.71**	—	
6.False growth									
effort vs. ability	81	47.81	20.16	-.27*	-.08	-.36*	.01	-.05	—
ability flexibility	77	33.82	29.62	.04	.03	.11	-.02	-.14	-.14

Note. *$p < 05$. **$p < 001$. Intelligence mindset, Failure mindset, and Brilliance stereotype on a 6-point Likert scale from strongly disagree to strongly agree (the midpoint is 3.5). Brilliance mindsets and Gender-role beliefs on a 7-point Likert-scale from *strongly disagree* to *strongly agree* (the midpoint is 4, neither agree nor disagree).

I ran a follow up series of regressions with intelligence, brilliance, and failure mindsets separately included in the primary GLM model as continuous predictors of the type of feedback provided by parents. Neither were significantly predictive of person-process feedback overall (intelligence mindsets, IRR = 1.13, p = 0.25; failure, IRR = 0.98, p = 0.89; brilliance, IRR = 1.06, p = 0.41). Accordingly, intelligence mindsets were not predictive of person- (IRR = 1.24, p = 0.14) nor process- (IRR = 1.04, p = 0.76) oriented feedback specifically, nor were parents' failure mindsets (person, IRR = 1.09, p = 0.60; process, IRR = 0.88, p = 0.43). Parents' mindsets also were not predictive of product feedback (intelligence mindsets, IRR = 1.07, p = 0.65; failure, IRR = 1.05, p = 0.78; brilliance, IRR = 1.15, p = 0.20), nor other feedback (intelligence mindsets, IRR = 1.17, p = 0.20; failure, IRR = 1.05, p = 0.76; brilliance, IRR = 1.03, p = 0.71).

Parents' intelligence, brilliance, and failure mindsets' predictive effects were further explored in interaction with children's gender. Intelligence and brilliance mindsets did not interact with gender to predict person (intelligence × gender, IRR = 0.97, p = 0.92; brilliance × gender, IRR = 0.98, p =0.91) or process (intelligence × gender, IRR = 1.30, p = 0.33; brilliance × gender, IRR = 1.22, p = 0.28) messages. The interaction between gender and failure mindsets was also not significant in predicting person feedback (IRR = 0.67, p =0.26). However, both the main effect and the interaction effect of parents' failure mindsets with gender in predicting process-oriented messages approached significance. Similarly to Study One, the main effect of parents' failure mindsets was marginally significant (IRR = 0.66, 95% CI = 0.41 – 1.05, p = 0.08), suggesting that increasing endorsement of a debilitating view of failure decreases the expected count of process feedback by a factor of 0.66. Additionally, the interaction between gender and parents' failure mindsets was also marginally significant (IRR = 1.71, 95% CI = 0.92 – 3.21, p = 0.09), suggesting that the relationship between parent's failure mindsets and the amount of process-oriented feedback provided differs by child's gender. Interestingly, for boys,

as parents increasingly endorse a debilitating view of failure, they provide process feedback at a rate that is 1.71 times higher than the rate at which they provide process feedback to girls. The amount of product messages provided did not differ as a function of children's gender and parents' intelligence mindsets (IRR = 1.10, p = 0.76), brilliance mindsets (IRR = 0.98, p = 0.94), nor failure mindsets (IRR = 1.05, p = 0.89). Similarly, no interaction effects were found to be significantly predictive of other feedback (intelligence × gender, IRR = 1.26, p = 0.35; brilliance × gender, IRR = 0.88, p = 0.45; failure × gender, IRR = 0.73, p = 0.27).

Lastly, no significant interactions between gender and parents' brilliance stereotyping and gender role attitudes were found. Parents' endorsement of the brilliance stereotype did not predict person (IRR = 0.86, p = 0.66), process (IRR = 1.05, p = 0.88), product (IRR = 1.33, p = 0.42), or other (IRR = 1.35, p = 0.30) feedback as a function of children's gender. Parents' attitudes about men's and women's social roles similarly did not significantly interact with gender to predict the amount of person (IRR = 0.92, p = 0.84), process (IRR = 1.20, p = 0.63), product (IRR = 1.22, p = 0.62), or other (IRR = 1.07, p = 0.84) feedback provided.

Children's mindsets. Children's instability and malleability scores on the GM-C scale were significantly correlated, r = 0.51, p < 0.001, and were thus averaged into a composite score (see Muradoglu et al., 2022). Overall, children endorsed stronger growth beliefs about intelligence (M = 0.22, SD = 0.22; t(97) = -12.86, p < .001, 95% CI [0.18, 0.26]. I specified a linear regression model with the composite mindset score as a dependent variable, and gender and order as predictors, lm(TOTAL_Avg ~ gender + order, data =). The overall model was not statistically significant (F(2, 90) = 0.20, p = .82) – children's gender (B = 0.01, SE = 0.05, p = .89) and order of presentation (B = -0.01, SE = 0.02, p = .55) were not statistically significant predictors of children's intelligence mindset scores on the GM-C. The residuals deviated significantly from a normal distribution (W = 0.86, p < .001), and upon visual inspection of the data, the histogram

plot revealed a left-skewed distribution. I ran a follow up robust linear regression with MM (Mestimation) to account for the deviation in residuals, and gender was nonetheless not a significant predictor, b = 0.025, SE = 0.039, p = .522.

I examined the relation between parents' intelligence and failure mindsets with their children's intelligence mindsets. Children's intelligence mindsets were not associated with their parents' intelligence mindsets, both on the traditional measure, r = -0.01 and the alternative measures (effort vs. ability, r = -0.10; ability flexibility, r = -0.04). Children's mindsets were also not associated with their parents' failure mindsets, r = -0.08.

3.4 Discussion

Study Two builds on Study One's exploration of parents' gendered failure feedback messages, explicitly highlighting intellectual brilliance in the presentation of the challenging puzzles, described as being for "kids who are really really smart". Overall, parents provided more feedback to boys than to girls, perhaps suggesting that boys are receiving more scaffolding in a variety of ways. Again, most of the feedback recorded did fall under other feedback categories (i.e., not specifically person- or process-coded utterances), including product, general statements, instructions, questions, and encouragement. Unlike Study One, children received an equal amount of person- and process-oriented feedback. Yet, while there was no gender difference in the amount of specifically labelled process- and person-oriented feedback, parents did provide more product focused feedback (e.g., "there you go", "well done", "that works", "not there"), pedagogical questions (e.g., "what do you think you should do next?", "where do you think that piece goes?"), instructions (e.g., "move that piece there", "turn it"), general statements ("that's a big puzzle"), and statements of encouragement ("you can do it!") to boys than to girls. Interestingly, such messages were associated with certain process-focused (i.e., growth)

feedback. That is, in the face of the challenging puzzles, parents who asked more pedagogical questions, and provided more instructions, comments, and encouragement in response to the outcome of their child's actions were also more likely to emphasize effort, strategy, mastery, and help-seeking behaviours as a means for learning, as well as speak of failure as enhancing.

While Study Two did not exactly replicate the finding that parents provided more messages in the specific language of process-oriented feedback to boys, the present results do offer support for the interpretation that boys are indeed receiving more overall support in contexts of failure than girls. Perhaps most notably, parents provided more pedagogical questions to boys. Pedagogical questions are questions that serve to facilitate learning and have been found to be used as a teaching tool among teachers and parents (Leonard et al., 2021; Yu et al., 2019). Here, exemplars of pedagogical questions commonly used by parents looked like "where do you think that piece goes?", "what do you think you should do next? and "how can you make that piece fit?". Such questions are intended to help the child learn in a manner that supports autonomy. In line with growth views, encouraging children to explore, analyze, and make choices in their learning process reflects a belief in the malleability of intellectual ability (Yeager & Dweck, 2020). Additionally, the correlations among feedback further support the interpretation that boys are indeed receiving more scaffolding: pedagogical questions were associated with help-seeking feedback (e.g., "you can ask for help if you need"), plus product feedback and instructions, which boys also received more of, positively correlated with many of the process categories (e.g., effort, strategies, mastery, and failure as enhancing). In sum, while an open question remains as to whether parents are more or less likely to employ explicit process- versus person-focused language to boys, parents are nonetheless providing more supportive feedback overall to boys compared to girls in the face of setbacks.

An alternative interpretation proposed in response to Study One's finding that parents provided more growth messages to boys was the possibility of said messages conveying underlying fixed views. That is, perhaps parents' endorsement of growth concepts could in part be explained through the lens of false growth beliefs. In line with the fixed nature of brilliance beliefs, it is reasonable to expect boys to receive more fixed messages about ability veiled in growth language. Study Two provides additional considerations for this interpretation. Upon further inspection of false growth feedback in Study Two, gender did not predict the amount of false growth messages (e.g., "just keep trying") provided to children. Plus, parents' growth beliefs (assessed using the alternative effort versus ability mindset scale) aligned with their intelligence mindsets, that is parents who reported more growth views about intelligence and brilliance using traditional assessments were also more likely to attribute intelligence to effort over ability on the alternative mindset scale, providing supporting evidence for true underlying growth views.

As in Study One, parents' debilitating views of failure were (marginally) associated with a lower overall rate of process feedback, however in Study Two, results suggest that the effect of holding debilitating views of failure on the rate of process feedback differs by gender. Specifically, for boys, as parents increasingly endorse more debilitating views of failure, they tend to provide process feedback at a higher rate compared to girls. This finding supports the notion that fixed beliefs about failure may influence the way parents provide process feedback, particularly to boys. Note that the effect was marginal and that the interaction between parents' failure mindsets and gender did not predict the amount of product or other types of feedback provided more to boys in Study Two. Another consideration for this alternative interpretation is the replication of the association between performance feedback and certain process-oriented messages, namely strategy and help related feedback. This recurring association might suggest

that performance-oriented intentions or fixed beliefs about ability could underlie such process-focused messages. It is also possible however that the performance category reflects aspects of the study's methodology rather than parents' underlying beliefs. That is, the puzzles being introduced, to children and their parents, with a two-minute limit to completion – suggesting a goal of the activity to finish the puzzles in time. Indeed, much of the performance coded feedback stressed the two-minute time limit: "hurry to finish in two minutes", "you have to finish in two minutes". Arguably, such messages could be in response to the implied *goal* of the puzzle activity itself, hence serving more motivational purposes rather than stressing fixed, person-oriented performance outcomes. Future research is necessary to further investigate the underlying beliefs that contribute to the observed gender differences in failure feedback, particularly the reasons *why* boys receive more supportive feedback overall.

I also aimed to explore the relation between parents' mindsets, and their brilliance beliefs and gender role attitudes. Overall, parents endorsed growth views of intelligence and held enhancing views of failure. In line with Haimovitz and Dweck (2016), these views were related to one another across both studies. Parents' mindsets were associated with parents' brilliance beliefs and gender attitudes; fixed views of intelligence and debilitating views of failure were linked to stronger brilliance stereotyping and more traditional views of gender roles. Parents' brilliance mindsets were associated to their endorsement of the brilliance stereotype in a similar way, such that fixed views of brilliance were related to stronger endorsement of the brilliance is male belief. Parents' brilliance mindsets were also associated with their beliefs about intelligence, but not failure, in that parents who held fixed views of intelligence were more likely to hold fixed views of brilliance. The correlations suggest that parents' beliefs about intelligence and failure are indeed related to their attitudes towards brilliance and gender roles, yet neither

parents' brilliance mindsets, brilliance stereotyping, nor gender role attitudes were predictive of the failure feedback provided.

An additional consideration of Study Two was children's own implicit beliefs about intelligence, i.e., children's intelligence mindsets. Inspired by Muradoglu et al. (2022), I asked children about the instability and malleability of intellectual ability of different vignette characters, and found no difference in children's mindsets based on gender; both boys and girls were more likely to endorse growth beliefs. Methodologically, the Children's Mindset Scale (GM-C) used here was adapted from the original version (Muradoglu et al., 2022), to include two explicit gender labels for the characters in each domain (i.e., both a boy and a girl vignette were presented for each domain). In light of the data distribution highlighting a notable tendency to endorse growth responses on the GM-C, the presentation of the resulting *six* vignettes (vs. original three) may have led to practice effects among participants. That is, the increased repeated exposure of the items may have inadvertently influenced participants' responses to consistently select the same answers to the questions due to familiarity with the questionnaire format and item content.

Finally, neither parents' intelligence mindsets nor their failure mindsets were related to their children's mindsets. That being said, the lack of association between parents' and their children's mindsets here is not necessarily evidence against the assertion that failure mindsets are predictive of children's implicit beliefs about ability (see Haimovitz & Dweck, 2016). Rather, Study Two further highlights the complexity of how beliefs about intellectual ability are actually transmitted. A contributing factor to the lack of straightforward predictive results found in hypothetical scenarios, could be attributed to the varied forms of messages overall that children receive in real-world settings (see Leonard et al., 2021), reflecting a not so binary (i.e., growth versus fixed) nature of mindset transmission.

Chapter 4: General Discussion

4.1 Summary of Research Findings

The brilliance stereotype describes the gender-typed association of natural brilliance or high intellectual ability with men over women, reflecting a deeply ingrained gender bias in society (Leslie et al., 2015; Meyer et al., 2015). This stereotype not only attributes innate brilliance more frequently to men (e.g., Storage et al., 2020) but also leads to differential parenting practices (e.g., Stephens-Davidowitz, 2014; Tenenbaum & Leaper, 2003; Vial & Cimpian, 2020; Zhao et al., 2022). In general, praise for natural ability tends to be more prevalent for boys, especially when their performance aligns with societal gendered expectations of brilliance (see Vial & Cimpian, 2020). However, Haimovitz and Dweck (2017) highlight that response to failure versus success reveals crucial insights into how messages about the nature of intellectual ability (i.e., mindsets) are being transmitted to children. Specifically, it is less how adults respond to success that informs children's implicit beliefs about ability, but instead how they respond to failure. The present research project placed children and their parents in a not so uncommon context of failure: doing challenging puzzles together. Inevitably, children did not perform brilliantly, and I in turn explored parents' responses to their failure. Across both Study One and Two, more overall scaffolding was recorded in the response provided to boys compared to girls in such challenging contexts. The following discussion summarizes the findings, then considers their implications in the context of our stereotyped beliefs about intellectual ability and how they are transmitted.

Study One and Study Two both took an exploratory approach to examining the feedback parents provide to their 5- and 6-year-old children during a challenging puzzle task. Specifically, I examined parent's failure feedback as a potential source of gendered messages about

intellectual ability. As children struggled with the puzzles in both studies, parents offered a mix of messages to their children: feedback that focused on inherent traits or abilities (i.e., person); efforts and strategies (i.e., process); responses to children's actions (i.e., product); as well as a lot of instructions, statements about the puzzles, questions for their children, and encouragement. I explored whether feedback highlighting effort (i.e., process) versus natural ability (i.e., person) differs based on children's gender.

Higher rates of certain growth-oriented feedback messages were provided to boys compared to girls, yet parents spoke more to boys, overall, across most failure feedback categories. In Study One, parents provided boys with more feedback emphasizing strategies like trying different approaches to the puzzles (e.g., "maybe you can try turning the pieces in different ways"). In Study Two, parents commented more on boys' actions (e.g., like moving a piece to the right spot, "there you go" or wrong spot, "that doesn't fit there"), provided more statements (e.g., "that's a lot of pieces") and explicit instructions for completing the puzzles (e.g., "move that piece there"), asked significantly more pedagogical questions (e.g., "where do you think that piece goes?"), and offered more encouraging statements (e.g., "let's go!") to boys compared to girls – feedback messages which were associated with process-oriented messages. Such findings may suggest a gendered pattern in parental responses, with boys receiving more emphasis on effort and learning strategies in the face of setbacks compared to girls. Yet, the interpretation of the data remains unclear as to whether boys are indeed receiving more messages that are specifically process-typed or more broadly, that boys are receiving more scaffolding and support in general from parents, compared to girls. Overall, boys received more combined person- and process-oriented utterances (Study One) and total amount of feedback all together (Study Two) than girls did, which could simply indicate that parents are coaching their boys more through the task than they are coaching their girls, in a variety of ways. Nonetheless, the present work does

suggest that boys are indeed afforded more support in the face of setbacks, highlighting an interesting venue for future research to investigate the qualitative nature of the gendered differences in messages children receive.

Both empirical studies also examined parents' own implicit beliefs about intellectual ability and how such reported beliefs may be reflected in the types of feedback messages parents provide to their children. Across Studies One and Two, the findings support well-established literature suggesting that fixed, essentialized thinking tends to be associated with negative gender stereotyping in general (Bastian & Haslam, 2006; Levy et al., 1998). Parents' who held fixed views of intelligence were more likely to hold limiting beliefs of failure and fixed views of brilliance. Parents who endorsed such fixed views were also more likely to agree with statements in line with the brilliance stereotype such as "extreme intellectual brilliance is more common in men than in women" and "on average, men tend to have higher intellectual capacities than women". Across both studies, parents' brilliance stereotyping and gender role attitudes were not predictive of the feedback they provided, regardless of children's gender. Parents' implicit beliefs about intelligence were also not related to their feedback, and neither did intelligence beliefs interact with children's gender. Instead, in support of Haimovitz and Dweck's (2016) findings, parents' implicit beliefs about failure were suggested to be predictive of the amount of process feedback provided, in that debilitating views of failure were associated with less process messages overall. However, failure beliefs may not be influencing feedback provided to all children in the same way: parents' debilitating views of failure were suggested to be related to increased process feedback provided to boys, but not girls. The present exploratory findings build on past work and encourage further investigation of parents' failure (vs. intelligence) mindsets in understanding the transmission of implicit beliefs about abilities to children. The findings reveal

a complex relationship between parents' beliefs about intelligence and failure, in particular how these beliefs are not being conveyed in a straightforward way through feedback to their children.

4.2 Gender Stereotypes and Intellectual Ability

Explicit expressions of gender biases are less socially acceptable than they once were (Swim et al., 1995). While adults are unlikely directly telling children that boys are brilliant and girls are not, they may still indirectly convey beliefs about intellectual gender differences through subtle cues in their language and behaviors. The increased feedback provided in response to boys' failures compared to girls' (Study One and Two), especially in contexts of brilliance (Study Two), may serve to attribute boys' "less than brilliant" performance (i.e., failures) to insufficient effort rather than lack of inherent ability. In the context of the present study, boys are being afforded more luxury to work through intellectual challenges, perhaps with the implication that they *can* do better – even brilliantly – if they just tried harder. Conversely, girls are not scaffolded as much in the face of failure; girls received fewer strategies and were provided less room for autonomy, perhaps implicating the belief that they *cannot* do better. In line with the present findings, past research shows that parents tend to engage boys more frequently than girls in intellectually challenging conversations in general; that is, boys receive more detailed math and science explanations and instructions (e.g., Chang et al., 2011; Crowley et al., 2001), as well as more causal explanations, conceptual questions, and are exposed to more scientific vocabulary than girls.

Girls are not only not praised for personal brilliance (Cimpian et al., 2016; Fennema et al., 1990; Napp & Breda, 2022; Yee & Eccles, 1988) but, as our results suggest, would also lack the support and tools needed to navigate failure positively. Boys are praised for their intellectual abilities and offered more encouragement for their efforts in failure situations (Dweck et al.,

1978). This inverted pattern of evaluative feedback perpetuates the belief that boys are naturally brilliant while girls must work hard to compensate for a perceived lack of innate ability, highlighting a nuanced view on beliefs about brilliance. That is, in line with the notions of universal mindsets (Rattan, Good, et al., 2012; Rattan, Savani, et al., 2012), only certain individuals, namely boys, possess the potential for brilliance, which, as it is conveyed in the responses to their failures, can be actualized through effort. Girls are not perceived as inherently capable of brilliance; their achievements are reflections of effort and in situations of failure, the value of their efforts is diminished. In other words, girls may be less likely to receive as much supportive feedback in response to failure because they are already perceived to be trying their best – their failures are hence taken as evidence for a lack of ability. We find tangential support for such reasoning in students' beliefs of others' perceptions of them: boys and girls tend to think that people believe boys' intelligence can improve more with effort than girls', whereas girls' who are viewed to be putting in a lot of effort are not perceived has having as much potential for future success (Verniers & Martinot, 2015). We see similar discounting of the value of effort in attributions of talent, likelihood of future success and hireability with people described as "strivers" over people described as "naturals" (Tsay & Banaji, 2011). In sum, a compelling explanation for why parents provide more feedback to boys compared to girls is that girls' increased effort in the face of failure is perceived as futile because, in line with the brilliance stereotype, girls are not believed to possess the natural potential for brilliance (see also Di Battista, 2024). Boys' effort, on the other hand, is believed to lead to the realization of their high intellectual potential – allowing their intrinsic brilliance to shine.

Such an interpretation also serves to help explain evidence for gender differences, or the lack thereof, in mindsets. Empirical findings often reveal either no significant gender differences (e.g., Haimovitz & Dweck, 106; Tucker-Drob et al., 2016; Yan et al., 2014), or differences that

lean towards girls being more inclined to growth mindsets over fixed mindsets (e.g., Macnamara & Rupani, 2017; Muradoglu et al., 2022). The present findings further suggest the former; in Study Two, both girls and boys endorsed stronger growth beliefs. Despite this trend, girls are generally more likely to face repercussions typically associated with fixed beliefs. Girls are less likely to view themselves as inherently brilliant (Bian et al., 2017), show less interest in activities and fields that are associated with brilliance (Bian et al., 2018; Leslie et al., 2015; Meyer et al., 2015), and are even suggested to display more avoidance in the face of challenges (Dweck, 2007; see also Napp & Breda, 2022). In a recent study commissioned by LEGO for example, researchers found that girls between the ages of 5 and 12 show reluctance to taking creative risks and express fear of failure from societal pressures of perfection (LEGO, 2023). The apparent paradox between girls' growth views and the behavioural consequences typically associated with fixed beliefs likely stems from *environments* that inherently convey girls' intellectual ability as limited, rather than from girls' own implicit beliefs about ability alone.

The present studies suggest a potential feature of how such fixed beliefs about girls' ability may be conveyed in their surroundings: while girls may not be getting more explicit fixed messages about ability than boys (i.e., girls are not directly being told that they are not brilliant), the comparative lack of support and effort encouragement in situations of failure may nonetheless inadvertently convey fixed perceptions about their abilities. In turn, such fixed perceptions may lead to consequential behavioural effects. Some examples are found in school settings: students are more inclined to feel anxious, hopeless, and less motivated in classroom settings in which their teachers endorse fixed views of ability compared to having teachers with growth views, (Heyder et al., 2020, 2023; Heyder & Brunner, 2018; Mesler et al., 2021; Seo & Lee, 2021). This potential indirect communication of perceived fixed beliefs about girls' intelligence also speaks to the intriguing finding that while parents' fixed mindsets are related to

endorsing more gender stereotypes about ability, these beliefs do not directly translate into how parents talk to their children. Parents may hold certain fixed beliefs about ability and gender, yet these beliefs do not necessarily manifest in their *explicit* feedback or conversations with their children – at least not in the ways that might have been expected, i.e., debilitating views of failure and limiting beliefs of gender leading to more person- (vs. process-) oriented feedback.

Such findings underscore the multifaceted nature of the socialization of gendered messages about intelligence. The following section speaks to the practical implications of the findings and offers considerations for a holistic approach toward effectively addressing the transmission of our implicit beliefs about intellectual ability.

4.3 Implications for The Transmission of Growth Beliefs

We often turn to growth mindset interventions to mitigate consequences for negatively stereotyped or underrepresented groups. And with seemingly good reason, growth mindset interventions lead to beneficial outcomes for said groups (e.g., Aronson et al., 2002; Blackwell et al., 2007; Claro et al., 2016; Good et al., 2003; Lin-Siegler et al., 2016; Paunesku et al., 2015; Rattan et al., 2015; Yeager et al., 2016): teaching growth mindsets, for example, encourages women's interest and motivation in fields associated with brilliance (e.g., Degol et al., 2018; Smith et al., 2013). Yet, while the underlying aim of fostering value in effortful learning and development is meaningful (Yeager et al., 2016; Yeager & Dweck, 2012, 2020), targeting specific groups in silos without addressing broader cultural stereotypes may offer suboptimal solutions to the negative effects of stereotyping. In recent years, we have witnessed critical considerations of growth mindset interventions. Some have suggested that many of the overall effects found in interventional studies are nonsignificant (Macnamara & Burgoyne, 2023), or that growth

mindsets alone might not be driving the effects of the interventions and that we have yet to uncover the factors that might be (Sisk et al., 2018). Others point to heterogeneity of the effects (i.e., different effects for different people and contexts, e.g., Burnette et al., 2023) to explain the inconsistency in certain systematic reviews of the findings (see Yeager & Dweck, 2020). In the spirit of growth, such critical considerations of mindset interventions provide valuable insights for working toward more effectiveness in their practical applications.

Indeed, much can be learned from successful implementations of growth mindset interventions. Take for example the features of certain growth mindset protocols that have shown promise in improving academic outcomes and reducing gender disparities. The most well-cited mindset intervention study to date (i.e., Blackwell et al., 2007) includes stereotyping lessons about gender (e.g., the nature of stereotyping and its pitfalls) in addition to standard growth lessons about intelligence in their experimental protocol. In fact, many interventions involve multiple factors alongside the growth lessons (see Macnamara & Burgogne, 2023), interestingly many of which echo the types of feedback boys were more likely to receive across both studies here (e.g., effort encouragement, Li & Bates, 2019; strategies to overcome challenges and support for reaching out for help when needed, Burnette et al., 2020). Smith et al. (2013) offer another promising example in their implementation of a mindset intervention that normalized effort as critical for success for *everyone*. Women reported more self-competence, motivation, and feelings of belonging when told that "like everyone else, [they] would likely have to put in a lot of effort" to achieve success compared to just being told that "[they] would likely have to put in a lot more effort than other people". The protocol simulates a context that demystifies the perceived assumption that natural ability is required for success and assigns equivalent value to effort for everyone versus a select few (see also Rattan et al., 2012).

Social context and cues about the nature of intellectual ability do indeed play an important role in promoting the beneficial outcomes typically associated with growth mindsets. Many recent large-scale interventions support that the teaching of growth mindsets shows greatest promise when the features of the environments they are applied in align with growth views (e.g., Mesler et al., 2021; Porter et al., 2022; Walton & Yeager, 2020; Yeager et al., 2022). In contrast, perception of fixed mindsets, for example, in STEM classrooms negatively impacts students' motivation, engagement and experiences, especially undermining women's performance (Canning et al., 2019, 2022; Heyder & Brunner, 2018; LaCosse et al., 2021; Muenks et al., 2020; Seo & Lee, 2021). That being said, although an intuitive response to our pattern of results (i.e., girls not receiving as much process feedback in response to failure as boys) could be to merely provide girls with more growth-oriented messages, doing so in isolation may only further reinforce the "inference that effort compensates for a lack of ability" (Vial, Cimpian, 2020; see also Amemiya & Wang, 2018). Girls may accept tenets of growth beliefs, but if girls see that their setbacks are perceived as reflecting an innate lack of intellectual ability, their behaviour may be less in line with their own implicit beliefs (see Walton & Yeager, 2020).

A final consideration for the transmission of growth beliefs relates to a notable feature of the findings - the mixed nature of the feedback provided to children. Across both studies, almost all parents provided both person- and process-oriented messages, in addition to mostly other feedback including product-focused comments, instructions, questions, encouragement, and general statements about the puzzles. In contrast to the portrayal of straightforward fixed versus growth messages in response to hypothetical failure scenarios (e.g., Haimovitz & Dweck, 2016), the results here are in line with what appears to be more common real world parenting practices (e.g., Leonard et al., 2021). This complexity is likely a significant factor in the lack of clear correlations between parents' mindsets and their children's mindsets. As is often noted in the

research literature (Gunderson et al., 2013; Haimovitz & Dweck, 2016; Park et al., 2016), adults' implicit beliefs about ability seldom align with their children's beliefs – here, neither parents' intelligence mindsets nor their failure mindsets were related to their children's mindsets. While there might be trends suggesting parents' implicit beliefs about failure could predict specific types of feedback (Haimovitz & Dweck, 2016), such as the marginal trend highlighting parents' enhancing views of failure as predictive of more process-oriented feedback, such trends may not be consistent enough to establish a clear, direct link between parents' beliefs and the transmission of those beliefs. Indeed, such implicit failure beliefs may also be interacting with children's gender to predict process messages in ways that align with fixed beliefs about boys' innate brilliance, wherein stronger fixed views of failure predict more process feedback to boys in particular (Study Two). The present work acknowledges the complex, messy reality of how beliefs are communicated within parent-child dynamics: parents are not singular in the messages they provide; instead, they deliver a mix of messages that reflect both fixed and growth views.

Such mixed messages likely have differing effects on children's behaviour. For example, while children's persistence after failure increases the more non-generic praise children receive (i.e., process-oriented, e.g., "you did a good job drawing"), even a small proportion (25%) of non-generic messages among mostly generic praise (i.e., person-oriented, e.g., "you are a good drawer") has been shown to lead to higher self-evaluations (Zentall & Morris, 2010). Plus, certain feedback boys received more of in the present studies was associated with performancefocused messages. While performance goals are typically linked to fixed mindsets (Haimovitz & Dweck, 2016), perhaps such messages might be serving to convey more comprehensive growth views. In line with the cautionary tales of distilling growth beliefs down to mere effort (Amemiya & Wang, 2018; Dweck, 2015; Dweck, 2017), focus on effort alone is not sufficient for fostering true growth mindsets. Instead, integrating the process with an

outcome, by connecting efforts to tangible goals for example, provides a more genuine understanding of the correlation between individuals' actions and the eventual achievement outcomes. In sum, the noted complexity of feedback children receive in response to failure can have varied implications for the transmission and development of children's own beliefs about intellectual ability.

4.4. Limitations and Future Directions

The present work explored the messages girls and boys receive from their parents in response to failure as a potential source of gender stereotypes about intellectual ability. In exploring the development of children's stereotypical beliefs however, it is imperative to address the broader context of social identities, particularly across intersections and beyond the gender binary. The following section highlights the need for a broader understanding of how diverse social inputs inform children's beliefs, underscoring the significance of a holistic approach in studying the environmental influences on children's social cognition.

Social identities beyond the gender binary are further factors to consider in the acquisition of children's brilliance beliefs. The intersection between brilliance beliefs and race, for example, remains unclear. The findings are mixed as to whether high intellectual ability is associated exclusively to white men. Some findings suggest that both adults and children associate brilliance to white and Black men over women (Storage et al., 2022), while there is growing evidence to suggest that the intersections of different social identities may indeed be informing the construction of children's stereotypes (e.g., associating brilliance with White and Asian men, but not with Black men, Jaxon et al., 2019; Zhao et al., 2022). As for gender, here I looked at messages provided to boys and girls as the gender binary is still the most salient use of gender categorization in the research literature and made up the overwhelming majority of

reported gender identities provided by parents for the 5- and 6-year-olds in our studies. By referring to the binary, we can directly name and address some of the issues related to gender that continue to persist in our societies, yet there is a lack of research consideration for such beliefs among individuals who identify beyond the binary. A more complete understanding of the development of brilliance beliefs among children is necessary because mindsets and gender stereotypes have varying implications across different groups (i.e., do not apply equally, Malespina et al., 2022; Purdie-Vaughns & Eibach, 2008).

Further, while the focus of the present study is on *parents*' communication of intelligence beliefs, we must not overlook the plethora of socialization agents in children's environments. Caregivers, educators, peers, media are all essential contributors to children's development, and each have their own role to play in the transmission of gendered beliefs across generations (Martin & Ruble, 2004; Rubin et al., 2011; Tenenbaum & Leaper, 2002). Children's peer groups, for example, can already serve gatekeeping roles for growth opportunities that highlight high intellectual ability, as six-year-olds are less likely to choose girls as teammates for games described as being "for really really smart kids" (Bian et al., 2018). Children's media also presents a notable source for cultural beliefs about brilliance: messages associating brilliance with men is prevalent in film history over the last 50 years (Gálvez et al., 2019). Our future technologies are already showing signs of the same bias; for example, text outputs from large language models like ChatGPT tend to reflect biases consistent with gender stereotypical information (e.g., using more communal and social language to generate text for women compared to men, Kaplan et al., 2024; see also Acerbi & Stubbersfield, 2023). In sum, parents are undoubtedly prominent influencers in children's development, but by no means are they the sole source of gendered messages. Plus, socialization is not a one-way direct transmission of information from parents to children. Instead, it is a dynamic interplay between social actors.

Here, parents provided feedback in response to children's failures, but not all feedback utterances were spontaneous; some were in response to children's own solicitations (e.g., "does this go here?"). It is worth examining the dynamism of the parent-child socialization process more closely. Future research would benefit from a more holistic approach to the environmental profiles that influence children's beliefs.

Finally, our understanding of children's mindsets is in its infancy, particularly in how children conceptualize intelligence versus brilliance. Although the present work looked at messages children hear about intellectual ability, we cannot infer causality from the data regarding the transmission between said messages and children's mindsets nor their stereotyped beliefs about brilliance. Instead, the present exploration provides valuable insights about the features of the social environment children navigate and the potential cues they are receiving about intellectual ability – pointing to interesting aspects of parent-child interactions worth further investigation. Similarly, although the results here do not exactly replicate Haimovitz and Dweck's (2016) finding that parents' failure mindsets predict the type of feedback they provide, this does not necessarily negate their proposal. The primary GLM Poisson regressions utilized here highlighted interesting trends in the data, offering a rich exploration of subtle influences of gender on parents' failure feedback, however, it is important to note that the power to detect effects was below 80%. Accordingly, including parents' mindset scores as additional predictors added further complexity to the model, potentially affecting its robustness. That being said, future research should continue to explore parent-child dynamics in the transmission of beliefs about intelligence and brilliance, providing further data and insights to enhance our understanding of the patterns of parental influence on these beliefs.

Further, such research on *how* said beliefs are being transmitted to children must consider children's own developing mindsets. Here, I looked at children's mindsets about intelligence

using an adapted version of the GM-C (Muradoglu et al., 2022), but research has yet to consider children's mindsets about brilliance specifically. Continuing to investigate the development of children's mindsets in tandem with gender stereotypes about ability may reveal nuances such as potential similarities in endorsement of implicit beliefs about intelligence but differences in beliefs about brilliance (i.e., conceptualizing intelligence and brilliance differently). Such next steps will advance our understanding of mindset development and its intersection with gender beliefs, providing further valuable information for effective intervention practices.

4.5 Conclusion

More broadly, the implications of the present research area extend beyond students' achievements and increasing women's representation in high-status positions to address the issue of assigning value predominantly to men. Parallel to the strikingly early onset of the gender brilliance stereotype (i.e., 6-year-old children's ratings of boys as more "really really smart" than girls, Bian et al., 2017), children similarly assign more social status to masculinity from a young age (Liben et al., 2001; Mandalaywala et al., 2020; Terrizzi et al., 2019). The concept of brilliance as a marker of status raises concerns about the equitable assignment of societal value, particularly concerning gender roles. Professions predominantly occupied by women (e.g., education and nursing) are consistently perceived as less intellectually demanding compared to fields dominated by men esteemed as requiring higher levels of natural intellect (Leslie et al., 2015). These stereotypical beliefs perpetuate gender disparities within various disciplines and can significantly influence policymaking and resource allocation decisions, ultimately contributing to the chronic undervaluation of women's roles in society.

The current research took a developmental approach to exploring features in children's environments that potentially reinforce beliefs that likely serve to sustain such social hierarchies.

Addressing these broader concerns requires interventions that challenge existing perceptions and attributions, emphasizing the importance of broader societal changes rather than solely targeting underrepresented or negatively stereotyped groups with messages of equivalence in intellectual ability.

References

Acerbi, A., & Stubbersfield, J. M. (2023). Large language models show human-like content biases in transmission chain experiments. *Proceedings of the National Academy of Sciences*, *120*(44), e2313790120. https://doi.org/10.1073/pnas.2313790120

Ambady, N., Shih, M., Kim, A., & Pittinsky, T. L. (2001). Stereotype Susceptibility in Children: Effects of Identity Activation on Quantitative Performance. *Psychological Science*, *12*(5), 385–390. https://doi.org/10.1111/1467-9280.00371

Amemiya, J., & Wang, M.-T. (2018). Why Effort Praise Can Backfire in Adolescence. *Child Development Perspectives*, *12*(3), 199–203. https://doi.org/10.1111/cdep.12284

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing the Effects of Stereotype Threat on African American College Students by Shaping Theories of Intelligence. *Journal of Experimental Social Psychology*, *38*(2), 113–125. https://doi.org/10.1006/jesp.2001.1491

Athenstaedt, U., Haas, E., & Schwab, S. (2004). Gender Role Self-Concept and Gender-Typed Communication Behavior in Mixed-Sex and Same-Sex Dyads. *Sex Roles*, *50*(1/2), 37–52. https://doi.org/10.1023/B:SERS.0000011071.68830.48

Barger, M. M., Xiong, Y., & Ferster, A. E. (2022). Identifying false growth mindsets in adults and implications for mathematics motivation. *Contemporary Educational Psychology*, *70*, 102079. https://doi.org/10.1016/j.cedpsych.2022.102079

Bastian, B., & Haslam, N. (2006). Psychological essentialism and stereotype endorsement. *Journal of Experimental Social Psychology*, *42*(2), 228–235. https://doi.org/10.1016/j.jesp.2005.03.003

Bates D, Mächler M, Bolker B, Walker S (2015). "Fitting Linear Mixed-Effects Models Using lme4." *Journal of Statistical Software*, **67**(1), 1–48. doi:10.18637/jss.v067.i01.

Bem, S. L. (1983). Gender Schema Theory and Its Implications for Child Development: Raising Gender-Aschematic Children in a Gender-Schematic Society. *Signs: Journal of Women in Culture and Society*, *8*(4), 598–616. https://doi.org/10.1086/493998

Bian, L., Leslie, S.-J., & Cimpian, A. (2017). Gender stereotypes about intellectual ability emerge early and influence children's interests. *Science*, *355*(6323), 389–391. https://doi.org/10.1126/science.aah6524

Bian, L., Leslie, S.-J., Murphy, M. C., & Cimpian, A. (2018). Messages about brilliance undermine women's interest in educational and professional opportunities. *Journal of Experimental Social Psychology*, *76*, 404–420. https://doi.org/10.1016/j.jesp.2017.11.006

Bianco, M., Harris, B., Garrison-Wade, D., & Leech, N. (2011). Gifted Girls: Gender Bias in Gifted Referrals. *Roeper Review*, *33*(3), 170–181. https://doi.org/10.1080/02783193.2011.580500

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit Theories of Intelligence Predict Achievement Across an Adolescent Transition: A Longitudinal Study and an Intervention. *Child Development*, *78*(1), 246–263. https://doi.org/10.1111/j.1467-8624.2007.00995.x

Boston, J. S., & Cimpian, A. (2018). How Do We Encourage Gifted Girls to Pursue and Succeed in Science and Engineering? *GIFTED CHILD TODAY*, *41*(4).

Brown, C. S., Biefeld, S. D., & Tam, M. J. (2020). *Gender in Childhood* (1st ed.). Cambridge University Press. https://doi.org/10.1017/9781108874281

Burnette, J. L., Billingsley, J., Banks, G. C., Knouse, L. E., Hoyt, C. L., Pollack, J. M., & Simon, S. (2023). A systematic review and meta-analysis of growth mindset interventions: For whom, how, and why might such interventions work? *Psychological Bulletin*, *149*(3–4), 174–205. https://doi.org/10.1037/bul0000368

Burnette, J. L., Hoyt, C. L., Russell, V. M., Lawson, B., Dweck, C. S., & Finkel, E. (2020). A Growth Mind-Set Intervention Improves Interest but Not Academic Performance in the Field of Computer Science. *Social Psychological and Personality Science*, *11*(1), 107–116. https://doi.org/10.1177/1948550619841631

Canning, E. A., Muenks, K., Green, D. J., & Murphy, M. C. (2019). STEM faculty who believe ability is fixed have larger racial achievement gaps and inspire less student motivation in their classes. *Science Advances*, *5*(2), eaau4734. https://doi.org/10.1126/sciadv.aau4734

Canning, E. A., Ozier, E., Williams, H. E., AlRasheed, R., & Murphy, M. C. (2022). Professors Who Signal a Fixed Mindset About Ability Undermine Women's Performance in STEM. *Social Psychological and Personality Science*, *13*(5), 927–937. https://doi.org/10.1177/19485506211030398

Chang, A., Sandhofer, C. M., & Brown, C. S. (2011). Gender Biases in Early Number Exposure to Preschool-Aged Children. *Journal of Language and Social Psychology*, *30*(4), 440–450. https://doi.org/10.1177/0261927X11416207

Cheryan, S., Master, A., & Meltzoff, A. N. (2015). Cultural stereotypes as gatekeepers: Increasing girlsâ€™ interest in computer science and engineering by diversifying stereotypes. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00049

Chestnut, E. K., & Markman, E. M. (2018). "Girls Are as Good as Boys at Math" Implies That Boys Are Probably Better: A Study of Expressions of Gender Equality. *Cognitive Science*, *42*(7), 2229–2249. https://doi.org/10.1111/cogs.12637

Chestnut, E. K., Zhang, M. Y., & Markman, E. M. (2021). "Just as good": Learning gender stereotypes from attempts to counteract them. *Developmental Psychology*, *57*(1), 114–125. https://doi.org/10.1037/dev0001143

Cimpian, A., Arce, H.-M. C., Markman, E. M., & Dweck, C. S. (2007). Subtle Linguistic Cues

Affect Children's Motivation. *Psychological Science*, *18*(4), 314–316. https://doi.org/10.1111/j.1467-9280.2007.01896.x

Cimpian, J. R., Lubienski, S. T., Timmer, J. D., Makowski, M. B., & Miller, E. K. (2016). Have Gender Gaps in Math Closed? Achievement, Teacher Perceptions, and Learning Behaviors Across Two ECLS-K Cohorts. *AERA Open*, *2*(4), 233285841667361. https://doi.org/10.1177/2332858416673617

Claro, S., Paunesku, D., & Dweck, C. S. (2016). Growth mindset tempers the effects of poverty on academic achievement. *Proceedings of the National Academy of Sciences*, *113*(31), 8664–8668. https://doi.org/10.1073/pnas.1608207113

Crowley, K., Callanan, M. A., Jipson, J. L., Galco, J., Topping, K., & Shrager, J. (2001). Shared scientific thinking in everyday parent-child activity. *Science Education*, *85*(6), 712–732. https://doi.org/10.1002/sce.1035

Cvencek, D., Meltzoff, A. N., & Greenwald, A. G. (2011). Math-Gender Stereotypes in Elementary School Children: Gender Stereotypes. *Child Development*, *82*(3), 766–779. https://doi.org/10.1111/j.1467-8624.2010.01529.x

Cvencek, D., Meltzoff, A. N., & Kapur, M. (2014). Cognitive consistency and math–gender stereotypes in Singaporean children. *Journal of Experimental Child Psychology*, *117*, 73–91. https://doi.org/10.1016/j.jecp.2013.07.018

De Caroli, M. E., & Sagone, E. (2007). Toys, Sociocognitive Traits, and Occupations: Italian Children's Endorsement of Gender Stereotypes. *Psychological Reports*, *100*(3_suppl), 1298–1311. https://doi.org/10.2466/pr0.100.4.1298-1311

Degol, J. L., Wang, M.-T., Zhang, Y., & Allerton, J. (2018). Do Growth Mindsets in Math Benefit Females? Identifying Pathways between Gender, Mindset, and Motivation. *Journal of Youth and Adolescence*, *47*(5), 976–990. https://doi.org/10.1007/s10964-017-

0739-8

Deiglmayr, A., Stern, E., & Schubert, R. (2019). Beliefs in "Brilliance" and Belonging Uncertainty in Male and Female STEM Students. *Frontiers in Psychology*, *10*, 1114. https://doi.org/10.3389/fpsyg.2019.01114

Del Río, M. F., & Strasser, K. (2013). Preschool Children's Beliefs about Gender Differences in Academic Skills. *Sex Roles*, *68*(3–4), 231–238. https://doi.org/10.1007/s11199-012-0195-6

Di Battista, S. (2024). 'She is failing; he is learning': Gender-differentiated attributions for girls' and boys' errors. *British Journal of Educational Psychology*, bjep.12665. https://doi.org/10.1111/bjep.12665

Diesendruck, G., & Menahem, R. (2015). Essentialism promotes children's inter-ethnic bias. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.01180

Dweck, C. (2015). *Carol Dweck Revisits the "Growth Mindset." Education week*, *35*(5), 20-24.

Dweck, C. S. (2017). The Journey to Children's Mindsets-and Beyond. *Child Development Perspectives*, *11*(2), 139–144. https://doi.org/10.1111/cdep.12225

Dweck, C. S., Davidson, W., Nelson, S., & Enna, A. (1978). *Sex Differences in Learned Helplessness: II. The Contingencies of Evaluative Feedback in the Classroom and III.An Experimental Analysis*. *Developmental psychology*, *14*(3), 268.

Dweck, C. S., & Leggett, E. L. (1988). A Social-Cognitive Approach to Motivation and Personality. *Psychological review*, *95*(2), 256.

Elmore, K. C., & Luna-Lucero, M. (2017). Light Bulbs or Seeds? How Metaphors for Ideas Influence Judgments About Genius. *Social Psychological and Personality Science*, *8*(2), 200–208. https://doi.org/10.1177/1948550616667611

Fennema, E., Peterson, P. L., Carpenter, T. P., & Lubinski, C. A. (1990). Teachers' attributions and beliefs about girls, boys, and mathematics. *Educational Studies in Mathematics*, *21*(1), 55–69. https://doi.org/10.1007/BF00311015

Friedman, S. (2015). Still a "Stalled Revolution"? Work/Family Experiences, Hegemonic Masculinity, and Moving Toward Gender Equality. *Sociology Compass*, *9*(2), 140–155. https://doi.org/10.1111/soc4.12238

Frome, P. M., & Eccles, J. S. (1988). *Parents' Influence on Children's Achievement-Related Perceptions*. *Journal of personality and social psychology*, *74*(2), 435.

Furnham, A., Reeves, E., & Budhani, S. (2002). Parents Think Their Sons Are Brighter Than Their Daughters: Sex Differences in Parental Self-Estimations and Estimations of Their Children's Multiple Intelligences. *The Journal of Genetic Psychology*, *163*(1), 24–39. https://doi.org/10.1080/00221320209597966

Gálvez, R. H., Tiffenberg, V., & Altszyler, E. (2019). Half a Century of Stereotyping Associations Between Gender and Intellectual Ability in Films. *Sex Roles*, *81*(9–10), 643–654. https://doi.org/10.1007/s11199-019-01019-x

Gelman, S. A., & Markman, E. M. (1986). Categories and induction in young children. *Cognition*, *23*(3), 183–209. https://doi.org/10.1016/0010-0277(86)90034-X

Gil-White, F. (2001). *Are Ethnic Groups Biological "Species" to the Human Brain? Essentialism in Our Cognition of Some Social Categories*. *Current anthropology*, *42*(4), 515-553. https://doi.org/10.1086/321802

Good, C., Aronson, J., & Inzlicht, M. (2003). Improving adolescents' standardized test performance: An intervention to reduce the effects of stereotype threat. *Journal of Applied Developmental Psychology*, *24*(6), 645–662. https://doi.org/10.1016/j.appdev.2003.09.002

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of Personality and Social Psychology*, *102*(4), 700–717. https://doi.org/10.1037/a0026659

Gunderson, E. A., Gripshover, S. J., Romero, C., Dweck, C. S., Goldin-Meadow, S., & Levine, S. C. (2013). Parent Praise to 1- to 3-Year-Olds Predicts Children's Motivational Frameworks 5 Years Later. *Child Development*, *84*(5), 1526–1541. https://doi.org/10.1111/cdev.12064

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The Role of Parents and Teachers in the Development of Gender-Related Math Attitudes. *Sex Roles*, *66*(3–4), 153–166. https://doi.org/10.1007/s11199-011-9996-2

Gunderson, E. A., Sorhagen, N. S., Gripshover, S. J., Dweck, C. S., Goldin-Meadow, S., & Levine, S. C. (2018). Parent praise to toddlers predicts fourth grade academic achievement via children's incremental mindsets. *Developmental Psychology*, *54*(3), 397–409. https://doi.org/10.1037/dev0000444

Haimovitz, K., & Dweck, C. S. (2017). The Origins of Children's Growth and Fixed Mindsets: New Research and a New Proposal. *Child Development*, *88*(6), 1849–1859. https://doi.org/10.1111/cdev.12955

Haimovitz, K., Wormington, S. V., & Corpus, J. H. (2011). Dangerous mindsets: How beliefs about intelligence predict motivational change. *Learning and Individual Differences*, *21*(6), 747–752. https://doi.org/10.1016/j.lindif.2011.09.002

Hammond, M. D., & Cimpian, A. (2017). Investigating the cognitive structure of stereotypes: Generic beliefs about groups predict social judgments better than statistical beliefs. *Journal of Experimental Psychology: General*, *146*(5), 607–614. https://doi.org/10.1037/xge0000297

Henderlong Corpus, J., & Lepper, M. R. (2007). The Effects of Person Versus Performance Praise on Children's Motivation: Gender and age as moderating factors. *Educational Psychology*, *27*(4), 487–508. https://doi.org/10.1080/01443410601159852

Heyder, A., & Brunner, M. (2018). Teachers' aptitude beliefs as a predictor of helplessness in low-achieving students: Commonalities and differences between academic domains. *Learning and Individual Differences*, *62*, 118–127. https://doi.org/10.1016/j.lindif.2018.01.015

Heyder, A., Steinmayr, R., & Cimpian, A. (2023). Reflecting on their mission increases preservice teachers' growth mindsets. *Learning and Instruction*, *86*, 101770. https://doi.org/10.1016/j.learninstruc.2023.101770

Heyder, A., Weidinger, A. F., Cimpian, A., & Steinmayr, R. (2020). Teachers' belief that math requires innate ability predicts lower intrinsic motivation among low-achieving students. *Learning and Instruction*, *65*, 101220. https://doi.org/10.1016/j.learninstruc.2019.101220

Heyman, G. D., & Compton, B. J. (2006). Context sensitivity in children's reasoning about ability across the elementary school years. *Developmental Science*, *9*(6), 616–627. https://doi.org/10.1111/j.1467-7687.2006.00540.x

Hong, Y., Chiu, C., & Dweck, C. S. (1999). *Implicit Theories, Attributions, and Coping: A Meaning System Approach*. *Journal of Personality and Social psychology*, *77*(3), 588.

Hyde, J. S., Bigler, R. S., Joel, D., Tate, C. C., & Van Anders, S. M. (2019). The future of sex and gender in psychology: Five challenges to the gender binary. *American Psychologist*, *74*(2), 171–193. https://doi.org/10.1037/amp0000307

Jaxon, J., Lei, R. F., Shachnai, R., Chestnut, E. K., & Cimpian, A. (2019). The Acquisition of Gender Stereotypes about Intellectual Ability: Intersections with Race. *Journal of Social Issues*, *75*(4), 1192–1215. https://doi.org/10.1111/josi.12352

Kalender, Z. Y., Marshman, E., Schunn, C. D., Nokes-Malach, T. J., & Singh, C. (2022). Framework for unpacking students' mindsets in physics by gender. *Physical Review Physics Education Research*, *18*(1), 010116. https://doi.org/10.1103/PhysRevPhysEducRes.18.010116

Kamins, M. L., & Dweck, C. S. (1999). *Person Versus Process Praise and Criticism: Implications for Contingent Self-Worth and Coping*. *Developmental psychology*, *35*(3), 835.

Kaplan, D. M., Palitsky, R., Arconada Alvarez, S. J., Pozzo, N. S., Greenleaf, M. N., Atkinson, C. A., & Lam, W. A. (2024). What's in a Name? Experimental Evidence of Gender Bias in Recommendation Letters Generated by ChatGPT. *Journal of Medical Internet Research*, *26*, e51837.

Kiefer, A., & Shih, M. (2006). Gender Differences in Persistence and Attributions in Stereotype Relevant Contexts. *Sex Roles*, *54*(11–12), 859–868. https://doi.org/10.1007/s11199-006-9051-x

Kollmayer, M., Schultes, M.-T., Schober, B., Hodosi, T., & Spiel, C. (2018a). Parents' Judgments about the Desirability of Toys for Their Children: Associations with Gender Role Attitudes, Gender-typing of Toys, and Demographics. *Sex Roles*, *79*(5–6), 329–341. https://doi.org/10.1007/s11199-017-0882-4

Kollmayer, M., Schultes, M.-T., Schober, B., Hodosi, T., & Spiel, C. (2018b). Parents' Judgments about the Desirability of Toys for Their Children: Associations with Gender Role Attitudes, Gender-typing of Toys, and Demographics. *Sex Roles*, *79*(5–6), 329–341. https://doi.org/10.1007/s11199-017-0882-4

LaCosse, J., Murphy, M. C., Garcia, J. A., & Zirkel, S. (2021). The role of STEM professors' mindset beliefs on students' anticipated psychological experiences and course interest.

Journal of Educational Psychology, *113*(5), 949–971. https://doi.org/10.1037/edu0000620

Lei, R. F., Green, E. R., Leslie, S.-J., & Rhodes, M. (2019). Children lose confidence in their potential to "be scientists," but not in their capacity to "do science." *Developmental Science*, *22*(6), e12837. https://doi.org/10.1111/desc.12837

Leonard, J. A., Martinez, D. N., Dashineau, S. C., Park, A. T., & Mackey, A. P. (2021). Children Persist Less When Adults Take Over. *Child Development*, *92*(4), 1325–1336. https://doi.org/10.1111/cdev.13492

Leslie, S.-J., Cimpian, A., Meyer, M., & Freeland, E. (2015). Expectations of brilliance underlie gender distributions across academic disciplines. *Science*, *347*(6219), 262–265. https://doi.org/10.1126/science.1261375

Levy, G. D., Sadovsky, A. L., & Troseth, G. L. (2000). Aspects of Young Children's Perceptions of Gender-Typed Occupations. *Sex roles*, *42*, 993-1006.

Levy, S. R., Stroessner, S. J., & Dweck, C. (1998). Stereotype Formation and Endorsement: The Role of Implicit Theories. *Journal of personality and social psychology*, *74*(6), 1421.

Leyens, J.-P., Rodriguez-Perez, A., Rodriguez-Torres, R., Gaunt, R., Paladino, M.-P., Vaes, J., & Demoulin, S. (2001). Psychological essentialism and the differential attribution of uniquely human emotions to ingroups and outgroups. *European Journal of Social Psychology*, *31*(4), 395–411. https://doi.org/10.1002/ejsp.50

Li, Y., & Bates, T. C. (2019). You can't change your basic ability, but you work at things, and that's how we get hard things done: Testing the role of growth mindset on response to setbacks, educational attainment, and cognitive ability. *Journal of Experimental Psychology: General*, *148*(9), 1640–1655. https://doi.org/10.1037/xge0000669

Liben, L. S., Bigler, R. S., & Krogh, H. R. (2001). Pink and Blue Collar Jobs: Children's

Judgments of Job Status and Job Aspirations in Relation to Sex of Worker. *Journal of Experimental Child Psychology*, *79*(4), 346–363. https://doi.org/10.1006/jecp.2000.2611

Limeri, L. B., Carter, N. T., Lyra, F., Martin, J., Mastronardo, H., Patel, J., & Dolan, E. L. (2023). Undergraduate Lay Theories of Abilities: Mindset, universality, and brilliance beliefs uniquely predict undergraduate educational outcomes. *CBE—Life Sciences Education*, *22*(4), ar40. https://doi.org/10.1187/cbe.22-12-0250

Lin-Siegler, X., Ahn, J. N., Chen, J., Fang, F.-F. A., & Luna-Lucero, M. (2016). Even Einstein struggled: Effects of learning about great scientists' struggles on high school students' motivation to learn science. *Journal of Educational Psychology*, *108*(3), 314–328. https://doi.org/10.1037/edu0000092

Lucca, K., Horton, R., & Sommerville, J. A. (2019). Keep trying!: Parental language predicts infants' persistence. *Cognition*, *193*, 104025. https://doi.org/10.1016/j.cognition.2019.104025

Macnamara, B. N., & Burgoyne, A. P. (2022). *Do Growth Mindset Interventions Impact Students' Academic Achievement? A Systematic Review and Meta-Analysis With Recommendations for Best Practices*. *Psychological Bulletin*.

Macnamara, B. N., & Rupani, N. S. (2017). The relationship between intelligence and mindset. *Intelligence*, *64*, 52–59. https://doi.org/10.1016/j.intell.2017.07.003

Macrae, C. N., & Bodenhausen, G. V. (2000). Social Cognition: Thinking Categorically about Others. *Annual Review of Psychology*, *51*(1), 93–120. https://doi.org/10.1146/annurev.psych.51.1.93

Makkonen, T., Lavonen, J., & Tirri, K. (2019). *General and Physics-Specific Mindsets about Intelligence and Giftedness: A Study of Gifted Finnish Upper-Secondary-School Students*

and Physics Teachers. *International Journal for Talent Development and Creativity*, *7*, 39-52.

Malespina, A., Schunn, C. D., & Singh, C. (2022). Whose ability and growth matter? Gender, mindset and performance in physics. *International Journal of STEM Education*, *9*(1), 28. https://doi.org/10.1186/s40594-022-00342-2

Mandalaywala, T. M., Tai, C., & Rhodes, M. (2020). Children's use of race and gender as cues to social status. *PLOS ONE*, *15*(6), e0234398. https://doi.org/10.1371/journal.pone.0234398

Maranges, H. M., Iannuccilli, M., Nieswandt, K., Hlobil, U., & Dunfield, K. (2023a). Brilliance Beliefs, Not Mindsets, Explain Inverse Gender Gaps in Psychology and Philosophy. *Sex Roles*, *89*(11–12), 801–817. https://doi.org/10.1007/s11199-023-01406-5

Maranges, H. M., Iannuccilli, M., Nieswandt, K., Hlobil, U., & Dunfield, K. A. (2023b). What determines feelings of belonging and majoring in an academic field? Isolating factors by comparing psychology and philosophy. *Current Research in Behavioral Sciences*, *4*, 100097. https://doi.org/10.1016/j.crbeha.2023.100097

Marshman, E., Kalender, Z. Y., Schunn, C., Nokes-Malach, T., & Singh, C. (2018). A longitudinal analysis of students' motivational characteristics in introductory physics courses: Gender differences. *Canadian Journal of Physics*, *96*(4), 391–405. https://doi.org/10.1139/cjp-2017-0185

Martin, C. L., & Ruble, D. (2004). Children's Search for Gender Cues: Cognitive Perspectives on Gender Development. *Current Directions in Psychological Science*, *13*(2), 67–70. https://doi.org/10.1111/j.0963-7214.2004.00276.x

Martin, C. L., Ruble, D. N., & Szkrybalo, J. (2002). Cognitive theories of early gender development. *Psychological Bulletin*, *128*(6), 903–933. https://doi.org/10.1037/0033-

2909.128.6.903

Master, A., Cheryan, S., & Meltzoff, A. N. (2016). Computing whether she belongs: Stereotypes undermine girls' interest and sense of belonging in computer science. *Journal of Educational Psychology*, *108*(3), 424–437. https://doi.org/10.1037/edu0000061

Master, A., Cheryan, S., Moscatelli, A., & Meltzoff, A. N. (2017). Programming experience promotes higher STEM motivation among first-grade girls. *Journal of Experimental Child Psychology*, *160*, 92–106. https://doi.org/10.1016/j.jecp.2017.03.013

Master, A., Meltzoff, A. N., & Cheryan, S. (2021). Gender stereotypes about interests start early and cause gender disparities in computer science and engineering. *Proceedings of the National Academy of Sciences*, *118*(48), e2100030118. https://doi.org/10.1073/pnas.2100030118

Mesler, R. M., Corbin, C. M., & Martin, B. H. (2021). Teacher mindset is associated with development of students' growth mindset. *Journal of Applied Developmental Psychology*, *76*, 101299. https://doi.org/10.1016/j.appdev.2021.101299

Meyer, M., Cimpian, A., & Leslie, S.-J. (2015). Women are underrepresented in fields where success is believed to require brilliance. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00235

Morgenroth, T., & Ryan, M. K. (2021). The Effects of Gender Trouble: An Integrative Theoretical Framework of the Perpetuation and Disruption of the Gender/Sex Binary. *Perspectives on Psychological Science*, *16*(6), 1113–1142. https://doi.org/10.1177/1745691620902442

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National*

Academy of Sciences, *109*(41), 16474–16479. https://doi.org/10.1073/pnas.1211286109

Mueller, C. M., & Dweck, C. S. (1998). *Praise for Intelligence Can Undermine Children's Motivation and Performance*. *Journal of personality and social psychology*, *75*(1), 33.

Muenks, K., Canning, E. A., LaCosse, J., Green, D. J., Zirkel, S., Garcia, J. A., & Murphy, M. C. (2020). Does my professor think my ability can change? Students' perceptions of their STEM professors' mindset beliefs predict their psychological vulnerability, engagement, and performance in class. *Journal of Experimental Psychology: General*, *149*(11), 2119–2144. https://doi.org/10.1037/xge0000763

Muradoglu, M., Arnold, S. H., Leslie, S.-J., & Cimpian, A. (2023). "What Does It Take to Succeed Here?": The Belief That Success Requires Brilliance Is an Obstacle to Diversity. *Current Directions in Psychological Science*, *32*(5), 379–386. https://doi.org/10.1177/09637214231173361

Muradoglu, M., & Cimpian, A. (2020). Children's Intuitive Theories of Academic Performance. *Child Development*, *91*(4). https://doi.org/10.1111/cdev.13325

Muradoglu, M., Porter, T., Trzesniewski, K., & Cimpian, A. (2022). *Developing and Validating a Growth Mindset Scale for Young Children (GM-C)*. https://doi.org/10.31234/osf.io/fgw8t

Murphy, M. C., & Reeves, S. L. (2019). Personal and organizational mindsets at work. *Research in Organizational Behavior*, *39*, 100121. https://doi.org/10.1016/j.riob.2020.100121

Muzzatti, B., & Agnoli, F. (2007). Gender and mathematics: Attitudes and stereotype threat susceptibility in Italian children. *Developmental Psychology*, *43*(3), 747–759. https://doi.org/10.1037/0012-1649.43.3.747

Napp, C., & Breda, T. (2022). The stereotype that girls lack talent: A worldwide investigation. *Science Advances*, *8*(10), eabm3689. https://doi.org/10.1126/sciadv.abm3689

Nicholls, J. G. (1984). Achievement Motivation: Conceptions of Ability, Subjective Experience, Task Choice, and Performance. *Psychological review*, *91*(3), 328.

Nix, S., Perez-Felkner, L., & Thomas, K. (2015). Perceived mathematical ability under challenge: A longitudinal perspective on sex segregation among STEM degree fields. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00530

Nussbaum, A. D., & Dweck, C. S. (2008). Defensiveness Versus Remediation: Self-Theories and Modes of Self-Esteem Maintenance. *Personality and Social Psychology Bulletin*, *34*(5), 599–612. https://doi.org/10.1177/0146167207312960

Park, D., Gunderson, E. A., Tsukayama, E., Levine, S. C., & Beilock, S. L. (2016). Young children's motivational frameworks and math achievement: Relation to teacher-reported instructional practices, but not teacher theory of intelligence. *Journal of Educational Psychology*, *108*(3), 300–313. https://doi.org/10.1037/edu0000064

Parsons, J. E., & Ruble, D. N. (1977). The development of achievement-related expectancies. *Child Development*, 1075-1079.

Passolunghi, M. C., Rueda Ferreira, T. I., & Tomasetto, C. (2014). Math–gender stereotypes and math-related beliefs in childhood and early adolescence. *Learning and Individual Differences*, *34*, 70–76. https://doi.org/10.1016/j.lindif.2014.05.005

Patrick, S. K., & Joshi, E. (2019). "Set in Stone" or "Willing to Grow"? Teacher sensemaking during a growth mindset initiative. *Teaching and Teacher Education*, *83*, 156–167. https://doi.org/10.1016/j.tate.2019.04.009

Paunesku, D., Walton, G. M., Romero, C., Smith, E. N., Yeager, D. S., & Dweck, C. S. (2015). Mind-Set Interventions Are a Scalable Treatment for Academic Underachievement. *Psychological Science*, *26*(6), 784–793. https://doi.org/10.1177/0956797615571017

Pehrson, S., Brown, R., & Zagefka, H. (2009). When does national identification lead to the rejection of immigrants? Cross-sectional and longitudinal evidence for the role of essentialist in-group definitions. *British Journal of Social Psychology*, *48*(1), 61–76. https://doi.org/10.1348/014466608X288827

Pomerantz, E. M., & Kempner, S. G. (2013). Mothers' daily person and process praise: Implications for children's theory of intelligence and motivation. *Developmental Psychology*, *49*(11), 2040–2046. https://doi.org/10.1037/a0031840

Porter, T., Catalán Molina, D., Cimpian, A., Roberts, S., Fredericks, A., Blackwell, L. S., & Trzesniewski, K. (2022). Growth-Mindset Intervention Delivered by Teachers Boosts Achievement in Early Adolescence. *Psychological Science*, *33*(7), 1086–1096. https://doi.org/10.1177/09567976211061109

Poulin-Dubois, D., Serbin, L. A., Eichstedt, J. A., Sen, M. G., & Beissel, C. F. (2002). Men Don't Put on Make-up: Toddlers' Knowledge of the Gender Stereotyping of Household Activities. *Social Development*, *11*(2), 166–181. https://doi.org/10.1111/14679507.00193

Puente-Díaz, R., & Cavazos-Arroyo, J. (2017). The influence of creative mindsets on achievement goals, enjoyment, creative self-efficacy and performance among business students. *Thinking Skills and Creativity*, *24*, 1–11. https://doi.org/10.1016/j.tsc.2017.02.007

Purdie-Vaughns, V., & Eibach, R. P. (2008). Intersectional Invisibility: The Distinctive Advantages and Disadvantages of Multiple Subordinate-Group Identities. *Sex Roles*, *59*(5–6), 377–391. https://doi.org/10.1007/s11199-008-9424-4

Quinn, K. A., & Macrae, C. N. (2011). The face and person perception: Insights from social cognition. *British Journal of Psychology*, *102*(4), 849–867. https://doi.org/10.1111/j.2044-8295.2011.02030.x

Quinn, P. C., Lee, K., & Pascalis, O. (2019). Face Processing in Infancy and Beyond: The Case of Social Categories. *Annual Review of Psychology*, *70*(1), 165–189. https://doi.org/10.1146/annurev-psych-010418-102753

Rattan, A., Good, C., & Dweck, C. S. (2012). "It's ok — Not everyone can be good at math": Instructors with an entity theory comfort (and demotivate) students. *Journal of Experimental Social Psychology*, *48*(3), 731–737. https://doi.org/10.1016/j.jesp.2011.12.012

Rattan, A., Savani, K., Chugh, D., & Dweck, C. S. (2015). Leveraging Mindsets to Promote Academic Achievement: Policy Recommendations. *Perspectives on Psychological Science*, *10*(6), 721–726. https://doi.org/10.1177/1745691615599383

Rattan, A., Savani, K., Naidu, N. V. R., & Dweck, C. S. (2012). Can everyone become highly intelligent? Cultural differences in and societal consequences of beliefs about the universal potential for intelligence. *Journal of Personality and Social Psychology*, *103*(5), 787–803. https://doi.org/10.1037/a0029263

R Core Team (2023). _R: A Language and Environment for Statistical Computing_. R Foundation for Statistical Computing, Vienna, Austria.https://www.R-project.org/.

Rhodes, M., & Baron, A. (2019). The Development of Social Categorization. *Annual Review of Developmental Psychology*, *1*, 359–386. https://doi.org/10.1146/annurev-devpsych-121318-084824

Rhodes, M., Leslie, S., Bianchi, L., & Chalik, L. (2018). The Role of Generic Language in the Early Development of Social Categorization. *Child Development*, *89*(1), 148–155. https://doi.org/10.1111/cdev.12714

Robinson-Cimpian, J. P., Lubienski, S. T., Ganley, C. M., & Copur-Gencturk, Y. (2014). *Teachers' Perceptions of Students' Mathematics Proficiency May Exacerbate Early*

Gender Gaps in Achievement. *Developmental psychology*, *50*(4), 1262.

Rogers, L. O., & Meltzoff, A. N. (2017). Is gender more important and meaningful than race? An analysis of racial and gender identity among Black, White, and mixed-race children. *Cultural Diversity and Ethnic Minority Psychology*, *23*(3), 323–334. https://doi.org/10.1037/cdp0000125

Roper, R. L. (2019). Does Gender Bias Still Affect Women in Science? *Microbiology and Molecular Biology Reviews*, *83*(3), e00018-19. https://doi.org/10.1128/MMBR.00018-19

Rubin, J. D., Atwood, S., & Olson, K. R. (2020). Studying Gender Diversity. *Trends in Cognitive Sciences*, *24*(3), 163–165. https://doi.org/10.1016/j.tics.2019.12.011

Ruzek, E., Jirout, J., Schenke, K., Vitiello, V., Whittaker, J. V., & Pianta, R. (2020). Using self report surveys to measure PreK children's academic orientations: A psychometric evaluation. *Early Childhood Research Quarterly*, *50*, 55–66. https://doi.org/10.1016/j.ecresq.2018.10.012

Scherr, R. E., Plisch, M., Gray, K. E., Potvin, G., & Hodapp, T. (2017). Fixed and growth mindsets in physics graduate admissions. *Physical Review Physics Education Research*, *13*(2), 020133. https://doi.org/10.1103/PhysRevPhysEducRes.13.020133

Schmalz, D. L., & Kerstetter, D. L. (2006). Girlie Girls and Manly Men: Chidren's Stigma Consciousness of Gender in Sports and Physical Activities. *Journal of Leisure Research*, *38*(4), 536–557. https://doi.org/10.1080/00222216.2006.11950091

Seo, E., & Lee, Y. (2021). Stereotype Threat in High School Classrooms: How It Links to Teacher Mindset Climate, Mathematics Anxiety, and Achievement. *Journal of Youth and Adolescence*, *50*(7), 1410–1423. https://doi.org/10.1007/s10964-021-01435-x

Sisk, V. F., Burgoyne, A. P., Sun, J., Butler, J. L., & Macnamara, B. N. (2018). To What Extent and Under Which Circumstances Are Growth Mind-Sets Important to Academic

Achievement? Two Meta-Analyses. *Psychological Science*, *29*(4), 549–571. https://doi.org/10.1177/0956797617739704

Skipper, Y., & Fox, C. (2022). Boys will be boys: Young people's perceptions and experiences of gender within education. *Pastoral Care in Education*, *40*(4), 391–409. https://doi.org/10.1080/02643944.2021.1977986

Sloutsky, V. M., & Fisher, A. V. (2012). Linguistic labels: Conceptual markers or object features? *Journal of Experimental Child Psychology*, *111*(1), 65–86. https://doi.org/10.1016/j.jecp.2011.07.007

Smith, J. L., Lewis, K. L., Hawthorne, L., & Hodges, S. D. (2013). When Trying Hard Isn't Natural: Women's Belonging With and Motivation for Male-Dominated STEM Fields As a Function of Effort Expenditure Concerns. *Personality and Social Psychology Bulletin*, *39*(2), 131–143. https://doi.org/10.1177/0146167212468332

Snyder, K. E., Malin, J. L., Dent, A. L., & Linnenbrink-Garcia, L. (2014). The message matters: The role of implicit beliefs about giftedness and failure experiences in academic selfhandicapping. *Journal of Educational Psychology*, *106*(1), 230–241. https://doi.org/10.1037/a0034553

Stephens-Davidowitz, S. (2014). *Google, Tell Me. Is My Son a Genius? The New York Times*, *19*.

Storage, D., Charlesworth, T. E. S., Banaji, M. R., & Cimpian, A. (2020). Adults and children implicitly associate brilliance with men more than women. *Journal of Experimental Social Psychology*, *90*, 104020. https://doi.org/10.1016/j.jesp.2020.104020

Storage, D., Horne, Z., Cimpian, A., & Leslie, S.-J. (2016). The Frequency of "Brilliant" and "Genius" in Teaching Evaluations Predicts the Representation of Women and African Americans across Fields. *PLOS ONE*, *11*(3), e0150194. https://doi.org/10.1371/journal.pone.0150194

Sun, K. L. (2019). The mindset disconnect in mathematics teaching: A qualitative analysis of classroom instruction. *The Journal of Mathematical Behavior*, *56*, 100706. https://doi.org/10.1016/j.jmathb.2019.04.005

Swim, J. K., Aikin, K. J., Hall, W. S., & Hunter, B. A. (1995). *Sexism and Racism: OldFashioned and Modern Prejudices*. *Journal of personality and social psychology*, *68*(2), 199.

Tenenbaum, H. R., & Leaper, C. (2003). Parent-child conversations about science: The socialization of gender inequities? *Developmental Psychology*, *39*(1), 34–47. https://doi.org/10.1037/0012-1649.39.1.34

Terrizzi, B. F., Shutts, K., Brey, E., & Beier, J. S. (2019). *Children's Developing Judgments About the Physical Manifestations of Power*. *Developmental psychology*, *55*(4), 793.

Tiedemann, J. (2000). *Parents' Gender Stereotypes and Teachers' Beliefs as Predictors of Children's Concept of Their Mathematical Ability in Elementary School*. *Journal of Educational psychology*, *92*(1), 144.

Titone, D., Tiv, M., & Pexman, P. M. (2018). The status of women cognitive scientists in Canada: Insights from publicly available NSERC funding data. *Canadian Journal of Experimental Psychology / Revue Canadienne de Psychologie Expérimentale*, *72*(2), 81–90. https://doi.org/10.1037/cep0000150

Tsay, C.-J., & Banaji, M. R. (2011). Naturals and strivers: Preferences and beliefs about sources of achievement. *Journal of Experimental Social Psychology*, *47*(2), 460–465. https://doi.org/10.1016/j.jesp.2010.12.010

Tucker-Drob, E. M., Briley, D. A., Engelhardt, L. E., Mann, F. D., & Harden, K. P. (2016). Genetically-mediated associations between measures of childhood character and

academic achievement. *Journal of Personality and Social Psychology*, *111*(5), 790–815. https://doi.org/10.1037/pspp0000098

Upson, S., & Friedman, L. F. (2012). Where are all the Female Geniuses? *Scientific American Mind*, *23*(5), 63–65. https://doi.org/10.1038/scientificamericanmind1112-63

Verniers, C., & Martinot, D. (2015). Perception of students' intelligence malleability and potential for future success: Unfavourable beliefs towards girls. *British Journal of Educational Psychology*, *85*(3), 289–299. https://doi.org/10.1111/bjep.12073

Vial, A. C., & Cimpian, A. (2020). Evaluative feedback expresses and reinforces cultural stereotypes. In E. Brummelman (Ed.), *Psychological Perspectives on Praise* (1st ed., pp. 119–128). Routledge. https://doi.org/10.4324/9780429327667-18

Walton, G. M., & Yeager, D. S. (2020). Seed and Soil: Psychological Affordances in Contexts Help to Explain Where Wise Interventions Succeed or Fail. *Current Directions in Psychological Science*, *29*(3), 219–226. https://doi.org/10.1177/0963721420904453

Wickham H (2016). *ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. ISBN 978-3-319-24277-4, https://ggplot2.tidyverse.org.

Wood, W., & Eagly, A. H. (2002). A cross-cultural analysis of the behavior of women and men: Implications for the origins of sex differences. *Psychological Bulletin*, *128*(5), 699–727. https://doi.org/10.1037/0033-2909.128.5.699

Yan, V. X., Thai, K.-P., & Bjork, R. A. (2014). Habits and beliefs that guide self-regulated learning: Do they vary with mindset? *Journal of Applied Research in Memory and Cognition*, *3*(3), 140–152. https://doi.org/10.1037/h0101799

Yeager, D. S., Carroll, J. M., Buontempo, J., Cimpian, A., Woody, S., Crosnoe, R., Muller, C., Murray, J., Mhatre, P., Kersting, N., Hulleman, C., Kudym, M., Murphy, M., Duckworth, A. L., Walton, G. M., & Dweck, C. S. (2022). Teacher Mindsets Help Explain Where a

Growth-Mindset Intervention Does and Doesn't Work. *Psychological Science*, *33*(1), 18–32. https://doi.org/10.1177/09567976211028984

Yeager, D. S., & Dweck, C. S. (2012). Mindsets That Promote Resilience: When Students Believe That Personal Characteristics Can Be Developed. *Educational Psychologist*, *47*(4), 302–314. https://doi.org/10.1080/00461520.2012.722805

Yeager, D. S., & Dweck, C. S. (2020). What can be learned from growth mindset controversies? *American Psychologist*, *75*(9), 1269–1284. https://doi.org/10.1037/amp0000794

Yeager, D. S., Walton, G. M., Brady, S. T., Akcinar, E. N., Paunesku, D., Keane, L., Kamentz, D., Ritter, G., Duckworth, A. L., Urstein, R., Gomez, E. M., Markus, H. R., Cohen, G. L., & Dweck, C. S. (2016). Teaching a lay theory before college narrows achievement gaps at scale. *Proceedings of the National Academy of Sciences*, *113*(24). https://doi.org/10.1073/pnas.1524360113

Yee, D. K., & Eccles, J. S. (1988). Parent perceptions and attributions for children's math achievement. *Sex Roles*, *19*(5–6), 317–333. https://doi.org/10.1007/BF00289840

Yu, Y., Bonawitz, E., & Shafto, P. (2019). Pedagogical Questions in Parent–Child Conversations. *Child Development*, *90*(1), 147–161. https://doi.org/10.1111/cdev.12850

Yzerbyt, V., Corneille, O., & Estrada, C. (2001). The Interplay of Subjective Essentialism and Entitativity in the Formation of Stereotypes. *Personality and Social Psychology Review*, *5*(2), 141–155. https://doi.org/10.1207/S15327957PSPR0502_5

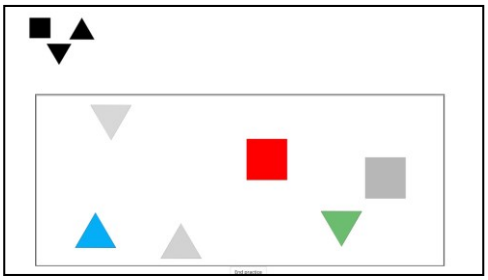
Zentall, S. R., & Morris, B. J. (2010). "Good job, you're so smart": The effects of inconsistency of praise type on young children's motivation. *Journal of Experimental Child Psychology*, *107*(2), 155–163. https://doi.org/10.1016/j.jecp.2010.04.015

Zhao, S., Setoh, P., Storage, D., & Cimpian, A. (2022). The acquisition of the gender-brilliance stereotype: Age trajectory, relation to parents' stereotypes, and intersections with race/ethnicity. *Child Development*, *93*(5). https://doi.org/10.1111/cdev.13809

Appendices

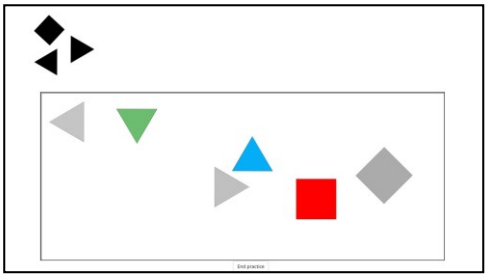
Appendix A: Tangram Puzzles, https://run.pavlovia.org/CSCDLab/s2-main-tangrams/

1

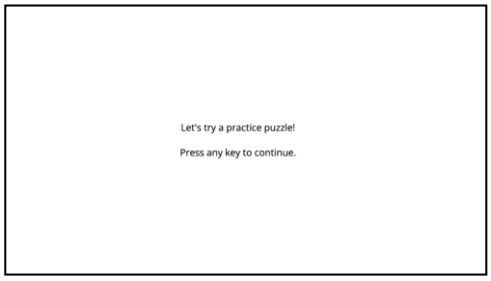


2

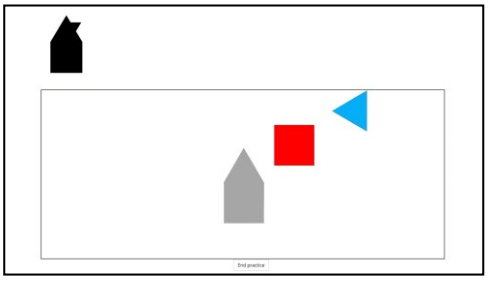
3



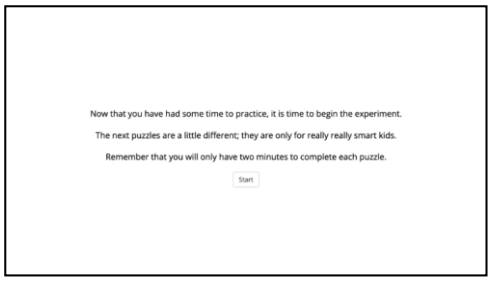
4



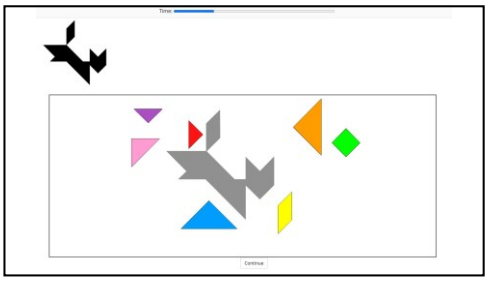
5



6


Now that you have had some time to practice, it is time to begin the experiment.
The next puzzles are a little different; they are only for really really smart kids.
Remember that you will only have two minutes to complete each puzzle.
Start

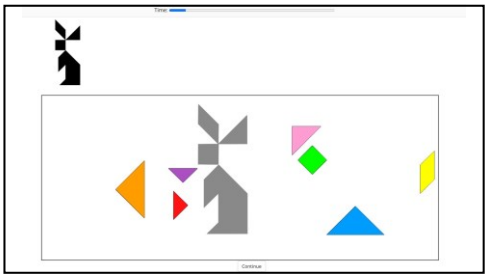
7


Time:
Continue

8


Time's up!
When you are ready, press the button to see the next puzzle.
Continue

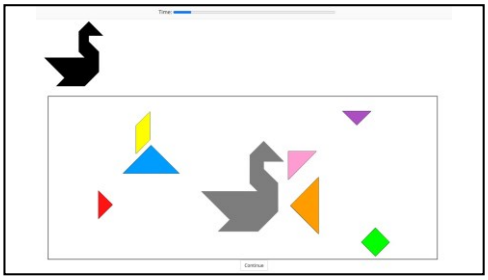
9


Time:
Continue

10


Time's up!
When you are ready, press the button to see the next puzzle.
Continue

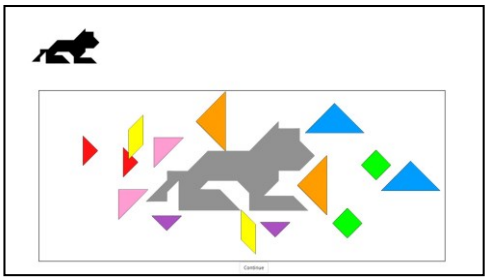
11


Time:
Continue

12


Time's up!
When you are ready, press the button to see the next puzzle.
Continue

13



14

Appendix B: Failure Feedback Coding Manual

Failure Feedback Categories	Failure Feedback Subcategories	Definition	Examples of Utterances
Process-oriented feedback	**Judgments of effort** (Haimovitz & Dweck, 2016;Pomerantz & Kempner, 2013)	Communicates that performance on the task is related to effort/practice, or lack thereof	*You need to practice* *You are working hard*
	Strategies (Haimovitz & Dweck, 2016; Gunderson et al., 2013)	Emphasizes recognizing, applying, and refining various strategies as part of the process in general, or specifc to the puzzles	*Maybe you can start with the big pieces first (specific) You can try different pieces in different ways (specific) Take your time (general)* *Try different things (general)*
	Help seeking (Haimovitz & Dweck, 2016)	Encourages the child to recognize when help is needed/understand that seeking help is okay	*Let me know if you need help* *You can just ask for help when you need it* *We can work together*
	Interest (Haimovitz & Dweck, 2016;Pomerantz & Kempner, 2013)	Emphasizes the importance of nurturing a genuine interest in the process versus the outcome.	*It's about having fun* *It's a good challenge*
	Mastery as a goal (Haimovitz & Dweck, 2016)	Focuses on understanding and improvement over performance	*You are getting the hang of it* *You got this now*
	Failure as enhancing (Haimovitz & Dweck, 2016)	Positively frames failure as part of the process	*It's okay if you get it wrong* *It's okay to make mistakes*

	Non-generic language (Pomerantz & Kempner, 2013; Rhodes et al., 2018)	The use of specific language versus generic praise or criticism	*You did good* *You are doing a good job*
Person-oriented feedback	**Judgments of ability** (Haimovitz & Dweck, 2016; Pomerantz & Kempner, 2013)	Communicates that performance on the task is related to ability, or lack thereof, as a stable trait	*You are so smart* *You did your best*
	Comfort for lack of ability (Haimovitz & Dweck, 2016; Rattan et al., 2012)	Communicates comfort attributed to a perceived lack of perceived ability	*It's ok, it's too hard for you* *You can do something easier*
	Self-worth contingency (Haimovitz & Dweck, 2016)	Suggests that the person's value is contingent on their performance	*I'm impressed* *I'm proud of you* *Sorry, she/he is normally good* *I don't like that you give up*
	Pity (Haimovitz & Dweck, 2016)	Communicates pity for child's lack of ability	*N/A*
	Performance as a goal (Haimovitz & Dweck, 2016)	Emphasizes a specific, measurable outcome as the goal of the activity (e.g., completing the puzzle)	*You have to finish in 2 minutes* *Get it perfect*
	Social comparison (Haimovitz & Dweck, 2016)	Feedback that is relative/compares to someone else	*I couldn't even do that* *You are better than me at this* *I can't do it either*
	Generic language (Pomerantz&Kempner, 2013; Rhodes et al., 2018)	The use of general language versus specific praise or criticism	*You are good at this* *Good girl*

Other feedback	**Product-oriented** (Corpus & Lepper, 2007; Gunderson et al., 2013; see also Pomerantz & Kempner, 2013)	Directed toward the outcome of the child's action (e.g., placing a piece). General positive or netural valence.	*There you go* *That's wrong / That's right* *Nice (Positive)* *Ok (Neutral)*
	Technical instructions (Leonard et al., 2021)	Emphasizing the specific technical instructions of the tangrams (e.g., how to move and turn the pieces)	*Hold down and press the spacebar* *Use both hands on the keyboard* *Click and press*
	Direct instructions (Leonard et al., 2021)	Directly telling the child how/what to do to complete the puzzles	*Move that piece there* *Try putting that piece* *See if that fits there* *Try it like this*
	Statements	General statements about the puzzles	*It's a lion* *There are a lot of shapes* *Time's up*
	General questions	General questions related to the puzzles	*What animal is it?* *Are you ready?*
	Pedagogical questions (Leonard et al., 2021)	Guiding questions that support/encourage children's autonomy in completing the puzzles	*What are you going to do next?* *Where do you think that one goes?*
	Encouragement	Motivational statements aimed at encouraging persistence	*Let's go* *You can do it*
	False growth feedback (Dweck, 2015)	Focus on performance, conveyed in process language	*Keep going* *Just keep trying* *Try harder*

Every utterance provided by parents is transcribed and given a score (i.e., count) of 1.

Appendix C: Intraclass Correlation Coefficients (ICCs) for Studies One (S1) and Study Two (S2)

Failure Feedback Categories	Failure Feedback Subcategories	ICC S1	ICC S2
Process			
	Judgments of effort	0.73	0.66
	Strategies	0.80	0.84
	Help seeking	0.62	0.98
	Interest	0.71	0.93
	Mastery as a goal	0.89	0.79
	Failure as enhancing	0.51	1.00
	Non-generic language	0.45	NA
Person			
	Judgments of ability	0.70	0.98
	Comfort for lack of ability	0.75	0.83
	Self-worth contingency	0.50	1.00
	Pity	NA	NA
	Performance as a goal	0.89	0.92
	Social comparison	NA	0.83
	Generic language	NA	NA
Other			
	Technical instructions	0.64	0.95
	Direct instructions	0.56	0.99

	Statements	0.74	0.98
	General questions	0.92	0.98
	Pedagogical questions	-	0.97
False Growth	False growth feedback	0.60	0.88

Note: 25% double-coded. NA indicates no counts in the overlapping codes.

Appendix D: Traditional Intelligence Mindset Scale

People have a certain amount of intelligence, and they can't really do much to change it. No matter how much intelligence people have, they can always change it quite a bit. (reversed item)
People can learn new things, but they can't really change their basic intelligence.
Intelligence is something about people that they can't change very much.

Appendix E: Failure Mindset Scale

The effects of failure are negative and should be avoided. Experiencing failure facilitates learning and growth. (reversed item) Experiencing failure debilitates performance and productivity.
The effects of failure are positive and should be utilized. (reversed item) Experiencing failure enhances performance and productivity. (reversed item)
Experiencing failure inhibits learning and growth.

Appendix F: Explicit Gender-Brilliance Stereotype Endorsement and Awareness Scale

---

One is more likely to find a male with a genius-level IQ than a female with a genius-level IQ.

Extreme intellectual brilliance is more common in men than in women.

On average, men tend to have higher intellectual capacities than women.

Even though it's not true of everyone, males are generally born with greater raw intelligence than females.

The reason why there are few female philosophers is that women tend to think more practically.

Men and women have complementary cognitive skills: Men are better at understanding objects and mechanical systems.

Even though it may not be politically correct to say it, males and females might be naturally suited for different kinds of intellectual activities.

Males' and females' biology has an effect on their cognitive abilities (even though the differences might be small)

---

1 - 4 : gender differences in overall amount of intellectual ability 5
- 8 : general intellectual differences between men and women

Appendix G: Adapted Questionnaire on Normative Gender Role Attitudes

Both boys and girls should undertake household chores. (reversed item)
Women are less interested in politics than men are.
For a good first impression, a neat appearance is more important for a woman than for a man.
A higher education is especially important for men as they are more represented in management positions than women.
Women are as qualified as men for a leadership position in an engineering company (reversed item)
A higher number of male preschool teachers would be pleasing. (reversed item)
For some professions, men are better qualified than women.
Every boy should own a doll. (reversed item)
Girls like helping around the household more than boys.
Female politicians are less trustworthy because they mostly have concerns on their minds other than work.
As men are more devoted to their job than women, they generally earn more money.
It would be less opportune if a woman became minister of defence.
Male police officers provide a greater sense of security than female police officers.
Stay at home husband is a desirable profession for a man as well. (reversed item)
Usually women have a greater responsibility in taking care of the household because they are better housekeepers.
Women and men are equally responsible for the family's wealth. (reversed item)

Appendix H: Brilliance Mindset Scale

People can learn new things, but they can't really change whether they have a genius-level IQ or not.

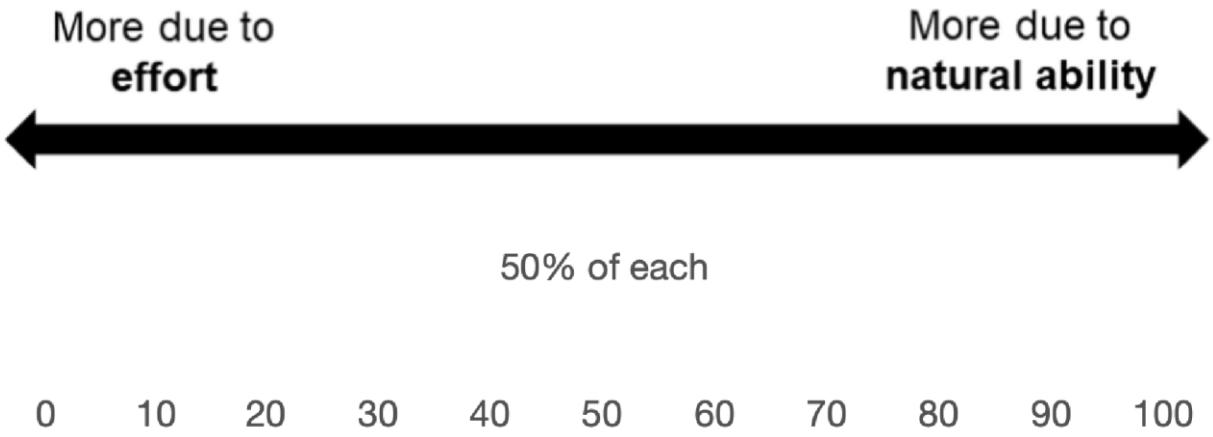
People have a certain amount of intellectual brilliance, and they can't really do much to change it.

Extreme brilliance is something about people that they don't have much control over.

Appendix I: Alternative Mindset Scale

Effort vs. Ability

What percentage of intelligence is due to natural ability? And what percentage is due to ability?



Ability Flexibility

We are interested in how people interpret standardized testing results. People often make conclusions about others when they learn about others' scores on an intelligence test.

We are going to tell you about several people that took a typical intelligence test and ask you what you think. The test has been used for many years and is generally considered an accurate measure of intelligence.

Scores on the test range from 0 to 100: 0 indicates the lowest intelligence score and 100 indicates the highest intelligence score. The score represents their percentile for their age group. In other words, the score is the percentage of people the same age that did better than the person on the test. For example, if a person receives a score of 50, they did better that 50% of test takers and is about average.

Person A received a score of **17 out of 100** (**17%**), compared to people of the same age.

Person A takes the same test one year later.

What is the lowest score you believe Person A could have if they took the same type of test next year?

What is the highest score you believe Person A could have if they took the same type of test next year?

Person B received a score of **55 out of 100** (**55%**), compared to people of the same age. Person B takes the same test one year later.

What is the lowest score you believe Person B could have if they took the same type of test next year?

What is the highest score you believe Person B could have if they took the same type of test next year?

Person C received a score of **92 out of 100** (**92%**), compared to people of the same age. Person C takes the same test one year later.

What is the lowest score you believe Person C could have if they took the same type of test next year?

What is the highest score you believe Person C could have if they took the same type of test next year?

Appendix J: Adapted GM-C Intelligence Mindset Questionnaire Items

(adapted from Muradoglu et al., 2022)

In this game, I'm going to tell you some things about some kids. When we talk about these kids, make sure you pay close attention, because I'll ask you some questions about these kids. Okay?

This is a [girl/boy]. And here's something about this [girl/boy]: [She/He] is not very good at math*. This [girl/boy] gets a lot of the math problems wrong on [her/his] schoolwork.

[Attention check] I just want to make sure you were paying attention: Is this [girl/boy] good at math? Or not good at math?
If "good": Actually, this [girl/boy] is not very good at math.
If "not good": That's right, [girl/boy] is not very good at math.

[INSTABILITY Test Question] Now here's a question for you: Will it *always* be this way? Will this [girl/boy] *always* be not very good at math?
How sure are you about this? Are you sort of sure? Or really sure?

Now let me tell you what happened with this [girl/boy]. When [she/he] was a little older, [she/he] moved to a school far away. At this school, kids did a lot of math. After this [girl/boy] started at this far-away school, [she/he] got to practice math a lot. This [girl/boy] did a lot of math at this new school.

[MALLEABILITY Test Question] Now here's a question for you: This [girl/boy] was at this school for a long time. When [she/he] left this school, was [she/he] good at math or not good at math?
[smiley scale]: Was [she/he] sort of good, good, or really good?
[frowny scale]: Was [she/he] sort of not good, not good, or really not good?

SCORING

Responses to the *always [Instability]* question set are scored:
No / Really sure = 0
No / Sort of sure = 0.33
Yes / Sort of sure = 0.667 Yes / Really sure = 1

Responses to *school [malleability]* question set for items are scored:
Really good = 0
Good = 0.2
Sort of good = 0.4
Sort of not good = 0.6
Not good = 0.8
Really not good = 1

*Same vignettes for Math, Spelling, and Drawing Domains;
Total 6 Vignettes; 12 item composite score [6 instability scores + 6 malleability scores]