Children's and Adults' Concepts of Disabilities

By

Nicolette Grace Granata

Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in

Psychology

May 10, 2024

Nashville, TN

Approved:

Jonathan Lane, Ph.D.

Amy Booth, Ph.D.

Amy Needham, Ph.D.

Jennifer Ledford, Ph.D.

ACKNOWLEDGMENTS

I have had the great privilege of working with my advisor, Jonathan Lane, for nearly 9 years. It is because of his dedication to his students that I can confidently say that the work we have produced together is of the highest quality. You can find us chatting away about our dogs, our backyards, the latest and greatest Amazon finds and innovations, and noise-reducing technologies (in addition to research). We share a deep love for the SC3 lab, always finding joy in planning fun lab parties and events for our research assistants, and ordering the latest and greatest toys from Target for our participants. Jon, thank you for your mentorship and friendship; I would not be the scholar or leader I am today without your influence! Speaking of our RAs – not a single part of this dissertation would be possible without you – I am endlessly grateful, especially for my collaborators on these projects: Chyna Bacchus, Melanie Leguizamon, Amanda Jones, and Isabella Lough.

I am equally grateful for the support and mentorship of Amy Booth and Amy Needham. Thank you, too, to Erin Barton for all her contributions to my milestones leading up to this dissertation, and to Jennifer Ledford for stepping up in her place on this committee with limited notice.

I am blessed beyond measure to have an equally incredible support system outside the walls of Hobbs. Robbie, words can’t sum up my gratitude to you for sticking by my side every step of the way over the past 5 years. To my rescue dogs, Lola Love and Jack Daniel…your goofiness and individuality lights up my life. To my Mom, Dad, and sisters, Mallory and Gabby…you have always encouraged me to chase my dreams and fostered my deep love for learning. You are the kindest, strongest, most hard-working people I know, and I could not be prouder to call you my family.

TABLE OF CONTENTS

LIST OF FIGURES

Figure Page

LIST OF TABLES

CHAPTER 1

Introduction

Persons with disabilities constitute the United States' largest minority, including 26% of adults (Centers for Disease Control and Prevention [CDC], 2020). Typically-developing children increasingly share classrooms with children with disabilities (National Center for Education Statistics, 2023). Over the past several decades, the challenges, pursuits, and voices of persons with disabilities have increasingly been brought to light, resulting in worldwide progress in how this often "invisible" minority group is recognized and treated (e.g., Conrad, 2020; de Carvalho et al., 2014; Peele et al., 2020; Tsiantis et al., 2006). There is now voluminous psychological research investigating people's concepts of many dimensions of the human experience (e.g., race, gender, and sexuality) that promises to make important contributions to society. What lags is a robust understanding of how children and adults think about disability and disabled persons.

In addition to its potential societal impact, research on concepts of disability can deepen our understanding of cognitive development through avenues such as children's concepts of social groups, human abilities (e.g., human limitations and adaptations, understandings of the non-obvious), morality (e.g., evaluations of non-normative behavior,), naïve biology (e.g., vitalistic causality), and naïve psychology (e.g., inferences about underlying mental states). Despite the comparatively sparse body of work on children's understanding of disability, I argue that studying children's concepts of disabilities *does not have to be* (and *should not be*) a fringe area of study; the theoretical motivations for this work are just as strong as the potential social implications. The studies presented in this dissertation make contributions to several areas of research in cognitive development.

Study 1 will investigate children's fairness evaluations of and reasoning about classroom accommodations for children with physical and cognitive disabilities. Do children think accommodations are fair? How do children *explain* accommodations in their spontaneous, open-ended reasoning? One possibility is that children's fairness evaluations and reasoning will differ based on whether the accommodations address physical or cognitive needs, given differences in children's concepts of physical and cognitive disabilities (e.g., Conant & Budoff, 1983; Nowicki, 2007). Another possibility is that evaluations and reasoning will differ based on whether there is a "match" between the type of accommodation (physical accommodation vs. cognitive accommodation) and the type of disability (physical disability vs. cognitive disability). Study 1 explores the breadth of an important shift often identified during middle childhood (e.g., Blake et al., 2015; Elenbaas, 2019) in evaluations of disadvantageous resource distributions, specifically, equity-based fairness evaluations.

Study 2 explores how adults and children reason about the sensory abilities of people who have a deficit in one sensory modality, testing for the presence of potential halo effects or compensatory effects in participants' reasoning. There has been no research, to my knowledge, that has investigated a seemingly common belief about heightened levels of some senses in the presence of a diminished sense (compensatory effects). How widespread is it and where does it come from (e.g., folklore, science fiction, pop culture, personal experience)? If these intuitions do exist in adults, are they formed in early childhood, separate from exposure to this kind of messaging? Or do children demonstrate halo effects in their reasoning about compromised senses, whereby the compromised sense suggests deficits in all remaining senses?

In both studies, I focus on a period in development (5- to 9-years of age) when children typically demonstrate remarkable advances in their understanding of sensory capabilities (e.g., O'Neill & Chong, 2001; Pillow, 1993), biological reasoning (e.g., Inagaki & Hatano, 1990, 1993), general moral reasoning (e.g., Killen et al., 2011), and evaluations of equity-based resource distributions (e.g., Elenbaas, 2019) —developments that might have a bearing on how children conceive of persons with disabilities.

In what follows in this introduction, I briefly review the research and theory that informs the research questions that I address with the current studies. I first discuss the ways in which disabled persons' actions may be perceived by others (i.e., as non-normative), which may trigger moral evaluations. I briefly review children's and adults' moral reasoning, including work on children's evaluations of disability-related, non-normative behaviors. Then, I consider how exploring concepts of disability with a moral lens adds to existing knowledge about the role of mental states (i.e., motive, intent) in evaluating non-normative behaviors. I argue that moral evaluations of disability-related behaviors are inseparable from how persons understand different types of disabilities (e.g., physical, sensory, and cognitive disabilities) and their implications. Finally, I review past work on adults' and children's concepts of physical, sensory, and cognitive abilities and disabilities, and highlight gaps in that literature.

Children's Moral Evaluations

Every day, often unconsciously, we interpret and evaluate others' behaviors. For example, think about your last trip to the grocery store – chances are someone bumped into your cart, blocked the aisle you were trying so adamantly to reach, or perhaps even cut you off in the parking lot. In those fleeting moments you had to make quick decisions about how to process these behaviors, and chances are that impressions of persons' knowledge (i.e., Did they see me there?) and external circumstances (i.e., Did they have their hands full with crying children? Were they taking an important phone call?) factored into your evaluations of the acts.

Evaluations of right vs. wrong, good vs. bad, and fair vs. unfair have long intrigued cognitive scientists. Often, moral evaluations are rendered in terms of what is considered the "norm". People seem to have strong intuitions about what is normative, even in their earliest years. Children 3-5 years protest non-normative behavior (e.g., non-normative game play affecting the chance to win a prize) whether the behavior affects them (e.g., non-normative game play means they lose a prize) or someone else (e.g., non-normative game play means someone else loses a prize) (Hardecker et al., 2016). As well, 5-year-olds appropriately use normative vocabulary (e.g., "wrong", "right", "must", "ought"), demonstrating early normative understanding (Göckeritz et al., 2014).

Norms come in many forms. Some norms involve universal concerns, such as avoiding harm to other people, upholding justice, and respecting individual rights (Tisak & Turiel, 1988). Other norms are specific to individual social systems; they build upon arbitrary, mutual expectations for behavior (Ball et al., 2016). Some norms are fairness-related (Yucel et al., 2022), while others are pragmatic or personal (Dahl & Kim, 2014; Nucci, 1981). Norms of all types may be especially likely to be violated by persons with disabilities – by virtue of having a disability, one's interactions with the world are often going to be atypical. For example, someone with a walking disability might move unnaturally slow on a bustling city sidewalk. How would this slow walking be evaluated by persons walking behind them? Would they assume the slow-walking person intends to, or is motivated to, inconvenience others? The answers to these questions require considerations of the role of *mental states* in moral evaluations – how does inferred *intent* or *motive* matter in how non-normative behavior is evaluated?

In everyday life, we witness numerous violations of norms without the opportunity to ask the violator about the intention behind the behavior(s). Killen and colleagues (2011) argue that "morally relevant contexts are those that generate conflict and misattributions of intention in actual daily life" (p. 210). Evaluating norm violations means fielding a large amount of information, with intent being just one piece of the puzzle. Over the course of development, children seem to rely more heavily on the role of intent (vs. outcome) in making moral judgments (Cushman et al., 2013; Hebble, 1971; Smetana, 1981). When presented with accidental transgressions, 3.5-to-7-year-olds increasingly cited the absence of negative intent on the part of the transgressors in their evaluations of the acts as being moral violations or not (Killen et al., 2011). A key issue is that even if two persons perform identical behaviors *with* intention, actor *motives* might be important in evaluations (Baird & Astington, 2004). Baird and Astington (2004) presented children with scenarios in which actors performed identical, intentional actions and had different motives (good vs. bad motive) and found that 5- and 7-year-olds used information about the motives to evaluate the morality of the actions. For example, children rated the action of turning on a hose as naughtier for a character who wanted to destroy a sandcastle her brother had built versus a character who wanted to help her mother take care of the garden. Thus, by 5 years of age, children consider whether actors have good or bad motives in tailoring their evaluations of actors' behavior.

Studying children's impressions of disabled persons provides unique opportunities to capture how children consider people's motives when evaluating intentional, non-normative behavior. For example, a person with a particular disability may know they are about to perform a certain non-normative behavior (the intent is there), but their motive is typically not to cause harm or inconvenience by virtue of that behavior. Instead, these behaviors are often due to disability-related restrictions on free choice: "an aspect of our moral practice that is intimately related to assessing agent intentionality (and assigning blame accordingly)" (Josephs et al., 2016, p. 248).

Studying concepts of the role of disability in non-normative behavior is a natural way of evaluating how children reason about constraints on behavior. Granata and colleagues (2022) examined 3-to-8-year-olds' evaluations of persons with disabilities (walking and hearing disabilities) who produced non-normative behaviors, and children's explanations for their behaviors. For example, in one scenario, a character asked several other children in the classroom to "run and play" with them at recess, and none of three characters played with them; one of these characters had a walking disability, one had a hearing disability, and one was typically-developing (TD). At around 4.5-years, children evaluated persons with disabilities as less naughty than TD persons who produced identical behaviors. Children's mentioning of characters' *limitations* (e.g., "His legs don't work") and children's inferences about characters' *negative attributes* (e.g., "He's a mean boy") predicted how naughty the disabled characters were judged for their non-normative behaviors; children who mentioned *limitations* judged characters as less naughty, while children who mentioned *negative attributes* judged characters as naughtier. In sum, by the late preschool years, children adjusted their evaluations of persons who committed norm violations when those persons had disabilities that accounted for their behavior (Granata et al., 2022).

There are many dimensions on which non-normative behavior can be evaluated. Granata et al. (2022), described above, had children evaluate the "naughtiness" (goodness/badness) of the behaviors. But non-normative behaviors can also be evaluated according to their fairness – how fair or unfair is the behavior? Study 1 of this dissertation examines how 5- to 9-year-olds evaluate the fairness of accommodation-related behaviors, focusing on accommodations that are often provided to school children with special needs (e.g., extra time working on assignments). Behaviors are never described as related to accommodations or to special needs because accommodations are rarely described as such in actual classrooms (Lalvani, 2015; Ware, 2001). This allows examination of how *children themselves* infer the reasons behind accommodation-related behaviors and how those inferences relate to children's evaluations of those behaviors. For ease of readability, accommodation-related behaviors are referred to as "accommodations" throughout the dissertation.

In sum, disabilities place unique restrictions on behavior, and how others interpret these behaviors (i.e., Good or bad? Fair or unfair?) might depend on their knowledge and understanding of these persons' disabilities. Study 2 evaluates how children conceptualize disabilities themselves. In sections below, I review existing work on children's concepts of disabilities, with an emphasis on those disabilities relevant to the studies in this dissertation.

The Development of Children's Concepts of Disabilities

It may seem obvious that to study children's concepts of disabilities, we need a strong grasp on children's concepts of *abilities*. For example, it is difficult to imagine studying children's concepts of blindness (the absence of vision) without knowing anything about their concepts of seeing (the presence of vision). Social-cognitive research has long investigated children's concepts of ordinary human abilities such as communicating (e.g., Wellman & Lempers, 1977; Shatz et al., 1983), thinking/knowing (e.g., Johnson & Wellman, 1980; Pillow, 1989; Wellman & Johnson, 1979; Wimmer et al., 1988), seeing/hearing (e.g., Flavell et al., 1980; Flavell et al., 1978; Melis et al., 2010; Moll et al., 2014; Pratt & Bryant, 1990; Williamson, et al., 2015), as well as other psychological and physiological functions (e.g., Gottfried et al., 1999). Studying children's and adults' concepts of the limitations and adaptability of human mobility, sensation, perception, and cognition has implications for several fields, including psychology and education.

Children place immense value on physical ability, specifically, movement. In fact, they often see movement as what categorizes something as "living". Richards and Siegler (1986) asked children ages 4-to-11-years to name the qualities of something "living"; while there were developmental differences in what children mentioned, with children younger than 7 years mentioning mostly qualities unique to animals (vs. plants), movement was the top cited quality across ages. In a subsequent experiment, children aged 5-11 years distinguished between different types of movement with respect to aliveness when presented objects (i.e., rectangles) moving on a screen. The movements differed in spontaneity (e.g., a rectangle moves with or without external force applied), goal-directedness (e.g., the rectangle stops its movement just short of a desired object, suggesting its movement lacks goal-directedness), movement apparatus (i.e., leg-like or wheel-like appendages), and terrain (e.g., movement across a flat or downward-sloped terrain). Children across the age range strongly associated the type of movement apparatus (legs vs. wheels) with aliveness, reporting on 73% of trials that the rectangle with leg-like appendages was alive versus only 37% of the trials for the rectangle with wheel-like appendages. In sum, movement is highly salient to young children as a critical part of living beings, and human-like movement is especially associated with aliveness. How do children reason about persons for whom mobility is impaired?

Physical disabilities are most obvious to children, compared to sensory or cognitive disabilities. For example, when presented photographs of children with different disabilities, young children (3-6 years) across several studies were significantly more aware of physical disabilities than perceptual or cognitive disabilities – they made more spontaneous comments about the physical disabilities (e.g., "her legs are broken") (Diamond & Hestenes, 1996). Given its visual salience, adaptive medical equipment for physical disabilities (e.g., wheelchairs, walkers, crutches) may facilitate this awareness (Diamond & Hestenes, 1996; Diamond & Kensinger, 2002; Huckstadt & Shutts, 2014), but may also have negative consequences on children's perception of children with physical disabilities. When 3-to-5-year-olds were asked to choose between two otherwise matched photographs (i.e., age, hair color, race, gender) of a child in a wheelchair and a child with no wheelchair, they preferred to befriend the child with no wheelchair (Huckstadt & Shutts, 2014); the wheelchair alone influenced children's friendship decisions. Children in this age range do seem to appreciate that certain activities would be more appropriate than others for someone with a physical disability, though, and choose appropriate activities for these persons accordingly (e.g., a puzzle vs. dancing) (Diamond & Hong, 2010; Diamond et al., 2008). No research that I know of has directly examined children's understanding of *interventions* that might help persons with physical disabilities *accomplish* ordinary activities (i.e., other people's assistance, crutches, wheelchairs, etc.).

Sensory disabilities often involve less salient or misleading indicators; a visually-impaired person's posture and eye orientation may indicate they are looking at something in particular. Despite this, early concepts of vision and visual access would appear to set children up well to understand the consequences of visual deficits. By 2.5-3 years of age, children understand that four conditions must hold if a person is to "see" an object: 1) at least one eye is open, 2) eyes must be aimed towards a target, 3) there can be nothing blocking the line of sight towards a target, and 4) what they "see" is not necessarily what others' "see" (Flavell, 2004). When children grasp these four conditions, it allows them to encourage, prevent, or evaluate seeing in others – they can manipulate persons' body orientation, line of sight, or occlusions to encourage or discourage visual access to a target object (Flavell, 2004).

Conant and Budoff (1982) explored concepts of blindness via open-ended interviews in a foundational study of five age groups (preschool, primary school, junior high, high, and adults). Researchers asked participants whether they "had ever known a blind person, or had ever heard about blind people"; to "describe blind people and what it would be like to be blind"; "how people become blind, whether blindness is usually permanent, and whether blind people are ever teased or ridiculed" (pp. 86-87). Over 75% of preschoolers provided answers that suggested they understood that blindness had to do with an inability to see; all older participants had this awareness. Between the preschool years and high-school, children increasingly referred to various components of blindness and the blind experience, including causes of blindness, distinguished between different degrees of visual impairment, distinguished between congenital and adventitious blindness, expressed a realistic view of the permanence or reversal of blindness, distinguished between curing versus adapting to blindness, referred to interventions and equipment (e.g., canes, guide dogs, braille), mentioned realistic medical interventions, and mentioned psychological adaptations to blindness. High school students were on par with adults, yet even they expressed knowledge of only about a third of these components.

In a classic study, Pillow (1993) investigated children's understanding that certain perceptual modalities (i.e., seeing, hearing, touch) provide certain types of knowledge—a concept referred to as "aspectuality." They found that, while 3-4-year-old children generally understood the link between perception and knowledge, they struggled with distinguishing *which* perceptual modalities relate to which types of knowledge. For example, that listening (vs. looking or touching) would be the best way to gain information about an object's sound. O'Neill

& Gopnik (1991) found that 4- and 5-year-olds could distinguish between which of three experiences (i.e., seeing, being told, or feeling) led to a belief, but 3-year-olds could not. O'Neill and Chong (2001) largely replicated this finding, testing children's understanding with respect to all five senses (seeing, smelling, tasting, hearing, touch). Children were asked to discover a property of an object (e.g., its scent) that could only be discovered through one sensory modality (smelling). Three-year-olds, and many 4-year-olds, struggled to know what sorts of information could be gained from different sensory experiences, with performance hovering around chance level.

Compared to physical and sensory disabilities, cognitive disabilities seem to be the most difficult for young children to grasp. Not until primary school did any children in Conant and Budoff (1983) express even minimal awareness of cognitive disabilities: "a demonstration of the ability to discuss any material at all relevant to the disability" (p. 121) (e.g., acknowledging that a person could have trouble learning). Understanding the role of the brain in learning, remembering, and forgetting seems especially important in understanding the implications of a cognitive disability. Children hold rich concepts of the mind and brain by the end of the preschool years (Wellman, 2014). For example, by 4 years of age, children regularly reference their own and others' epistemic functions, with words such as "know" and "think" (Ronfard et al., 2018), and they demonstrate an initial understanding that people are prone to forgetting learned content (Lyon & Flavell, 1993). By at least 5-6 years of age, children typically appreciate that these and other cognitive processes occur physically in the "head" or "brain" (Johnson & Wellman, 1982).

Nowicki (2007) interviewed 5- and 9-year-olds to evaluate their concepts of cognitive disabilities (and physical disabilities). Children were given verbal descriptions of the disabilities in addition to a depiction of a wheelchair for characters with physical disabilities. Children were asked questions that pertained to why the disabilities exist (e.g., "Why do some children find learning difficult?"; "Why do some children use wheelchairs?"), and whether the disabilities will always be present (e.g., "Do you think this girl/boy will always find learning difficult? Why or why not?"; "Do you think this girl/boy will always need to use a wheelchair? Why or why not?"). Both 5- and 9-year-olds provided responses specific to the type of disability being discussed, suggesting that children as young as 5-years can begin to distinguish between these types of disabilities (Nowicki, 2007). Most older children could provide some information about learning disabilities, whereas only one-third of younger children could. Furthermore, older children, when compared to younger children, reasoned that learning difficulties were more in a person's control than physical difficulties; older children often argued that learning difficulties could be overcome by a learner's effort, or by getting more help from parents or teachers.

In summary, by 7 years of age, most children will be aware of some physical and sensory disabilities and their implications, and at least some children will be aware of certain cognitive disabilities. Thus, the studies in this dissertation include children as young as 5 and as old as 10 years of age, so that important developments in children's concepts of disabilities around 7-8 years of age (e.g., Nowicki, 2007) can be captured. In Study 1, I examine how children evaluate the fairness of accommodations provided to persons with physical (walking) and cognitive (learning) disabilities. In Study 2, I examine how children (and adults) estimate the sensory abilities of persons with varying degrees of visual impairment.[1]

[1] Portions of Chapter 1 were borrowed from: Granata, N. & Lane, J. D. (in-prep). Children's concepts of disabilities: A review and recommendations for continued research.

CHAPTER 2

Study 1

In the classroom, many children with disabilities receive accommodations—adaptations or changes to the educational environment or practices that assist students in being successful despite challenges presented by a disability (IRIS Center). For example, accommodations may include extra time on exams or assignments, a desk placed close to the board (preferential seating), or frequent breaks. Other, non-accommodated students in a classroom may reach varied conclusions about the fairness of such accommodations—accommodations may be considered fair interventions that help to correct for existing inequalities, or they may be considered unfair, unequal distributions of resources. Sensitivity to equality emerges early in childhood and across cultures (Blake et al., 2014; Elenbaas, 2019; Geraci & Surian, 2011), with children increasingly emphasizing equity-based (as opposed to equality-based) distributions (Blake et al., 2015; Elenbaas, 2019; Smith & Warneken, 2016). Accommodations that are offered in the classroom are often not explained to typically-developing (TD) classmates (Lalvani, 2015; Ware, 2001), and thus TD classmates are left to their own devices to make sense of these accommodations. This raises several important questions. How do TD children interpret the function of these accommodations? Do TD children believe that accommodations are fair? Answers to these questions can shed light on the rigidity vs. flexibility of children's subscription to equity-based vs. equality-based distributions of resources, and children's understanding of disabilities.

School-age children regularly witness accommodations provided to peers with disabilities and are curious about them (Lalvani, 2015). Yet, no studies to my knowledge have directly measured how children evaluate the fairness of these accommodations and how they reason about their purpose. In the current study, I investigate how 5- to 9-year-olds in the United States evaluate the fairness of classroom accommodations provided to children with physical and cognitive disabilities. TD participants are presented scenarios in which other children with physical or cognitive disabilities receive physical or cognitive accommodations, and participants are asked to evaluate these accommodations. Conceivably, the ways in which children interpret accommodations (e.g., their understanding that accommodations are designed to address limitations and inequities) may influence their accommodation evaluations. Thus, I also explore the reasoning that children use to account for accommodations and how this relates to their evaluations. [2]

Concepts of Fairness

Scholars have identified three main types of "fairness": equality-based, equity-based, and merit-based (McAuliffe et al., 2017). "Equality-based" fairness is when resources are distributed evenly regardless of how much each person has to begin with. Using school lunch as an example, *every* student would get free lunch from school. "Equity-based" fairness is when more resources are distributed to persons who start with less; students who do not have secure access to food at home would get free lunch from school. Finally, "merit-based" fairness is when more resources are distributed to persons who made the greatest contribution or worked the hardest; students with the best grades or best behavior would get free lunch from school.

How do these ideas of fairness develop across childhood? Infants' and young children's fairness principles are typically assessed via expectations about or evaluations of others' behaviors. Elenbaas (2019) examined 3-8-year-old children's judgments of resource distributions that either aligned with principles of equality, equity, or merit. Participants were asked to evaluate these distributions on a scale from "really not ok" to "really okay." For equity-based

[2] Much of Chapter 2 was borrowed directly from: Granata, N., Bacchus, C., Leguizamon, M., & Lane, J. D. (under review). Children's fairness evaluations of and reasoning about disability-related accommodations

distributions, with age, children increasingly opposed inequitable distributions (i.e., viewing them as closer to "really not ok"), but they did not increasingly support equitable distributions (i.e., viewing them neutrally). Elenbaas' (2019) participants held a third-party role when evaluating these distributions; there was no self-interest in the outcomes. In the case of accommodations, it seems critical to evaluate children's evaluations when they are on the non-receiving end of the distribution, as this is how accommodations work in the classroom environment. This is how I approach Study 1.

Blake and colleagues (2015) studied evaluations of distributions where self-interest *is* involved between 4 and 15 years of age, across seven different societies. Specifically, distributions of disadvantageous inequity (a peer receives more than the self) versus advantageous inequity (the self receives more than a peer). To test this, they used "the inequity game," which involves two children (an "actor" and a "recipient") seated across from one another with an apparatus in the middle. The actor, but not the passive recipient, is able to use the apparatus (via handles that drop resources either into the middle where no one can have them, or to the participants) to accept or reject advantageous or disadvantageous distributions of resources. Rejection of disadvantageous distributions illustrates "disadvantageous inequity aversion" (DI), meaning the child is averse to a peer receiving more of something than them. DI was present in all seven societies, emerged early in childhood (by 4-6 years of age in the U.S), and strengthened with age. In Study 1, I am specifically interested in this type of aversion.

Given that accommodations are often disadvantageous inequities (as formally defined above) for TD children, one might take the findings of Blake et al. (2015) to suggest that accommodations may be evaluated by U.S. children as unfair overall, with older children evaluating them as most unfair. But age-related patterns for judgments of accommodations may not look the same as judgments of disadvantageous inequities in past work; developmental differences may exist in how children understand accommodations as something that classmates with disabilities "need," versus something they "want," and this may affect judgments. Moore and colleagues (1995) explored 3-5-year-olds' knowledge of the pragmatic and semantic differences between "need" vs. "want." Children heard various stories in which one character faces a problem (e.g., a red crayon falling off the table and rolling under the couch) that a certain object (e.g., a new red crayon) will resolve, and another character (not faced with a problem) desires that same object; both characters request the desirable object. Most 4-5-year-olds, but not 3-year-olds, gave the object to the character who asked for it with a "need" statement (vs. a "want" statement); 3-year-olds' distributions did not differ from chance. These results suggest that preschoolers have a foundational understanding of situations in which a person needs versus wants a desirable object. But an understanding of need vs. want in the context of accommodation requires an understanding of *why* a certain accommodation is needed – in other words, what are the implications of certain disabilities?

The Current Study

Study 1 was designed to address several, pre-registered research questions (https://aspredicted.org/Y3P_QF9). I anticipated differences when children reasoned about physical disabilities versus cognitive disabilities and physical accommodations versus cognitive accommodations. With increasing age, I predicted children would judge accommodations as increasingly fair, with the biggest shift between 7- and 9-years of age. Due to children's limited grasp of cognitive disabilities in early childhood (e.g., Conant & Budoff, 1983; Nowicki, 2007), I anticipated that younger children would judge accommodations provided to persons with physical disabilities as fairer than accommodations provided to persons with cognitive disabilities; I predicted dissipation of this difference in the oldest age group (9-year-olds). Across age groups, I predicted that children would judge physical accommodations as fairer when they were given to a character with a physical disability than a character with a cognitive disability, and cognitive accommodations as fairer when they were given to a character with a cognitive disability than a physical disability (i.e., in both cases, the accommodation addresses the disability).

I also assess how children understand the purpose of accommodations via their open-ended reasoning, with potential differences in the same areas outlined above. I anticipated that children's mention of needs and limitations related to *characters' disabilities* and children's mention of *characters' negative traits/motives* would be among the most common forms of reasoning, as both reasoning categories were frequently found in Granata et al.'s (2022) study on children's evaluations of non-normative behaviors. I expected that with increasing age, children's use of disability-related reasoning would increase, with it being the dominant form of reasoning among the oldest children (9 years); references to characters' traits/motives would decrease with age, replaced by this disability-related reasoning. Finally, I aimed to investigate whether the reasoning that children used to account for a given accommodation relates to their fairness evaluations of that accommodation. I predicted positive associations between disability-related reasoning and fairness evaluations, so that when disability-related reasoning was used more frequently, accommodations for characters with disabilities would be evaluated as *fairer*. I predicted the opposite, negative association, would be found for mentioning characters' traits or motives and fairness evaluations – when traits or motives were mentioned more frequently to account for accommodations, accommodations for characters with disabilities would be evaluated as *less fair*.

Method

Participants

Children ages 5.00-5.99 (*n* = 36*;* 17 male, 19 female), 7.00-7.99 (*n* = 42*;* 25 male, 17 female), and 9.00-9.99 years (*n* = 44*;* 19 male, 25 female) were recruited from a medium-sized city in the Southeastern United States. Participants either completed the study in a quiet laboratory room (*n* = 59) or online (via Zoom, *n* = 63). Recruitment for both in-person and online participation allowed me to flexibly adapt to potential restrictions on participant interactions resulting from the ongoing COVID-19 pandemic. Additionally, these recruitment methods increased the diversity of my resulting sample – e.g., boosting participation of families unable to travel to our campus lab because of financial or time constraints. An additional 9 participants were interviewed, but their data were excluded because they failed to complete the study (*n* = 2), or they failed to pass at least 1 of the 2 introduction questions (*n* = 5) and at least 4 of the 6 memory-check questions about the focal characters with disabilities (*n* = 5). Participants were recruited by calling parents of children in the target age-range (5-9 years), who were living in the greater metropolitan area (using contact information from our department database).

My goal was to recruit a sample large enough to fulfill the requirements of an a priori power analysis (using G*Power 3.1; Faul et al., 2007) for ANOVAs that include age group (3 levels, between-subjects), character disability type (2 levels, between-subjects), and accommodation type (2 levels, within-subjects). The power analysis determined that I required a minimum of 120 participants to detect medium effect sizes ($fs \geq .25$; Cohen, 1992) with statistical power ≥ .80 and $\alpha = .05$ for almost all main effects and interaction effects except for my 2 (condition) x 3 (age group) between-subjects interaction, for which I had power to detect an effect size of $f = 0.29$. As outlined in my pre-registration, if that interaction effect involving age was marginally significant (between 0.099 and 0.051) with a sample of 120, I would proceed to collect a full sample of 162 participants, which would afford me power to detect an effect of $f = 0.25$ for my 2 x 3 between-subjects interaction. After collecting data from 120 participants, the interaction effect involving age was not marginally significant ($p = .56$), so I closed recruitment. Recruitment goals, inclusion criteria, and exclusion criteria were pre-registered (https://aspredicted.org/Y3P_QF9).

To help characterize my sample, I asked parents to complete a voluntary questionnaire, in which they reported family demographics, education-level, their child's exposure to persons with disabilities or media about persons with disabilities, and the amount of in-person time spent at school during COVID-19. Most of the participants (87.7%; $n = 107$) were identified by their parents as "White/Caucasian," followed by 9.8% ($n = 12$) as "Asian/Asian American," 3.3% ($n = 4$) as "Black/African American," 4.1% ($n = 5$) as "Hispanic or Latino," and 0.8% ($n = 1$) as "Native American." These categories were not mutually exclusive; parents could select more than one. Of these parents, 36.9% ($n = 45$) reported that their highest level of education was a master's degree, 31.1% ($n = 38$) reported a bachelor's degree, 18.9% ($n = 23$) reported a doctorate, 5.7% ($n = 7$) reported having completed some college, and 1.6% ($n = 2$) reported having earned a high school diploma. Seven parents did not report their education level. On these questionnaires, parents also reported their children's exposure to persons or media characters with disabilities and the amount of in-person time spent at school during COVID-19 — these descriptive data are presented in Appendix A (evaluating associations among these variables was beyond the scope of my research questions, so these data are not considered further herein). Participant recruitment, parent consent, child assent, and all study procedures were approved by Vanderbilt University's Institutional Review Board.

Materials

Materials included digital vector graphics (approximately 1.5 x 2.5 inches) depicting seated characters (10 possible girls, 10 possible boys) with differing physical features (e.g., different hair color, hair style, eye color, clothing color, skin tone). All characters were seated, to avoid visually distinguishing the characters with physical disabilities (who must be seated) from the other characters (who could conceivably stand). Two scenes (one of a classroom and one of an outdoor playground) were used as digital backgrounds (see Appendix B). The scenes and accompanying characters were shown to participants via PowerPoint presentation slides so that stimuli would be presented identically for in-person and virtual participants. There were 3 versions of the boy characters and 3 versions of the girl characters – experimenters randomly selected one of the versions (gender-matched to the participant) before running each study. If parents consented, study sessions were recorded via a hidden video camera or, if video technology failed, a small audio recorder, so that children's responses could later be transcribed.

Procedure

Introduction to Disabilities.

Before beginning the study, the experimenter (E) spent several minutes building rapport with each child. For participants completing the study in-person, E opened a laptop situated between them to a PowerPoint slideshow that began with a character graphic (matched to the participant's gender). Participants completing the study on Zoom were screen-shared the same PowerPoint presentation. As a warm-up, to increase children's comfort discussing the topic of fairness, the study began with E telling children, "Sometimes we feel like adults or other kids treat us in ways that aren't fair. We want to know what kids think about what is fair and what isn't fair." E then asked, "What does fair mean to you?" After children responded, E said, "Now

I'm going to tell you some stories about some kids your age whose [legs/brains] work different than most kids' [legs/brains]".

Children assigned to the physical (walking) disability condition (*n* = 59) heard: "This boy's/girl's legs work *different* than most kids' legs. So, this boy/girl moves around *slower* than most kids. They play sports in a different way. They need *extra time* to move around the school." Children assigned to the cognitive (learning) disability condition (*n* = 63) heard: "This boy's/girl's brain works *different* than most kids' brains. So, this boy/girl learns things *slower* than most kids. They do puzzles slower. They need *extra time* to do their classwork." E asked comprehension-check questions (e.g., "So what part of this boy's/girl's body works different than most kids?"; "Does this boy/girl [walk/learn things] *faster* or *slower* than most kids?"), and either affirmed children's answers (e.g., "Yeah, their [legs/brain] work(s) different"; "Yeah they [move around/learn things] slower than most kids"), or corrected their answers (e.g., "Actually, their [legs/brain] work(s) different."; "Actually, they [move around/learn things] *slower* than most kids, because their [legs/brain] work(s) different."). These questions ensured that all children had some exposure to information about physical and cognitive disabilities before completing the focal part of the study, on children's inferences about and evaluations of these persons.

Accommodation Scenarios.

Participants were then shown a classroom scene with 14 graphics of children (male and female) seated in rows, as they would in a typical classroom. E told children that they were going to talk about some other characters the child's age, that this (the classroom scene) is "their classroom", and that there are "lots of different kids in the class" but that they will only "talk about a few". E told children that "some of these kids have [legs/brains] that work like most kids' [legs/brains], and some have [legs/brains] that work different than most kids' [legs/brains]". E asked children to "imagine" that they are a part of this classroom, and that they have been "all year long," to increase children's personal investment in the scenarios. The main purpose of including this classroom scene was to increase believability in the typicalness of the scenarios - even though children were asked questions mainly about characters with disabilities, I did not want children to think that they were reasoning about a classroom that they deemed unusual or that was actually unusual (i.e., even in inclusive schools, students with disabilities are often in the minority).

To identify accommodations that children in this age range deemed ordinarily unfair, during pre-testing I asked 30 children 4.85 – 9 years of age to evaluate the fairness of each of 12-14 accommodations afforded to a *typically-developing (TD)* child (see Appendix C Table C1). Six accommodations, which no more than 1/3 of children judged fair, were included in the final protocol—three physical accommodations (books are carried by someone else, child goes outside for playtime first, child plays soccer with hands) and three cognitive accommodations (child does less classwork, uses computer to read, has constant adult help with classwork) (see Appendix C Table C2). I also included in the final protocol three scenarios from the pre-testing pool (sits at desk for reading time, brings extra snacks, wears headphones in class) as "filler" scenarios – these were not analyzed. All nine scenarios included in this study can be found in Appendix D.

For each scenario, E showed children a slide with a single character in a classroom or on a playground (depending on the scenario; see Appendix B), and introduced the character's name, disabilities or abilities (for the TD characters in the "filler" scenarios), and an irrelevant fact (e.g., "she watches shows on the TV"). For example, a character in the physical disability condition, was introduced as follows: "This is [*Maddy/Michael*]. [*Maddy/Michael*] watches shows on the TV. Remember when we talked about girls/boys whose legs work different than most kids' legs? [*Maddy/Michael*] is one of those girls/boys. [*Maddy/Michael*]'s legs work different than most kids' legs." E asked a memory-check question about the disability or ability (similar to comprehension check questions in the *Introduction to Disabilities* section, described above), and each participant's answer was either affirmed or corrected, accordingly. E then told them that the character engaged in a certain accommodation-related behavior. For example, E said, "Every day in the classroom you see that [*Maddy/Michael*] does *less* classwork than you and all the other kids in the class." E then asked children to *explain* the character's behavior: "Why does [*Maddy/Michael*] do less classwork than you and all the other kids in class?" and then to *evaluate* the fairness of the accommodation: "Is it fair that [*Maddy/Michael*] does less classwork than you and all the other kids in class?" If the child responded "Yes", they were also asked: "So you think it is *fair*. Is it a *little* fair or *very* fair?" If the child responded "No", they were also asked: "So you think it is *not fair*. Is it a *little* not fair or *very* not fair?" This same procedure was repeated for the remaining scenarios. The scenarios were presented in two different orders (see Appendix D), evenly distributed within each age group and within condition (physical vs. cognitive disability). The entire study session lasted approximately 15-20 minutes (with the tasks reported herein lasting approximately 10-12 minutes), after which participants chose a small toy as a gift.

Scoring

Accommodation Evaluations.

Responses to the questions about whether it is fair that each character received each accommodation were assigned scores of 1 for "very fair," .667 for "a little fair," .334 for "a little unfair," and 0 for "very unfair" (in my pre-registration, I anticipated using the reverse scoring, but later realized that it would make greater intuitive sense for "very fair" to be coded 1; my results are the same regardless of the scoring direction). Four *fairness* composite scores were computed by averaging across responses for each of the four pairs of ability-accommodation scenarios: (1) Physical Disability-Physical Accommodation; (2) Physical Disability-Cognitive Accommodation; (3) Cognitive Disability-Cognitive Accommodation; (4) Cognitive Disability-Physical Accommodation. Scores for each composite could range from 0-1.

***Explanations*.**

Responses to the open-ended questions about why each character engaged in each accommodation were initially coded using a fine-grained system of 10 explanation categories (see Appendix E). For each reasoning category, responses were assigned scores of 0 if children did not use that category of reasoning, or 1 if children did. Each response could be coded into multiple categories. Responses were transcribed in a separate file and categorized by two coders who were blind to participants' ages and characters' abilities. Coders achieved 95.57% inter-rater reliability across approximately 20% of the data (2073 of 2160 codes matched), and 88% or greater reliability for each of the categories. Inter-rater reliability by category is presented in Appendix E. Having achieved high inter-rater reliability, one coder categorized the remaining 80% of data. For each reasoning category, a composite score was computed such that a score of 0% meant that the reasoning was never used across the six scenarios, and a score of 100% meant that the reasoning was used for all six scenarios.

Results

In preliminary analyses, I checked whether accommodation evaluations differed depending on the order in which children were presented these scenarios. These statistical models were similar to those reported herein but also included an "order" variable. I found a main effect of scenario order, indicating that for one order of the scenarios, children judged accommodations to be more unfair, $F(1, 117) = 5.92$, $p = .02$, $\eta_p^2 = .05$. Critically, this effect of scenario order did not interact with any of my variables of interest (Disability X Order, $F(1, 117) = .44$, $p = .51$, $\eta_p^2 = .004$; Accommodation X Order, $F(1, 117) = .48$, $p = .50$, $\eta_p^2 = .004$; Participant's Age X Order: $F(1, 116) = .91$, $p = .34$, $\eta_p^2 = .01$), and the effect of scenario order does not address my research questions. Thus, I do not consider this order effect in subsequent analyses.

Accommodation Evaluations

As a reminder, when I describe children's evaluations of accommodations, I am referring to their evaluations of accommodation-related behaviors (described earlier). Overall, across conditions, children evaluated accommodations near the mid-point of my 'fairness' scale ($M = .50$, $SE = .02$). Even when considering just whether children evaluated accommodations as "unfair" or "fair" (instead of the full scale from "very unfair" to "very fair"), children here evaluated accommodations as fairer ($M = .52$, $SD = .50$) than children in my pre-testing study, who evaluated the fairness of these same accommodations provided to typically-developing (TD) characters at .23 ($SD = .30$) on average (see Appendix C). I explored whether children's evaluations varied based on the type of disability that characters possessed and the type of accommodations they were offered, as well as whether evaluation patterns varied developmentally. Per my pre-registered data analysis plan (https://aspredicted.org/Y3P_QF9), a 3 (Participant's Age: 5, 7, 9 years) X 2 (Character's Disability: physical disability, cognitive disability) x 2 (Accommodation Type: physical accommodation, cognitive accommodation) ANOVA revealed significant effects of participant's age, $F(2, 116) = 5.54$, $p < .01$, $\eta_p^2 = .09$, and accommodation type, $F(1, 116) = 6.77$, $p = .01$, $\eta_p^2 = .06$, on children's evaluations. As expected, children evaluated accommodations as fairer with age: 9-year-olds evaluated accommodations as significantly fairer (M = .60, SE = .04) than 5-year-olds (M = .43, SE = .04, $p < .01$) and 7-year-olds (M = .48, SE = .04, $p < .05$); there were no significant differences in evaluations between 5- and 7-year-olds (p = .38). Only evaluations by 9-year-olds differed significantly from the 'neutral' mid-point of .5: $t(43) = 2.76$, $p < .01$ (5-year-olds: $t(35) = 1.75$, $p = .09$; 7-year-olds: $t(41) = 0.54$, $p = .59$). Across age groups, children evaluated cognitive accommodations as significantly fairer (M = .53, SE = .02) than physical accommodations (M = .47, SE = .02).

The significant main effect of accommodation type was subsumed under an interaction of Disability x Accommodation Type, $F(1, 116) = 5.98$, $p < .05$, $\eta_p^2 = .05$. As depicted in Figure 1, the effect of accommodation existed only for characters with a cognitive disability—children rated cognitive accommodations as significantly more fair than physical accommodations, $p < .05$. For characters with a physical disability, children judged cognitive accommodations to be just as fair as physical accommodations, p = .91., and physical accommodations were evaluated the same whether they were offered to persons with physical or cognitive disabilities (p = .96). Cognitive accommodations were evaluated as fairer when they were offered to persons with cognitive disabilities than persons with physical disabilities, $p < .05$. Compared against a neutral rating (.5), evaluations for physical disability-physical accommodation scenarios ($t(58) = 0.50$, $p = .62$), physical disability-cognitive accommodation scenarios ($t(58) = .74$, $p = .46$), and cognitive disability-physical accommodation scenarios ($t(62) = .74$, $p = .46$) did not differ significantly; evaluations for cognitive disability-cognitive accommodation scenarios were significantly fairer, $t(62) = 2.32$, $p < .05$. There were no significant interaction effects involving Age: Accommodation Type X Age, $F(2, 116) = .65$, $p = .56$, $\eta_p^2 = .01$; Disability X Age, F(2,

116) = .37, p = .69, η_p^2 = .01, Accommodation Type X Disability X Age, $F(2, 116)$ = .58, p = .56, η_p^2 = .01.

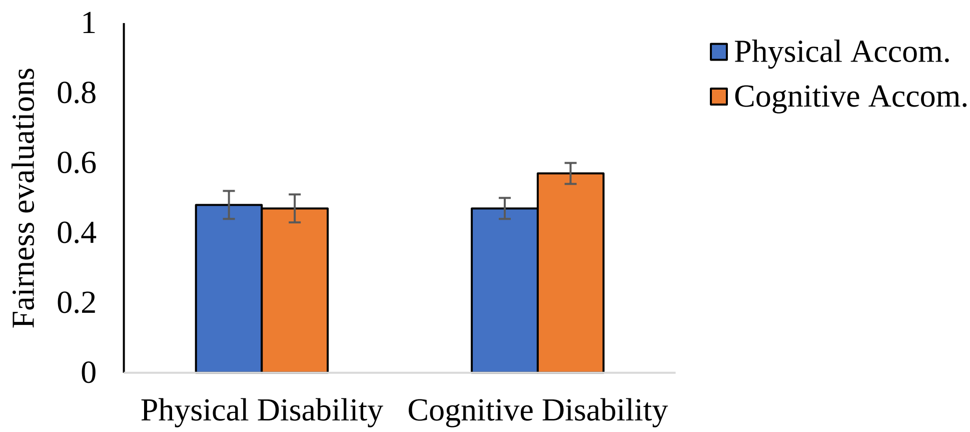


Figure 1. Evaluations of physical (blue bars) and cognitive (orange bars) accommodations, for characters with physical or cognitive disabilities. Scores can range from 0-1, with higher numbers reflecting ratings that accommodations are fairer. Error bars represent +/-1 standard error of the mean.

Thus, developmental trends existed in children's evaluations of accommodations. Relative to 5- and 7-year-olds, 9-year-olds rated accommodations to be significantly fairer. These age-related patterns emerged across all conditions—for evaluations of physical and cognitive accommodations, and for characters with physical or cognitive disabilities. Across age groups, children evaluated accommodations as fairest in cases where a person with a cognitive disability received a "matching" cognitive accommodation.

Explanations for Accommodations

Next, I explore children's explanations for accommodations across the six scenarios; for example, explanations for the question, "Why does [*Maddy/Michael*] do less classwork than you and all the other kids in class?" As a reminder, E never told participants that anyone (e.g., a teacher) had *given* an accommodation to any character, like how children in many classrooms are not explicitly told that their disabled classmate has received a specific accommodation for their disability. Rather, the characters were each described as partaking in a behavior that children ordinarily judged to be unfair (see Appendix C Table C1). This allowed me to capture children's *self-generated* inferences that accommodations were provided to assist with a disability, as well as any other type of reasoning that children generated. Two participants did not respond to most of the open-ended questions, so those participants' data are not included in these analyses (n = 120).

Table 1 presents the frequency with which children (grouped by age and condition--character with a physical or cognitive disability) used each of 9 types of explanations to account for physical and cognitive accommodations (in addition to a general 'Other' category of reasoning, not analyzed herein). In general, the most common explanation for an accommodation involved characters' *physical or cognitive limitations* (e.g., "Because his legs/brain"; 50% of total responses), the second most common explanation involved characters' *desires* (e.g., "Because he/she wants to go outside last"; 10.25% of total responses), and the third most common explanation was explicit reference to characters' *needs* (e.g., "She/He needs extra help because she doesn't remember most things"; "He/She needs help"); 9.29% of total responses. Surprisingly, most other reasoning categories were used rarely, including one category of particular interest to me—mentioning characters' *negative motives/traits* (e.g., "Because they are a bad kid") (2.32% of responses). This prompted me to question whether my fine-grained, 10-category coding system (see Appendix E) could be reduced to fewer, broader categories that encompass a greater proportion of children's responses. These broader categories were conceptually guided by the two broader categories of reasoning that I initially hoped to capture and analyze: recognition of characters' *needs* and inferences about characters' individual *motives.*

Thus, I created a more general “characters’ needs” category by combining codes for mentioning characters’ *physical or cognitive limits,* mentioning characters’ *other limitations* (e.g., “His/Her arms aren’t strong”), or explicitly mentioning characters’ *needs.* And I created a more general “characters’ motives” category by combining codes for mentioning either *characters’ negative motives/traits* or *characters’ desires* (e.g., “Because he/she wanted to play”).

Table 1

Reasoning about Accommodations by Characters with Physical or Cognitive Disabilities, using Fine-Grained Coding System

Physical Disability										
Age (years)	Phys./Cog. Limits	Other Limits	Need	Desire	Negative Trait/Motive	Difficult Task	Rule/Auth. Permits	Lack of Knowledge	Neutral Fact	Other
5	35.4%	7.8%	7.3%	14.06%	4.7%	3.1%	3.1%	6.8%	1.6%	27.1%
7	62.88%	14.02%	9.85%	6.82%	0.76%	3.79%	3.03%	3.03%	0.76%	5.68%
9	71.83%	7.14%	14.29%	7.14%	0.79%	5.16%	5.56%	2.38%	0.79%	8.73%
Total	58.62%	9.89%	10.73%	8.90%	1.84%	4.10%	3.95%	3.81%	0.99%	12.57%
Cognitive Disability										
Age (years)	Phys./Cog. Limits	Other Limits	Need	Desire	Negative Trait/Motive	Difficult Task	Rule/Auth. Permits	Lack of Knowledge	Neutral Fact	Other
5	41.25%	7.50%	7.50%	17.08%	3.33%	1.67%	3.33%	10.83%	0%	14.17%
7	35.42%	5%	10%	10.83%	2.5%	6.67%	5%	12.92%	3.33%	20.83%
9	48.19%	7.97%	6.52%	7.25%	2.54%	6.52%	7.97%	7.61%	3.62%	10.87%
Total	41.93%	6.88%	7.94%	11.51%	2.78%	5.03%	5.56%	10.32%	2.38%	15.08%

Overall, children referred to *needs* for 68% of the scenarios and *motives* for 12.5% of the scenarios. I examine how children's reasoning about characters' *needs* (mentioning characters' *limitations*, or *needs*) varies across participants' age, characters' disabilities, and accommodation type with a 3 (Participant's Age: 5, 7, 9) X 2 (Character's Disability: physical disability, cognitive disability) X 2 (Accommodation Type: physical accommodation, cognitive accommodation) mixed-effects ANOVA, with accommodation type as a within-subjects factor. This analysis revealed a significant effect of participant's age, $F(2,116) = 9.44$, $p < .01$, $\eta_p^2 = .14$. Five-year-olds ($M = 45\%$; $SE = 5\%$) mentioned characters' needs significantly less than 7-year-olds ($M = 64\%$; $SE = 4\%$) and 9-year-olds ($M = 70\%$, $SE = 4\%$), *p's* < .01. There were no significant differences between 7- and 9-year-olds, $p = .30$. This analysis also revealed a significant effect of character's disability, $F(1,116) = 6.88$, $p = .01$, $\eta_p^2 = .06$. Children mentioned characters' needs significantly more often for characters with physical disabilities ($M = 66\%$, $SE = 3\%$) than cognitive disabilities ($M = 53\%$, $SE = 3\%$).

This analysis also revealed two significant 2-way interaction effects: Character's Disability X Participant's Age: $F(2, 116) = 7.12$, $p < .01$, $\eta_p^2 = .11$, and Accommodation Type X Character's Disability: $F(1, 116) = 4.81$, $p < .05$, $\eta_p^2 = .04$. Although the 3-way interaction was non-significant, I display the data split by age, disability type, and accommodation type to better unpack the interaction effects in context (Figure 2). First, I interpret the interaction of Character's Disability by Participant's Age. Post-hoc analyses reveal that 7-year-olds ($M = 79\%$, $SE = 6\%$) and 9-year-olds ($M = 80\%$, $SE = 6\%$) reasoned about characters' needs significantly more often for characters with physical disabilities than cognitive disabilities, *p*'s < .01. This difference was not found among 5-year-olds, $p = .13$.

According to the interaction of Accommodation Type by Character's Disability, children mentioned characters' needs more often when physical accommodations were provided to characters with physical disabilities (*M* = 70%, *SE* = 4%) vs. cognitive disabilities (*M* = 51%, *SE* = 4%, $p < .01$). I did not see this same effect when cognitive accommodations were provided to characters with cognitive disabilities (*M* = 56%, *SE* = 4%) vs. physical disabilities (*M* = 62%, *SE* = 4%), $p = .31$. I did not find a significant 2-way interaction of Accommodation Type by Participant's Age, $F(2, 116) = .40$, $p = .67$, $\eta_p^2 = .01$, or significant 3-way interaction of Accommodation Type X Participant's Age X Character's Disability, $F(2, 116) = .70$, $p = .50$, $\eta_p^2 = .01$.

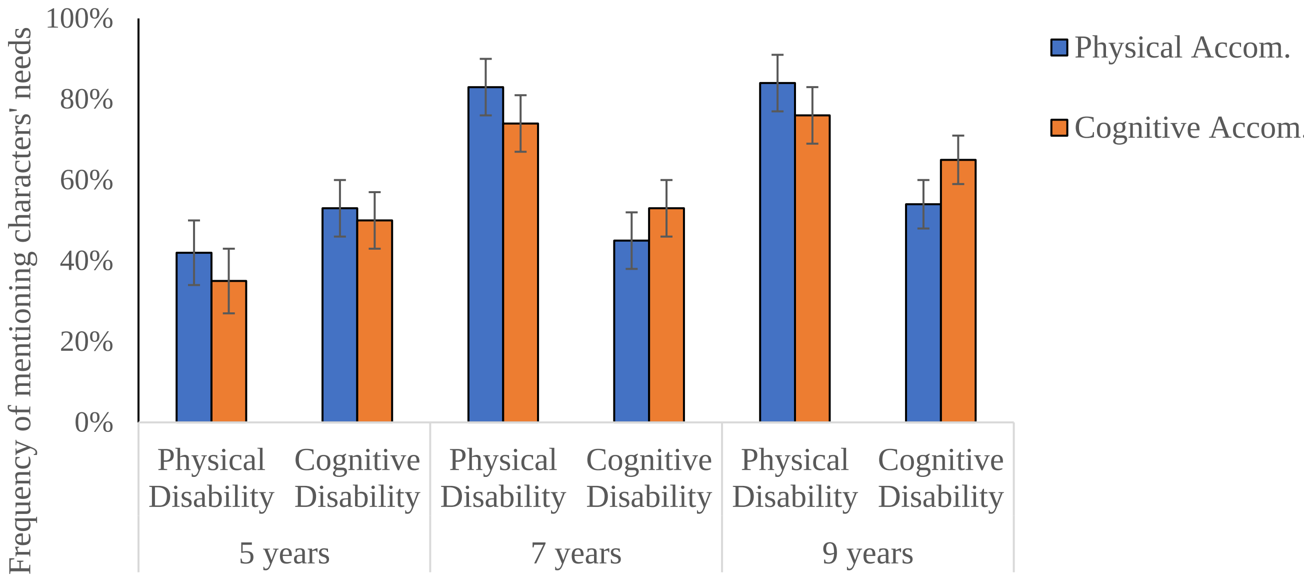


Figure 2. Frequency of mentioning characters' needs when reasoning about characters' physical (blue bars) or cognitive (orange bars) accommodations, among children 5-, 7-, and 9-years of age. Characters either possessed a physical disability or a cognitive disability. Individual scores can range from 0-1. Error bars represent +/- 1 standard error of the mean.

Next, I examine how children's reasoning about characters' *motives* (mentioning characters' *negative traits or motives* or mentioning characters' *desires*) varies across participants' age, characters' disabilities, and accommodation type with a 3 (Participant's Age: 5, 7, 9) X 2 (Character's Disability: physical disability, cognitive disability) X 2 (Accommodation Type: physical accommodation, cognitive accommodation) mixed-effects ANOVA, with accommodation type as a within-subjects factors. This analysis revealed a significant effect of Participant's Age, $F(2,116) = 3.53$, $p < .05$, $\eta_p^2 = .06$. Five-year-olds (M = 17%; SE = 3%) mentioned characters' motives significantly more than 7-year-olds (M = 9.2%; SE = 3%) and 9-year-olds (M = 7.2%, SE = 3%), *p's* < .05. There were no significant differences between 7- and 9-year-olds, $p = .59$. This analysis did not reveal any other significant main effects or interactions: Character's Disability ($F(1,116) = .49$, $p = .48$, $\eta_p^2 = .004$), Participant's Age X Character's Disability ($F(2,116) = .36$, $p = .70$, $\eta_p^2 = .006$), Accommodation Type X Participant's Age ($F(2,116) = 1.8$, $p = .17$, $\eta_p^2 = .03$), Accommodation Type X Character's Disability ($F(1,116) = .03$, $p = .86$, $\eta_p^2 = .00$), Accommodation Type X Participant's Age X Character's Disability ($F(2,116) = 2.3$, $p = .11$, $\eta_p^2 = .04$).

In summary, when interpreting characters' engagement with accommodations, children frequently mentioned disabled *characters' needs,* especially when characters were physically disabled. This reasoning increased with age, especially when interpreting the actions of characters with physical (vs. cognitive) disabilities. In contrast, children's references to *characters' motives* decreased with age. Next, I explore associations between children's use of these two categories of reasoning and their evaluations of accommodations' fairness.

Relations Between Explanations for Accommodations and Fairness Evaluations

Finally, I examine associations between children's explanations for accommodations and their evaluations of accommodations. I focus on how children's accommodation evaluations are associated with the two broad reasoning categories analyzed thus far--mentioning *characters' needs* and mentioning *characters' motives.*

Initial correlations revealed that children's references to *characters' needs* in general (i.e., reasoning scores aggregated across the six scenarios) were positively and significantly associated with their accommodation evaluations in general (i.e., accommodation evaluation scores aggregated across scenarios; $r = .20$, $p < .05$). Thus, the more children referred to characters' needs, the fairer they evaluated characters' accommodations. To analyze how children's accommodation evaluations are associated with their references to characters' needs within each scenario, while accounting for participant-level variability, and while testing for potential interactions with other variables of interest, I conducted a mixed multilevel regression to predict children's accommodation evaluations for each scenario (nested within participant), from children's age (a continuous, centered variable), mentioning characters' needs for each scenario (nested within participant), character disability (physical or cognitive), and accommodation type (physical or cognitive). The analysis revealed no significant 4-way or 3-way interactions between any of these variables, so these interaction effects were removed from the model.

The reduced model (see Appendix F) revealed that children's accommodation evaluations were associated with participant age ($\beta = .04$, $SE = .01$, $z = 3.29$, $p < .01$, 95% CI [.02, .07]) and were predicted by an interaction of characters' disability and accommodation type ($\beta = .09$, $SE = .04$, $z = 2.05$, $p < .05$, 95% CI [.00, .18]); these effects were identified and interpreted in earlier analyses. More novel and central to the purpose of this analysis, this model revealed that children's fairness evaluations were significantly associated with children's referencing characters' needs (β = .10, *SE* = .04, *z* = 2.67, *p* < .01, 95% CI [.03, .17]), an association which varied by character's accommodation type (β = -.11, *SE* = .05, *z* = 2.34, *p* < .05, 95% CI [-.20, -.02]). Pairwise comparisons revealed that, when children supplied this reasoning, they evaluated physical accommodations (*M* = .52, *SE* = .03) and cognitive accommodations (*M* = .53, *SE* = .03) as equally fair, *p* = .68. When children did not supply this reasoning, they evaluated physical accommodations (*M* = .42, *SE* = .03) as less fair than cognitive accommodations (*M* = .54, *SE* = .03), *p* < .01. There were no other significant interaction effects.

I similarly examined how children's accommodation evaluations are associated with their references to character's *motives.* Use of this reasoning was negatively and significantly associated with evaluations of characters' accommodations (i.e., aggregated across scenarios; *r* = -.20, *p* < .01). I performed a mixed multilevel regression identical to the one described above, except reasoning about characters' *motives* was included as a predictor variable. This analysis revealed no significant 4-way or 3-way interactions between any variables, so these interaction effects were removed from the model. The reduced model (see Appendix G) revealed that children's accommodation evaluations were significantly predicted by children's age (β = .04, *SE* = .01, *z* = 3.24, *p* < .01, 95% CI [.02, .07]), characters' accommodation type (β = .11, *SE* = .03, *z* = 3.56, *p* < .01, 95% CI [.05, .17]), and the interaction of characters' disability and accommodation type (β = -.11, *SE* = .04, *z* = -2.58, *p* = .01, 95% CI [-.20, -.03]). All of these effects were identified and interpreted in earlier analyses. Focal to this analysis, this model revealed that reasoning about characters' motives was associated with accommodation evaluations (β = -.12, *SE* = .04, *z* = -3.05, *p* < .01, 95% CI [-.20, -.04]). When children supplied this reasoning, they evaluated accommodations as significantly less fair (M = .40, SE = .04) than when they did not use this reasoning (M = .52, SE = .02). There were no other significant interaction effects.

In sum, the reasoning that children used to account for characters' accommodation-related behaviors was associated with children's evaluations of those accommodations. When children *failed* to mention characters' *needs*, they tended to evaluate accommodations as less fair; this was particularly true when reasoning about physical accommodations. When children mentioned characters' *motives*, they evaluated both physical and cognitive accommodation as less fair.

Discussion

Study 1 of this dissertation was designed to examine 5- to 9-year-olds' evaluations of and explanations for physical and cognitive accommodations provided to children with physical or cognitive disabilities, and whether explanations relate to their accommodation evaluations. As I predicted, I found age-related shifts in children's evaluations of accommodations, with the oldest children (9-year-olds) evaluating accommodations to be significantly *fairer* than 5- or 7-year-olds. I also predicted that evaluations would vary based on whether an accommodation appropriately addressed a disability (e.g., a cognitive accommodation for a cognitive disability), or not (e.g., a physical accommodation for a cognitive disability). However, my data revealed that this match only mattered for characters with cognitive disabilities—cognitive accommodations utilized by children with cognitive disabilities were judged to be the fairest accommodations.

Children's explanations for accommodations were grouped into two conceptually-motivated categories: 1) mention of characters' needs and 2) mention of characters' motives.

Five-year-olds (when compared to the two oldest age groups) were significantly less likely to mention characters' needs in their reasoning, and significantly more likely to mention characters' motives. Across age groups, mentioning characters' needs was positively associated with fairness evaluations, while mentioning character's motives was negatively associated with fairness evaluations. Finer-grained analyses demonstrate that children who mentioned characters' needs judged physical accommodations as fairer than children who did not.

Age-related Differences in Children's Evaluations of Accommodations

My focal question was how children 5- to 9-years of age evaluate common school accommodations for children with physical and cognitive disabilities. I hypothesized that 5-year-olds would, on average, evaluate accommodations as "unfair," with judgments becoming fairer with age. On average, 5- and 7-year-olds rated accommodations neutrally; their fairness ratings hovered around chance, roughly consistent with the pattern found in Elenbaas' (2019) study on 3- to 8-year-olds' evaluations of equitable resource distributions. However, 9-year-olds, overall, judged accommodations to be a *little fair*. Thus, consistent with my hypotheses, there seems to be a significant shift somewhere around 8 years of age in children's evaluations of accommodations, which may reflect developments in how children reason not just about accommodations but about equitable resource distribution more generally.

My findings were not consistent with findings by Blake et al. (2015), where disadvantageous inequity aversion (DI) was present in all societies by 4-6 years of age and strengthened with age. In fact, I found the *opposite* pattern, with DI weakening with age. This finding provides support for my speculation that judgments of accommodations, though they are disadvantageous inequities, cannot necessarily be treated the same as disadvantageous inequities in past work. The existence of a disability as the reason for a disadvantageous inequity seems to swing older children's judgments to the "fair" side of a fairness scale. One explanation I proposed in hypothesizing about older children's evaluations of accommodations was that, because older children understand the way a disability impacts a person better than younger children (Conant & Budoff, 1983; Nowicki, 2007), they would evaluate accommodations as fairer. For younger children who do not understand the implications of disabilities as well, there is no reason to suppose that their judgments of accommodations would look any different than evaluations of any other disadvantageous inequity. My findings do seem to support this explanation, with a shift at around 8 years of age in the way that children evaluate accommodations.

Earlier, I described evidence that children younger than 8 years of age *do* understand some of the implications of disability: Granata et al. (2022) found that children 4.5 years and older generally judged persons with auditory or physical disabilities who engaged in non-normative behaviors (e.g., not helping someone who fell across the room; talking too loud in class) as significantly less naughty than TD children who performed identical behaviors. These findings suggest that children as young as 5 years do understand the role of physical and perceptual disabilities in related behavior, and adjust their evaluations accordingly. What accounts for the apparent discrepancy in findings? The most direct answer to the above question is that 5- and 7-year-olds' leniency towards disabled characters exists most strongly (or perhaps exclusively) when resource distribution is *not* at play. Participants in both the current study and in Granata et al. (2022) evaluated non-normative behaviors. But, whereas the behaviors in Granata et al. (2022) cost nothing of the participant, the behaviors in the current study involved resources that children (who imagined being part of the class) might desire for themselves, thus leading to harsher judgment. Another interpretation has to do with children's evaluations of fairness (as in the current study) vs. evaluations of naughtiness (as in Granata et al., 2022). As I proposed earlier, just because someone does not explicitly judge a distribution as "bad" does not necessarily mean they think that a distribution is fair; 5- to 9-year-olds in Granata et al. (2022) made evaluations that fell far below the midpoint of their 'naughtiness' scale (i.e., near floor -- not naughty) whereas even the oldest children (9-year-olds) barely rose above the midpoint of my 'fairness' scale in their evaluations in the current study.

Overall, developmental trends in children's fairness evaluations suggest that children's maturing concepts of disability play an important role in evaluating accommodations for persons with disabilities as "fair" (vs. neutrally). Consideration of children's open-ended reasoning provides even more perspective into how children evaluate accommodations for different types of disabilities.

Children's *Reasoning* Varied by Age and the Type of Disability

I was interested in what reasoning children would use when asked to evaluate the fairness of a given accommodation for a physical or cognitive disability. Mentioning characters' needs (including characters' limitations, and explicit reference to needs) increased with age. This finding is consistent with past research by Nowicki (2007), where older children could produce more ideas than younger children about potential causes of learning and physical disabilities. 5- and 7-year-olds in Study 1 of this dissertation used this type of reasoning significantly more for characters with physical disabilities than cognitive disabilities. This finding lends additional evidence that it seems to be easier for children to generate ideas about how physical disabilities (vs. perceptual or cognitive) relate to activities and behaviors (Diamond & Hestenes, 1996; Diamond et al., 2008; Diamond & Hong, 2010).

I hypothesized that another type of reasoning that children would frequently use to explain accommodations would be characters' motives, based on the findings of Granata et al. (2022). Yet, even with condensing two of my fine-grained coding categories into a conceptually driven "motives" category, this category was still used comparatively infrequently in Study 1. When it was mentioned, it was mentioned significantly more by younger participants (5-year-olds), perhaps because they are not yet as attuned (as older children) to how accommodations are afforded to address needs.

Children's Reasoning was Associated with their Fairness Evaluations

A final goal was to investigate whether children's reasoning about accommodations was associated with their fairness evaluations. As expected, I found associations between mentioning characters' needs and fairness evaluations, and associations between mentioning characters' motives and fairness evaluations. Though mentioning characters' motives was relatively infrequent, children who more often mentioned motives tended to evaluate accommodations as less fair. This suggests that children who used this reasoning (predominantly 5-year-olds) were not making a connection between a disability and an accommodation as a "need," attributing the accommodation-related behavior instead to a trait, motive, or desire. Indeed, mentioning characters' needs was associated with evaluating accommodations as fairer, especially physical accommodations.

Limitations and Future Directions

In the current study, I provided examples of some implications of a walking disability (e.g., walks slower), but there were likely individual differences in how children interpreted the "severity" of the disability on functioning; these individual differences may in turn have influenced fairness evaluations of accommodations. For example, a child who takes "walks differently" to mean walks with a slight limp vs. a child who takes "walks differently" to mean walks with crutches or a walker may evaluate accommodations for that walking disability differently. While the current study did not include visual depictions of disability, past research suggests that children hold negative sentiments toward medical equipment (Diamond et al., 2008; Huckstadt & Shutts, 2014). Future studies should continue to explore children's concepts of disabilities described in these increasingly common and inclusive ways (i.e., "walks differently" vs. "can't walk").

Although pretest participants tended to judge the six focal accommodations as unfair (if provided to a TD child) (see Appendix C Table C1), there were individual differences in evaluations of these scenarios; one potential factor is the desirability of the individual accommodations. For example, from my pre-test data, children seem to judge the physical accommodation involving playing soccer with one's hands as more unfair (0.17) than the physical accommodation involving going outside for recess first (0.30), because children in the early grade school years might desire an advantage in their favorite sport more than they do extra play time. Recent work by Echelbarger and Gelman (2023) examined the role of value in children's (4-9 years of age) reasoning about resources through the lens of "scarcity"; they found that "popularity" and "intrinsic nature" were important cues for indicating the scarcity (and thus, desirability) of resources. Once can see how different accommodations could be perceived as more or less scarce (e.g., playtime vs. use of limited technology), influencing the desirability of those resources and, in turn, fairness evaluations of those accommodations. Future research should continue to investigate children's evaluations of and reasoning about accommodations for children with disabilities, with consideration of the role of scarcity and desirability.

In summary, when considering children's developing fairness concepts of accommodations provided to persons with disabilities, older children's more advanced concepts of disability, particularly understanding the needs that stem from disabilities, seem to drive evaluations of these inequitable distributions as fairer. Despite age, children who are apt to explain accommodations as related to "need," as opposed to traits or motives of the person, appear to be more lenient in their fairness evaluations. My findings may inform initiatives to increase children's awareness of disabilities and related accommodations in hopes of promoting better understanding and inclusion of children with disabilities in the classroom.

CHAPTER 3

Study 2

Around 61 million adults in the United States live with a disability, many of whom have a visual or hearing impairment; in fact, the number of people living with a visual impairment is expected to double by 2050 (Martinez, 2022). Popular media provides examples of how these visual and hearing deficits affect the performance of alternate senses – "Daredevil" (Daredevil: Series, Marvel Comics, 1964) has radar sense, echolocation, and high sensitivity to tastes, smells, and sounds as a consequence of being blinded as child; "Toph" (also blind) can "see" by sensing vibrations in the ground (Avatar: The Last Airbender and Legend of Korra, 2012); Irwin Emery (Whistler) from "Sneakers" (1992) has enhanced hearing that enables navigation by sound to compensate for blindness. These representations and many other popular representations may reflect lay intuitions about intra-sensory dynamics, and these representations might influence developing intuitions about intra-sensory dynamics. Yet, no studies to my knowledge have directly tested for these intuitions in children or adults.

In the current study, I test for differences across the lifespan in how persons estimate intra-sensory performance in persons with an impairment in one sense. For example, do persons estimate above-average hearing abilities in persons with severe or moderate visual impairments? By identifying the existence or absence of these intuitions, I have the potential to expand work on children's understanding of the five primary senses (e.g., O'Neill & Chong, 2001; O'Neill & Gopnik, 1991; Pillow, 1993), children's concepts of learning (e.g., Pramling, 1988; Wang, 2010), children's and adults' concepts of biological processes (e.g., Carey, 1985; Inagaki & Hatano, 1990, 1993), children's and adults' susceptibility to "halo effects" (e.g., Dion, 1973;

Dion et al., 1972), and children's and adults' concepts of disability (e.g., Conant and Budoff, 1983).

Individuals with sensory disabilities report that their lives are most profoundly influenced by visual and hearing deficits (Brown et al., 2018), and persons without disabilities often assume that losing vision or hearing (compared to other senses) would most profoundly influence their wellbeing (Enoch et al., 2019; Scott et al., 2016). The importance that individuals assign to vision and hearing in particular motivated Study 2's focus on reasoning about people with vision and hearing deficits**.** Study 2 of this dissertation explores the extent to which both adults (Study 2A) and children (Study 2B) conceptualize a deficit in one sense (vision or hearing) as influencing the performance of other senses. Adults estimated the sensory performance of persons with hearing or seeing deficits and provided information on their exposure to messages about this topic via some of the sources mentioned above (i.e., popular media), academic sources (e.g., biology or neuroscience courses), and/or personal or familial experience with sensory deficits. Children 5-9 years of age provided similar estimates as adults, as well as ratings of their *own* sensory performance. I additionally investigate children's intuitions about others' sensory performance through a series of scenarios where a lost object must be found when no visual cues for the object are available (i.e., in the dark); children are asked to endorse a typically-developing (TD) character vs. a character with a visual deficit as better at finding the object. Children then provide their reasoning for these decisions, as the reasoning children use (e.g., references to halo effects, compensatory effects) may provide important insight into their endorsements.

There are many ways in which people may evaluate the role of sensory loss in the aptitude of one's remaining senses. Two ways include halo effects and compensatory effects. In the sections that follow, I first review existing literature on halo effects in children and adults, with a particular emphasis on the impact of disability-related halo effects. I then review literature on topics (e.g., naïve biology) that may inform hypotheses related to compensatory intuitions, given the lack of research (to the best of my knowledge) directly exploring children's and adults' reasoning about compensatory effects in persons with sensory loss.

Halo Effects

Both children (e.g., Dion, 1973; Marble & Boseovski, 2020) and adults (e.g., Dion et al., 1972; Eagly et al., 1991; Forgas & Laham, 2017; Nisbett & Wilson, 1977) are subject to "halo effects". Halo effects involve attributing clusters of positive qualities to persons who have other positive qualities, and clusters of negative qualities to persons with negative qualities (negative halo effects are also termed "horns effects" or "reverse halo effects"). For example, in a classic study, 3- to 6-year-olds inferred that other children whom they judged to be attractive were more likely to behave prosocially, and children who they judged to be unattractive were more likely to behave antisocially (Dion, 1973). Study 2 of this dissertation investigates how descriptions of characters as being visually- or hearing- impaired affects inferences about the performance of alternate senses (i.e., seeing, hearing, touch, taste, smell), and forced-choice decisions surrounding task performance (described in detail below). It is possible that the presence of a deficit in one sense (seeing or hearing) may lead children (and adults) to reason that other senses are also diminished via a negative halo effect. Conant and Budoff (1982) (discussed earlier) found that children in preschool and primary school were most likely to hold unrealistic beliefs about blindness (e.g., blind people cannot see because "they have black glasses on that keep them from seeing"; p. 89), but also had the fewest *negative* beliefs about blind people; negative evaluations of blindness (e.g., blind people are more emotional than other people, p. 89) increased with age. Thus, there may be developmental differences in the strength of negative halo effects related to blindness, if halo effects exist at all.

In a recent study, Wiebe and colleagues (2022) showed 3- to 6.99-year-old children scenarios where a disabled character (a walking disability or a hearing disability) looked inside a box to see what was inside, and a typically-developing (TD) character held the box but did not look inside. The characters made opposing claims about the contents of the box, and participants were asked to endorse one of the characters' claims. The authors predicted that children might choose to endorse the claims of the TD characters if characters' disabilities (assuming they are perceived negatively) influenced inferences about disabled characters' knowledge via a negative halo effect. This prediction was not supported, as children were significantly more likely to pick characters who had looked inside the box, regardless of disability-status. The authors interpreted their findings as suggesting that children may not conceptualize physical (walking) or perceptual (hearing) disabilities as particularly negative attributes when described verbally, or that perhaps children are hesitant to make inferences about the quality of people's knowledge based only on disability status (Wiebe et al., 2022). Despite these conclusions, I predict that I may find negative halo effects in the current study for several reasons. Children's exposure to persons with disabilities or stereotypes about persons with disabilities via popular media increases with age (Mitchell, 2008; Nelson, 2000; Price et al., 2015; Schwartz et al., 2010; Ware, 2001). In the current study, participants range from 5-10 years; this offers the opportunity to detect halo effects which might not emerge until late childhood. As well, perhaps halo effects are more likely to emerge in children's reasoning about intra-sensory associations—the topic of the current study.

The design of Study 2 allows for the detection of both compensatory reasoning about senses and reasoning that reflects halo effects. Conceivably, these two patterns might dominate children's reasoning at different points developmentally; I will be able to identify such developmental differences in Study 2.

Compensatory Effects

Intuitions about sensory compensation when one or more senses is diminished could be explained by concepts of modification/learning, formally known as *neural plasticity:* "the capacity of the nervous system to modify itself functionally and structurally in response to experience and injury" (Bernhardi et al., 2017). To the best of my knowledge, no studies have examined children's or adults' intuitions about this sort of neural plasticity. But other areas of research can inform this topic, such as how children and adults reason about uncontrollable biological processes.

In a classic paper, Carey (1985) argued that children under 10 years of age do not possess real biological knowledge – they cannot distinguish between biological processes and psychological ones. Inagaki and Hatano (1990) found evidence to the contrary: although 7- to 8-year-olds could not verbally *detail* the biological process of blood circulation, half of them reasoned that stopping of this circulation would affect the limbs of the body. In a subsequent study, Inagaki and Hatano (1993) proposed the idea of "vitalistic causality" as preceding advanced biological/mechanical reasoning: "the sense that the organ's activities include phenomena that are independent of the intention of the person who owns the organ" (Inagaki & Hatano, 1993, p. 1535).

In a series of experiments, 4- and 5-year-old children recognized that the functioning of insides (i.e., heartbeat, breathing, digestion) was outside of their intentional control (Inagaki & Hatano, 1993). Inagaki and Hatano (1993) also tested 6- and 8-year-old children's (and adults') reasoning about several biological processes in the body. They found that 6-year-olds were most likely to use vitalistic explanations (e.g., “We eat food because our stomach takes in vital power from the food”) vs. intentional (e.g., “Because we want to eat tasty food”) or mechanical (e.g., “Because we take the food into our body after its form is changed in the stomach and bowels”) explanations for bodily functions, especially for biological phenomena (vs. psychological phenomena). 8-year-olds used mechanical explanations most often, followed by vitalistic explanations. Adults predominantly used mechanical explanations. Thus, biological concepts were most often captured by mechanical explanations in older age groups (8-year-olds and adults), and vitalistic explanations preceded these mechanical explanations. The authors take these findings to support their argument that vitalistic reasoning might be a necessary step toward reasoning about biological phenomena using mechanical explanations.

While reasoning about sensory processes was not tested by Inagaki and Hatano (1993), I hypothesize that similar categories of reasoning could inform my research questions related to persons’ intuitions about intra-sensory performance. Children who use any sort of reasoning related to modification/compensation (whether vitalistic or mechanical) may be more likely to infer that one or more senses would be *stronger* than average because of a diminished one - as opposed to children who use other sorts of reasoning, such as reasoning driven by halo effects (discussed further below), who may be more likely to infer that one or more senses would be *weaker* than average because of a diminished one.

Study 2A

Method

All recruitment procedures, inclusion/exclusion criteria, and methods were pre-registered (https://aspredicted.org/X6F_Q4H).

Participants

Participants (*N* = 224, 113 men, 106 women, 5 gender not identified) ranging from 20 to 80 years in age (*M* = 42.06 years) were recruited online through Amazon's Mechanical Turk via CloudResearch's platform (Litman, n.d.) Participants had the option to identify with neither gender (*n* = 1) or indicate they prefer not to say (*n* = 4). Per my pre-registered exclusion criteria, participants were excluded if any of the following was true: they did not complete the study within a feasible time span (5 to 45 minutes) (*n* = 12), did not correctly answer 3 of the 4 U.S. location-check questions (*n* = 4), did not correctly answer 3 of the 4 "bot" checks (*n* = 4), did not correctly answer 3 of 4 memory-checks (*n* = 7) or completed less than 95% of the study. 22 total participants were excluded, with many of these participants excluded for multiple criteria simultaneously (so these *n*'s will not sum to 22). Participants were also excluded if they did not correctly reiterate the information given to them about sensory strength for at least 4 out of the 5 scenarios, with an error margin of 2 points. For example, if a participant was told that the strength of someone's vision was "50", when they were asked to estimate the strength of all 5 senses, they had to report that the person's vision was somewhere between 48 and 52; 43 participants were excluded for this reason, with overlap between participants excluded for other criteria (above).

My goal was to recruit a sample large enough to fulfill the requirements of an a priori power analysis (using G*Power 3.1; Faul et al., 2007) for an ANOVA that included assigned ability (2 levels, between subjects), ability strength (5 levels, within-subjects), and estimated ability type (5 levels, within subjects). The analysis determined that I required a minimum of 221 participants to detect medium-large sized (f = 0.32; Cohen, 1992) main effects and interactions effects with statistical power ≥ .80 and α = .05. I recruited 2 participants beyond my initial goal, and I decided to keep, rather than discard, their data.

Samples recruited from Amazon's Mechanical Turk are often more diverse than samples from U.S. undergraduate institutions, but less diverse than the general U.S. population (Litman, n.d.). In my final sample, 41.3% (n = 105) completed a bachelor's degree, 28.7% (n = 73) completed "some college," 13.8% earned a high school diploma (n = 35), 12.6% earned a master's degree (n = 32), 3.1% earned a doctorate (n = 8), and 0.4% (n = 1) completed "some high school". Most of the participants (77.6%; n = 197) identified as "White/European Descent", followed by 13% (n = 33) as "Black/African American", 9.8% (n = 25) as "Latinx," 5.5% (n = 14) as "Asian/Asian American," 2.4% (n = 6) as "Native American", 1.2% (n = 3) as "Middle Eastern", and 0.4% (n = 1) as "Indian/Salvadorian/Iranian" (this was participant-specified under the selection of "Other"). These categories were not mutually exclusive. Participants were also asked about the frequency of their relationships with persons with disabilities: 54.3% (n = 138) reported having "one or two" relationships, 29.1% (n = 74) reported no relationships, 13.8% (n = 35) reported "3-5 relationships," and 2.8% (n = 3) reported having "6+ relationships." Participant recruitment, consent, and all study procedures were approved by Vanderbilt University's Institutional Review Board.

To explore the role of experience in adults' intuitions about sensory performance and compensation, I asked a series of questions related to persons' self- deficits or disorders related to seeing or hearing, close friends' or family members' seeing or hearing deficits or disorders, exposure to psychology or neuroscience courses, and exposure to media where persons senses were heightened. In my final sample, 41.1% (*n* = 92) reported having deficits or disorders related to their own seeing, and 47.8% (*n* = 107) reported having family members or close friends with seeing deficits or disorders. Only 10.3% (*n* = 23) reported having deficits or disorders related to their hearing, and 28.6% (*n* = 64) reported family members or close friends having hearing deficits or disorders. Thirty-seven percent of my sample (*n* = 83) reported having taken a psychology or neuroscience course. I asked participants to describe any media (e.g., books, TV, movies) they consumed that included characters with heightened senses (e.g., super-hearing, super-smell, etc.). What I was especially interested in was whether participants were aware that any of the characters with heightened senses (if they described any) had a disability or deficit in another sense; 81 participants (36.2%, *N* = 222) expressed that they knew of characters with heightened senses who *also* had a disability or deficit in another sense.

Procedure

The survey was delivered online, constructed and hosted by Qualtrics.com. Participants read a consent document in which the stated purpose of the survey was to understand how adults think about the five senses. They read that total participation time is typically 10 minutes (so that participants can opt not to proceed if they do not have that much time to afford). After participants read the consent document and reported basic demographic information, they were informed that the survey is available only to participants in the United States, and to not proceed if they do not live the United States. Participants were encouraged to complete the survey on a computer with a keyboard rather than a phone or tablet, and silence distractions so they could focus on the study. Participants were then prompted to check a box confirming that they agree to read each description and question carefully.

Sensory Ratings - Self (Pre-Test Only)

To determine how participants estimated the performance of their own senses compared to an average person, I conducted a separate pre-test with 66 adults. Participants rated the performance of their five senses, relative to most other people, using a sliding scale. The top of the scale read (from left to right): “Worse than most people,” “Same as most people,” “Better than most people.” Underneath were numbers from 0 to 100 (in increments of 10), and the sliding function that allowed participants to drag and select any value within this range. For example, when asked to evaluate their vision, participants read: “Think about how the strength of your *vision* compares to other people’s vision”, and then, “On the scale below, the average person’s vision is “50”. Use this sliding scale to rate the strength of your vision.” Following their scale rating, participants read a prompt asking them why they provided the rating they did; for example, “Why did you provide the rating you did for your vision? Please provide as much detail as you see fit.”

On average, participants demonstrated subtle optimism effects for all five senses. Estimates of hearing and taste were the highest (*M’s* = 63.68 and 63.95, respectively), and estimates of vision were the lowest (M = 55.30). This is consistent with work demonstrating that adults rate themselves as slightly above average along many dimensions (e.g., Alicke & Govorun, 2005). Results from the pre-test gave me confidence that these scales were appropriate for use with adults. Participants were not wildly overestimating or underestimating their own sensory performance.

Introduction to Characters (Full Study Only)

In the full version of Study 2A, there were no self-ratings. Instead, after participants checked the box stating they would reach each question carefully, participants completed a set of *character estimates.* Before the character estimates, participants were told that they would read about "several middle-aged persons, one at a time." I specified that the characters in the descriptions are "middle-aged" so that participants would not hold systematically different assumptions about the *current* age of the characters.

Participants were oriented to the same scale described above for the self-ratings, but told instead that they would "estimate the strength of each person's five senses" and use the scale to do so - they were shown a picture of the scale. Additionally, I quantified the endpoints and midpoint of the scale for them: "0 means that the person's sense doesn't work at all, "50 means that the person's sense is average compared to most people", and "100 means that the person's sense is as strong as humanely possible."

Character Sensory Estimates

Participants were randomly assigned to provide subsequent sensory performance estimates for either characters with *visual abilities* that varied (n = 115), or characters with *hearing abilities* that varied (n = 109). Participants reasoned about characters with vision or hearing at five points along the scale: "much weaker than most people. They don't see/hear anything" (0), "a little weaker than most people. They don't see/hear things as well" (25), "the same as most people. They see/hear things as well as most people" (50), "a little stronger than most people. They see/hear things well" (75), and "a lot stronger than most people. They see/hear things very, very well" (99). I avoided asking about persons with sensory abilities of '100' because I wanted to avoid priming concepts of people who are all-seeing or all-hearing (if 0 means that someone sees nothing, then 100 might be interpreted as someone seeing everything—microscopic organisms, objects placed many miles away, in the dark, etc.). For clarity, I will walk through a full example for a character (Alex) with vision at a "0".

Participants first read: "Since they were born, Alex's vision has been much weaker than most people. They don't see anything." Then, above a picture of the scale with a "0" marked/selected" (see Appendix H) they read, "On the scale below, Alex's vision is a "0". Below the scale, they read, "Now we'll ask you questions about all five of Alex's senses. Think about how the strength of Alex's senses compare to most other people."

At the top of the page (visible during all the estimates) was a reminder about what "degree" of the sense they were reasoning about for the character; for my example above, it read: "Remember, Alex's vision is a "0."" Estimates of the seeing or hearing senses (depending on condition assigned) served as a memory/attention check. The order in which estimates for the 5 senses were presented for each character was randomized. As a reminder, participants completed 5 estimates for each of 5 characters, so 25 estimates in total. Participants then completed the remaining memory/attention check and demographic questions (described earlier).

Scoring

Participants read a total of five vignettes, where persons' abilities differed in strength – strength was specified on a scale from 0 to 100 (described above). Following each vignette, participants estimated the strength of persons' five senses on the same scale from 0 to 100. The key dependent variables are "Sensory Performance Judgments": 1) Vision, 2) Hearing, 3) Smell, 4) Taste, and 5) Touch when participants were given information about the strength (5 levels) of that person's A) Vision or B) Hearing abilities. Thus, individual scores can range from 0-100.

Results

I conducted analyses to explore how participants' sensory performance estimates varied based on information provided to them about visual or hearing abilities, the strength of those abilities, and subsequent estimations of all five senses. Consistent with my pre-registered analysis plan (https://aspredicted.org/X6F_Q4H), I first conducted a 3-way mixed ANOVA of Assigned Ability (2: vision, hearing; between-subjects) X Ability Strength (5: 0, 25, 50, 75, 99; within-subjects) X Estimated Ability Type (vision, hearing, smell, taste, touch; within-subjects), which revealed significant effects of Assigned Ability ($F(1, 222) = 12.90$, $p < .01$, $\eta^2_p = .06$), Ability Strength ($F(1.8, 398.92) = 91.47$, $p < .01$, $n^2_p = .29$), and Estimated Ability Type (F $(2.92, 648.13) = 41.24$, $p < .01$, $\eta^2_p = .16$). This analysis also revealed significant interactions between all my variables: Assigned Ability X Estimated Ability Type ($F(2.92, 648.13) = 116.36$, $p < .01$, $\eta^2_p = .34$), Assigned Ability X Ability Strength ($F(1.8, 398.92) = 10.06$, $p < .01$, $\eta^2_p = .04$), Estimated Ability Type X Ability Strength ($F(6.69, 1484.74) = 495.88$, $p < .01$, $\eta^2_p = .69$), and Estimated Ability Type X Ability Strength X Assigned Ability ($F(6.69, 1484.74) = 1065.65$, $p < .01$, $\eta^2_p = .83$). Mauchly's tests indicated that assumptions of sphericity had been violated (Estimated Ability Type: $\chi^2(9) = 206.51$, $p < .01$, Ability Strength: $\chi^2(9) = 485.10$, $p < .01$, Estimated Ability Type X Ability Strength: $\chi^2(135) = 1590.15$, $p < .01$), so Greenhouse-Geisser corrections are reported for results involving these variables.

Given the number and complexity of significant effects, to help interpret these patterns, I next conducted five separate mixed-effects ANOVAs, one per estimate of each of the five senses.

Vision

First, I conducted a 2-way mixed ANOVA of Assigned Ability (2: vision, hearing; between-subjects) X Ability Strength (5: 0, 25, 50, 75, 99; within-subjects) for participants' sensory performance estimates about *vision.* The analysis revealed significant effects of Ability Strength (F $(2.13, 473.77) = 897.02$, $p < .01$, $\eta^2_p = .80$), Assigned Ability (F $(1, 222) = 68.18$, p

$< .01$, $\eta^2_p = .24$), and a significant interaction of Ability Strength X Assigned Ability (F (2.13, 473.77) = 1440.90, $p < .01$, $\eta^2_p = .87$). Mauchly's tests indicated that assumptions of sphericity had been violated for Ability Strength, $\chi^2(9) = 324.66$, $p < .01$, so Greenhouse-Geisser correction was employed. Generally, characters' vision was rated as stronger among participants who were assigned to read about characters who differed in their hearing abilities (M = 56.53, SE = .57) than participants who read about characters who differed in their visual abilities (M = 50.02, SE = .55). Participants' estimates of characters' visual abilities were significantly different at every level of described ability: '0' (M = 32.88, SE = .82), '25' (M = 41.76, SE = .63), '50' (M = 51.42, SE = .34), '75' (M = 64.39, SE = .57), '99' (M = 75.94, SE = .77), all ps < .001.

These main effects of Assigned Ability and Ability Strength were subsumed under a significant interaction of Assigned Ability X Ability Strength. As expected, and as clearly depicted in Figure 3, participants' estimates of characters' visual acuity closely parallelled what they read about those characters' vision. For example, they reported that visual acuity was lowest for persons "who don't see anything" (0). Estimates at all five acuity levels (0, 25, 50, 75, 99) differed significantly from one another, all $ps < .001$. These findings essentially serve as a manipulation check. More central to my research questions were adults' estimates of people's visual abilities as a function of their *hearing* abilities. Estimates of persons' vision were significantly *higher* for persons with hearing of 0 vs. *all other*, more acute, hearing levels (25, 50, 75, 99, ps < .001) and were higher for persons with hearing of 25 versus more acute hearing (50, 75, 99, ps < .001). Vision estimates for persons with hearing acuity of 50, 75, and 99 did not significantly differ (ps > .15). In sum, for low levels of hearing acuity, I found compensatory effects for estimates of persons' vision. Adults surmised that persons' visual abilities would be *better* than average when deficits in hearing existed at severe (0 – cannot hear anything) or moderate (25 – cannot hear well) levels.

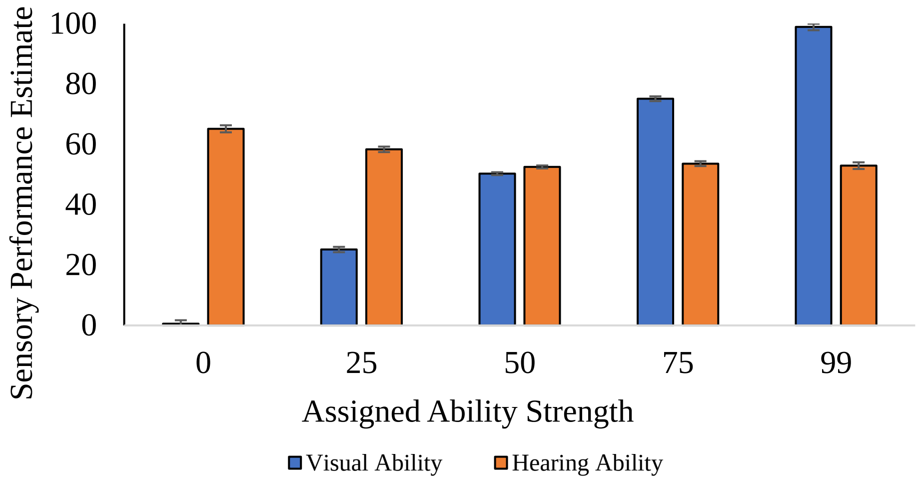


Figure 3. Adult's estimates of ***visual*** *performance when assigned to read about persons who differed in the strength of either their vision (blue bars) or their hearing (orange bars). Assigned ability strength (depicted along the x-axis) ranged from '0' ("can't see/hear at all"), to '99' ("can see/hear very, very well"). Individual sensory performance estimates (depicted along the y-axis) could range from 0 to 100. Error bars represent +/- one standard error of the mean.*

Hearing

Next, I conducted the same 2-way mixed ANOVA of Assigned Ability (2: vision, hearing; between-subjects) X Ability Strength (5: 0, 25, 50, 75, 99; within-subjects) for participants' sensory performance estimates for *hearing*. Like for estimates of vision (above), this analysis revealed significant effects of Ability Strength ($F(2.20, 488.43) = 476.83$, $p < .01$, $\eta^2_p = .68$), Assigned Ability ($F(1, 222) = 255.68$, $p < .01$, $\eta^2_p = .54$), and a significant interaction of Ability Strength X Assigned Ability ($F(2.20, 476.83) = 1143.47$, $p < .01$, $\eta^2_p = .84$); like for vision, Mauchly's test indicated that assumptions of sphericity had been violated for Ability Strength, $\chi^2(9) = 312.78$, $p < .01$, so Greenhouse-Geisser corrections were used for all results involving this variable. Participants who read about characters' differing vision judged participants' hearing abilities to be significantly higher on average ($M = 61.52$, $SE = .51$) than participants who read about characters' differing hearing (*M* = 49.74, *SE* = .53). Participants' estimates differed significantly at each acuity level: '0' (*M* = 39.06, *SE* = 1.00) vs. '25' (*M* = 45.38, *SE* = .74) vs. '50' (*M* = 51.41, *SE* = .40) vs. '75' (*M* = 64.87, *SE* = .61) vs. '99' (*M* = 77.40, *SE* = .78), all *p*s < .001.

These main effects were subsumed under an interaction of Ability Strength X Assigned Ability. Hearing acuity was estimated to be significantly lower for persons "who don't hear anything" (0) vs. persons "who don't hear things as well" (25), vs. persons "who hear as well as most people" (50), vs. persons "who hear things well" (75), vs. persons "who hear things very, very well" (99), all *p's* < .001. Here, I was particularly interested in estimates of persons' hearing abilities as a function of their *seeing*. These estimates were significantly *higher* for persons with seeing of 0 than all other, more acute seeing levels (25, 50, 75, 99, *ps* < .001), seeing of 25 vs. all other more acute levels (50, 75, 99, *p*s < .001), and seeing of 50 vs. 75 (*p* < .01) and 99 (*p* < .05). Hearing estimates did not differ significantly for persons with vison 75 vs. 99, *p* = .61. See *Figure 4.*

Thus, I also found compensatory effects for low levels of vision in estimates of persons' hearing, and these effects were even *stronger* in this case – adults had intuitions that persons' hearing abilities would be much better than the average person when deficits in vision existed at severe (0 – can't see anything) or moderate (25 – can't see well) levels.

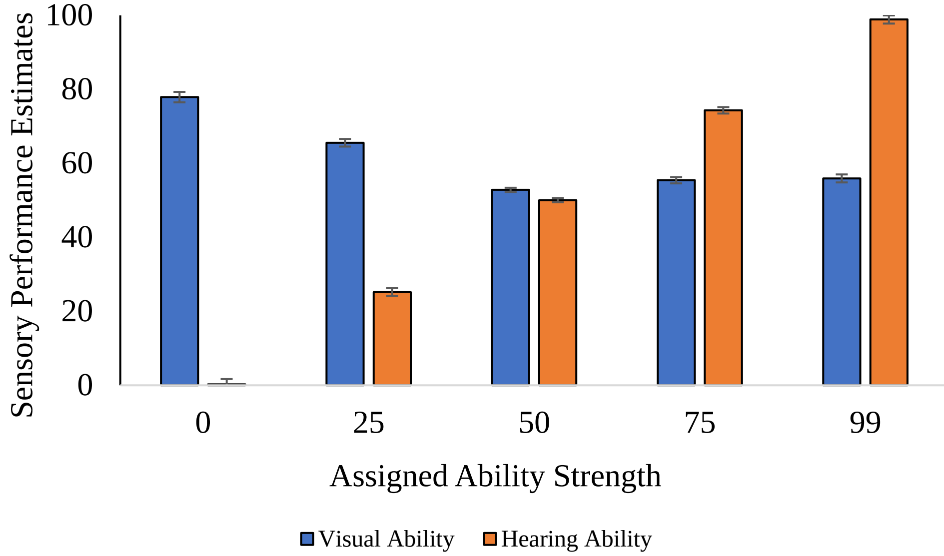


Figure 4. Adult's estimates of ***hearing*** *performance when assigned to read about persons who differed in the strength of either their vision (blue bars) or their hearing (orange bars). Assigned ability strength (depicted along the x-axis) ranged from '0' ("can't see/hear at all"), to '99' ("can see/hear very, very well"). Individual sensory performance estimates (depicted along the y-axis) could range from 0 to 100. Error bars represent +/- one standard error from the mean.*

Smell, Taste, and Touch

For the sake of conciseness, I present the remaining 3 ANOVAs succinctly: I ran the same 2-way mixed ANOVA of Assigned Ability (2: vision, hearing; between-subjects) X Ability Strength (5: 0, 25, 50, 75, 99; within-subjects) for participants' estimates of *smell, taste, and touch.* For all three analyses, I found significant main effects of Ability Strength (*smell*: $F(1.97, 436.65) = 58.61$, $p < .001$, $\eta^2_p = .21$; *taste*: $F(2.07, 459.43) = 24.38$, $p < .001$, $\eta^2_p = .10$; *touch*: $F(1.94, 430.03) = 72.44$, $p < .001$, $\eta^2_p = .25$), and significant main effects of Assigned Ability for estimates of *smell* and *touch* (*smell*: $F(1, 222) = 7.44$, $p < .001$, $\eta^2_p = .03$; *touch:* $F(1, 222) = 13.34$, $p < .001$, $\eta^2_p = .06$), but not estimates of *taste*, $F(1, 222) = 3.07$, $p = .08$, $\eta^2_p = .01$. I found significant interactions of Ability Strength X Assigned Ability for all three analyses (*smell*: $F(1.97, 436.65) = 10.81$, $p < .001$, $\eta^2_p = .05$; *taste*: $F(2.07, 459.43) = 3.33$, $p < .05$, $\eta^2_p = .02$; *touch*: $F(1.94, 430.03) = 11.43$, $p < .001$, $\eta^2_p = .05$). Just like my previous analyses, assumptions of sphericity were violated for Ability Strength (*smell*: $\chi^2(9) = 388.72$, $p < .01$, *taste*: $\chi^2(9) = 342.22$, $p < .01$, *touch*: $\chi^2(9) = 455.71$, $p < .01$) and Greenhouse-Geisser corrections were used for all results involving this variable.

Adults continued to estimate sensory performance significantly differently based on the information they were provided about the strength of persons' hearing or seeing abilities, with the highest ratings of sensory performance at ability level '0' (*smell*: $M = 66.66$, $SE = 1.16$; *taste*: $M = 61.78$, $SE = 1.15$; *touch*: $M = 69.13$, $SE = 1.27$). Estimates of *smell* and *touch* were significantly higher when participants read about persons whose visual abilities differed (*smell*: $M = 58.77$, $SE = .69$; *touch*: $M = 60.32$, $SE = .75$) vs. hearing abilities (*smell*: $M = 56.07$, $SE = .71$; *touch*: $M = 56.40$, $SE = .77$); I did not find a significant difference in estimates of *taste* (seeing: $M = 57.06$, $SE = .72$; hearing: $M = 55.25$, $SE = .74$).

Finally, when considering significant interactions of Ability Strength X Assigned Ability for these three senses, both levels of Assigned Ability (hearing and seeing) were of equal interest, as no estimates served as manipulation checks here. For all three senses, performance estimates were significantly higher at 0 than any other acuity level, specifically, when persons visual abilities differed, *p*s < .05. When hearing abilities differed, there was no significant difference between levels 0 and 99 for *taste*, $p = .19$. I found significant differences between acuity level 25 and remaining levels for *smell* and *touch* – especially in the s*eeing condition*, all *p*s < .05. In the *hearing* condition, these differences became nonsignificant for 25 vs. 75 and 99, *p*s > .06. See *Figures 5-7.*

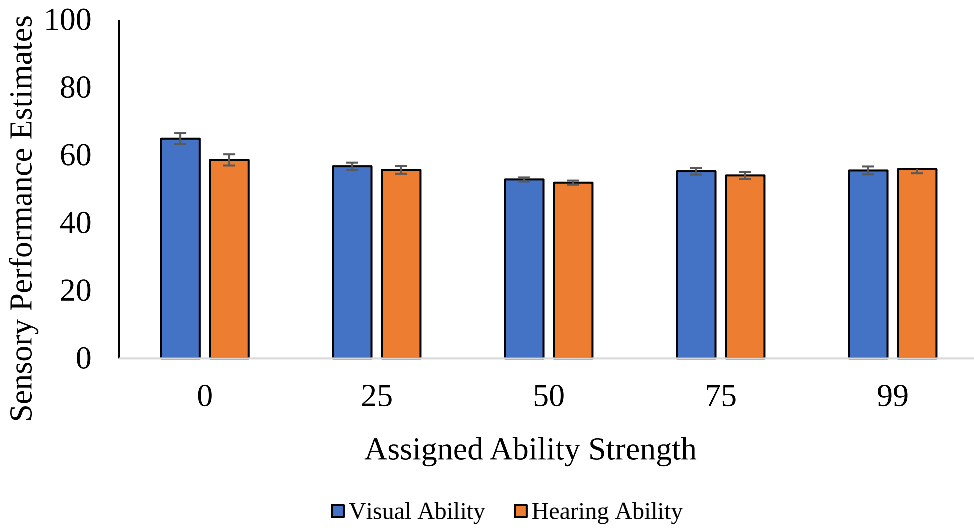


Figure 5. Adult's estimates of ***tasting*** *performance when assigned to read about persons who differed in the strength of either their vision (blue bars) or their hearing (orange bars). Assigned ability strength (depicted along the x-axis) ranged from '0' ("can't see/hear at all"), to '99' ("can see/hear very, very well"). Individual sensory performance estimates (depicted along the y-axis) could range from 0 to 100. Error bars represent +/1 one standard error from the mean.*

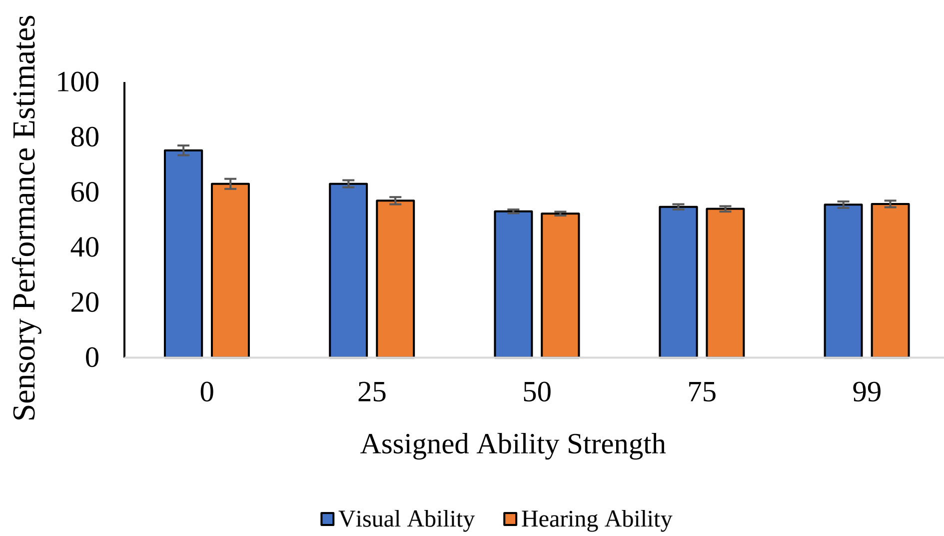


Figure 6. Adult's estimates of ***touchin****g performance when assigned to read about persons who differed in the strength of either their vision (blue bars) or their hearing (orange bars). Assigned ability strength (depicted along the x-axis) ranged from '0' ("can't see/hear at all"), to '99' ("can see/hear very, very well"). Individual sensory performance estimates (depicted along the y-axis) could range from 0 to 100. Error bars represent +/- one standard error from the mean.*

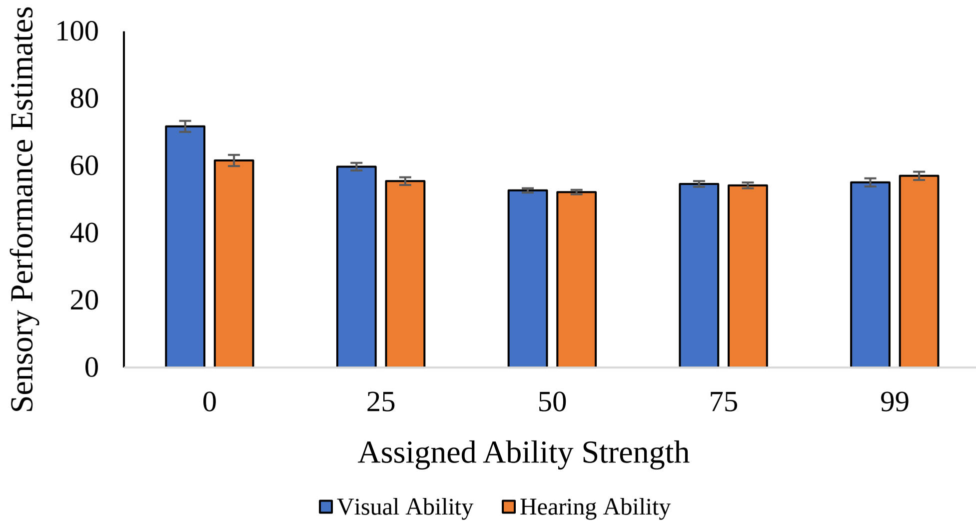


Figure 7. Adult's estimates of ***smelling*** *performance when assigned to read about persons who differed in the strength of either their vision (blue bars) or their hearing (orange bars). Assigned ability strength (depicted along the x-axis) ranged from '0' ("can't see/hear at all"), to '99' ("can see/hear very, very well"). Individual sensory performance estimates (depicted along the y-axis) could range from 0 to 100. Error bars represent +/- one standard error from the mean.*

The Role of Experience on Adults' Sensory Estimates

Finally, I conducted exploratory analyses to investigate relations between adults' *experience* related to sensory compensation and performance, and their intuitions about sensory compensation and performance. I evaluated how participants' estimates of hearing ability in characters with complete visual deficits and estimates of visual ability in characters with complete hearing deficits correlated with: 1) participants' reports of their own seeing or hearing deficits, 2) exposure to others' seeing or hearing deficits, 3) past psychology/neuroscience courses, and 4) awareness of media where characters with heightened senses had disabilities or deficits.

Negative relations between participants' own visual deficits and estimates of persons' hearing abilities when persons had complete vision loss trended towards, but did not reach, significance (r = -.17, p = .07) – in other words, persons who had a visual deficit estimated weaker compensatory effects. There were no significant relations between estimates of hearing abilities for persons with total vision loss and participants' knowledge of visual deficits in family/friends (r = -.05, p = .58), formal psychology/neuroscience exposure (r = -.05, p = .57), or relevant media exposure (r = -.11, p = .25). As well, there were no significant relations between estimates of visual abilities for persons with total hearing loss and participants' personal hearing deficits (r = .03, p = .75), knowledge of hearing deficits in family/friends (r = -.03, p = .77), formal psychology/neuroscience exposure (r = -.13, p = .17), or relevant media exposure (r = .12, p = .23).

Interim Discussion

In exploring adults' intuitions about sensory performance when the degree of persons' seeing or vision was manipulated, I was particularly interested in whether, and at what degree of impairment, I might find compensatory effects. The findings from Study 2A suggest that strong compensatory effects exist for *two* levels of seeing and hearing impairments ("0" – total impairment; "25" – moderate impairment). Specifically, participants seemed to have intuitions that visual impairments would result in particularly strong hearing abilities, and that hearing impairments would result in particularly strong visual abilities. Compensatory effects also existed in estimates of smell and touch, and to a lesser extent, taste. Exploratory analyses investigating relations between conditions where compensatory effects were estimated to be strongest (total visual and hearing impairments) and relevant experience suggest that the findings cannot be attributed to the types of experience that my questionnaire captured, or perhaps, that I did not capture these types of experiences well. Study 2B is designed to investigate whether these intuitions about intra-sensory compensation also exist in children ages 5-10 years, to pinpoint *when* in development these intuitions might arise.

Study 2B

Method

All recruitment procedures, inclusion/exclusion criteria, and methods were pre-registered (https://aspredicted.org/7X2_6SQ).

Participants

Participants (*N* = 58, 22 male, 36 female) ranging roughly from 5-10 years in age were recruited to participate in my campus lab (*n* = 2), a local school (*n* = 39), or virtually (Zoom) (*n* = 17). Children fell into one of three age groups: younger (4.9 – 6.5 years; *n* = 18, 7 male, 11 female), middle (6.9 – 8.5 years; *n* = 26, 10 male, 16 female), and older (8.9 – 10. 5 years; *n* = 14, 5 male, 9 female). For readability, going forward, I will refer to these age groups as 5-6-year-olds, 7-8-year-olds, and 9-10-year-olds. Parents in the broader community were contacted via the departmental database to ask whether they would be interested in participating on campus in my lab, or online via Zoom. Recruitment for both in-person and online participation helped increase the diversity of my resulting sample – families who could not travel to campus for various reasons (e.g., financial or time constraints) could participate online. Informed consent documents were distributed to a local private school; children whose parents offered consent were tested in a quiet room at their school, away from distractions. Additional participants (*n* = 8) were interviewed but ultimately excluded because they failed to complete the study (*n* = 1), incorrectly answered both scale practice questions (*n* = 1), or failed to pass all 6 memory-check questions about characters' vision (*n* = 6) — to pass these 6 memory-checks, participants must report that a character with a visual deficit (described as '1') has visual strength of '1' or '2', and that the character with typical vision (described as '3') has visual strength of '2,' '3,' or '4' — this allows a +/- 1 margin of error. Within each pair (i.e., one character with a visual deficit and one character with typical vision), children must have evaluated the two characters' visual strength differently (i.e., children who evaluated both characters' vision as '2' were excluded); otherwise, I could not be certain that children retained the key information that was provided to them: that the two characters' vision differed.

I aimed to recruit a sample large enough to fulfill the requirements of an a priori power analysis (using G*Power 3.1; Faul et al., 2007) for the most complicated analysis in my planned analyses – a power analyis was conducted with power = 0.80 and alpha = .05 to detect large-sized (f = 0.4) main effects and interaction effects for a 3 (between-subjects) X 2 (within-subjects) x 5 (within-subjects) ANOVA. This analysis indicated that I required a minimum sample size of of 128. I aimed to recruit 129 participants, with approximately 43 pariticpants per each of three age groups. In this dissertation, I present preliminary findings from approximately half of this planned total sample (n = 58).

Parents (n = 49) completed a voluntary questionnaire where they reported family demographics, their child's primary language, any developmental disabilities their child has, their education-level, any visual deficits, or devices they have or their child has, their child's exposure to persons with disabilities or media about persons with disabilities, and any media their child has consumed about characters with extraordinary abilities. In this preliminary sample, 36.7% (n = 18) completed a bachelor's degree, 30.6% earned a master's degree (n = 15), 24.1% earned a doctorate (n = 14), and 4.1% (n = 73) completed "some college.". Most of the participants (85.7%; n = 42) identified as "White/European Descent", followed by 6.1% (n = 3) as "Asian/Asian American", 6.1% (n = 3) as "Black/African American", and 2% (n = 1) as

“Hispanic/Latinx,” and. These categories were not mutually exclusive; participants could select more than one.

Parents were asked how often their child is around children with disabilities in his or her classroom or school: 60.4% (*n* = 29) of parents indicated that this occurred “rarely”, 29.2% (*n* = 14) indicated that this occurred “often”, 8.3% (*n* = 4) indicated that this occurred “very often”, and 2.1% (*n* = 1) indicated that this never occurred. Outside of the classroom setting, 71.4% (*n* = 35) of parents indicated that their child was “rarely” around people with disabilities, 20.4% (*n* = 10) indicated that their child was “often” around people with disabilities, 6.1% (*n* = 3) indicated that their child was “very often” around people with disabilities, and 2% (*n* = 1) indicated that their child was “never” around people with disabilities. Participant recruitment, consent, and all study procedures were approved by Vanderbilt University’s Institutional Review Board.

I was interested in the role of experience on children’s intuitions about sensory performance and compensation, so I asked questions related to whether parents or children in my sample had any self-reported visual deficits, and children’s exposure to media where persons senses were heightened; 73.5% (*n* = 36) of parents did not report any seeing deficits for themselves, and 93.9% (*n* = 46) of parents did not report any seeing deficits in their child. Finally, I asked parents about their child’s consumption of any media where characters had heightened senses (e.g., books, TV, movies). Like in Study 2A, I was especially interested in whether participants were aware that any of the characters with heightened senses (if they described any) had a disability or deficit in another sense; only five parents indicated that the characters with heightened senses they reported had a known disability or deficit. Given extremely small sample sizes in these sub-groups, I will not consider relations between these experience variables and children’s sensory estimates (as in Study 2A with adults).

Procedure

Before beginning the study, whether participating in-school, in-lab, or online, each child spent several minutes building rapport with the experimenter (E). Once the child was comfortable, E directed them to sit in a chair on E's side (for in-person studies), so that E and the child were seated on the same side of a table.

As a warm-up exercise, children saw a scale with several fruits on top and corresponding numbers on the bottom (see Appendix I). Children were asked to identify "which number is the strawberry?" and then "which fruit is the orange?" Children who answered correctly had their answers reaffirmed (e.g., "That's right! The strawberry is number 1!"). If children answered incorrectly, E would continue to ask similar questions with other fruits and numbers until the child understood how to use the scale. Following the "fruit scale" warm-up, children were provided with one more scale that was practice for the scales that would be used in subsequent parts of the study. This scale depicted "muscular arms" (biceps) increasing in size from left to right – there were 5 total pictures, numbered 1-5 underneath. After E explained what each picture in the scale represented (e.g., "The littlest arm means not strong at all…"), children were told it was "their turn to try", shown a picture of the "Incredible Hulk" followed by a "tiny baby", and asked: "Which picture shows how strong the Incredible Hulk/a tiny baby is?". Correct answers were affirmed ("That's right! The Incredible Hulk is super, super strong") and incorrect answers corrected ("Actually, the Incredible Hulk is here (E points to the appropriate picture/number) – the Incredible Hulk is super, super strong"); as a reminder, children that answered both questions incorrectly were excluded. After practicing using the scale with these two contrasting characters, children were asked which picture best shows how strong they are. This final question was to help children practice using this style scale to make self-ratings, which they would do in ratings immediately following this training.

After the warm-up and scale training was complete, E transitioned to the focal questions in the experiment by telling participants that they "have five senses" (E said each of them aloud) and that E would ask questions about their five senses.

Sensory Ratings - Self

To gather children's ratings of the performance of their own five senses, E showed a total of five scales (one scale per sense) that were set-up identically to the "strength" practice scale (above) (see Appendix J). Similar to the strength practice scale, E explained what each picture on the scale represented while pointing; for example, for "seeing" E said, "These pictures are about seeing. The smallest eye [point] means someone can't see anything at all. The next one [point] means someone can see a little, etc. Then, E asked participants "Which picture shows how you see with your eyes? Tell me the number." The same process was repeated for the remaining four senses. The order in which the scales for the five senses were presented depended on the version participants were randomly-assigned. Participants rated each of their own five senses using a scale ranging from 1 to 5; e.g., 1 ("can't see anything at all"), 2 ("can see a little"), 3 ("eyes are okay – they see as good as most kids your age"), 4 ("can see very good"), and 5 ("can see super, super good") (see Appendix K for full scale description).

Introduction to Characters

After participants' self-ratings were complete, E told children that "now we are going to listen to some stories and talk about some other kids your age." E then introduced the first character pair – participants saw three character-pairs in total. Each pair consisted of one character with a visual deficit and one character with typical eyesight. The character with the visual deficit was introduced as follows: e.g., “This is Chris. Chris’s eyes can’t see anything at all. Chris’s eyes are here [E points to ‘1’ on the scale]. Chris’s eyes have been like this their whole life.” The character with the typical vision was introduced as follows: e.g., “This is Hannah. Hannah’s eyes see okay – they see as good as most kids your age. Hannah’s eyes are here [E points to ‘3’ on the scale]. Hannah’s eyes have been like this their whole life.” The other pairs were described in the same way, except the characters had different names and different appearances (e.g., skin tone, hair style/color, shirt style/color).

Sensory Estimates – Other

Following the introductions (above) participants were asked to estimate the performance of each of those characters’ five senses (vision, hearing, smelling, tasting, touching; e.g., “How does Chris hear with their ears? Tell me the number”). The order in which the senses were estimated depended on the version participants were assigned. The strength of each person’s ability was specified on a scale ranging from 1 to 5; e.g., 1 (“can’t hear anything at all”), 2 (“can hear a little”), 3 (“ears are okay– they hear as good as most kids your age”), 4 (“can hear very good”), and 5 (“can hear super, *super* good”). Participants estimated all five senses for only the first character-pair in the study. (For subsequent scenarios, children estimated characters’ vision, but those estimates served only as memory checks).

Vignettes

After each character-pair introduction and estimates, E told participants that “Now we’ll hear stories about [character names]” - E said the names of the two characters in the pair while pointing to each of them in a picture where they were presented side by side. What followed were three scenarios, each set-up identically. Each scenario consisted of “background”, where the characters were engaging in some sort of activity in school or with classmates (e.g., playing in the gym for indoor recess) – see Appendix L for a full description of the scenarios. E told the participants that the lights went out suddenly for one of three reasons (e.g., a construction worker cuts the power by accident) and that another character in the scene loses an item (e.g., a tennis ball); the item in each of the scenarios was different. E told participants that "no one can see anything at all in the dark", and that "they can't use their eyes to find the [missing object]." E reminded participants that the two focal characters are present (while showing the same side-by-side picture from earlier and pointing to each character while their name is said). E then reminded participants of each character's visual abilities, using the same "seeing" scale from earlier, with the character pictured on top. For example, E said, "Remember, Chris's eyes can't see anything at all" [E points to picture '1' on the scale].

Character Selection

Following the reminders of characters' visual abilities, E proceeded to the forced-choice portion of the scenario, where participants were asked which character– one typically-sighted, and one visually impaired – would be better at finding the missing object "in the dark". For example, E asked, "Who would be better at finding the ball in the dark? Chris [E points] or Hannah [E points]?" If participants could not remember a character's name, or asked for a reminder of a character's visual abilities (e.g., "Which one can't see again?") E would remind them accordingly. In total, children heard three scenarios in which an object must be found but cues for the focal sense (vision) were unavailable (i.e., the lights were off in the room), and they chose either the typically-sighted or visually impaired character to help find the object. Children earned 1 point each time they endorsed the character with the visual deficit, so disabled *character selection* scores ranged from 0 to 3.

Character Selection Explanations

After the forced-choice selection, E asked participants to explain why they chose the character they did (the open-ended reasoning portion of the scenario): for example, "Why would [Chris OR Hannah] be better at finding the ball in the dark?"

Sensory-Specification Judgments

Finally, the scenario ended with what was known as the "sense specification" portion, where E asked participants what sense the character they selected would use to find the missing object in the dark (e.g., "How would [Chris OR Hannah] find the ball in the dark? Using their eyes, ears, mouth, nose, or hands?" [E points to each sense in a picture of all 5 senses side by side]). If children voluntarily offered up more than one sense (e.g., "eyes, ears, AND nose"), E prompted to child to designate "what they would use first", but still recorded all selected senses. Children earned a point each time they selected a sense. Thus, for any of the five senses, individual scores can range from 0-3.

After the sense specification, E reaffirmed that participants were doing great, and proceeded to the next two scenarios in the study. Depending on the version participants were randomly-assigned, they either saw scenario 1 ("tennis ball") or scenario 3 ("magician") first (see Appendix L).

Manipulation check

A manipulation check scenario was employed to provide a point of comparison for how children were following the stories that were "in the dark" vs. not. After the three vignettes that occurred in the dark, E presented a picture of a jar of marbles and told participants that it was a "bright, sunny day", that they were walking down the sidewalk with two other kids while holding the jar of marbles, and suddenly they sneeze and drop the jar of marbles. E introduced the two characters identically to the vignettes above – like previous scenarios, one character had a visual deficit, and one was typically-sighted – the only difference is that participants were not asked to provide any estimates (including estimating characters' "seeing" for memory-check purposes) after the character introductions. Given that it is "bright and sunny" (vs. dark), we would expect children in this age range to choose the typically-sighted character to help even if they had not previously done so, and say that the character could use their eyes to find the missing object; E emphasized that the "best way to find the marbles is by using our eyes." (As a reminder, in previous scenarios, participants were told that characters could *not* use their eyes to find the missing object). E then asked participants the same forced-choice, open-ended reasoning, and sense specification questions as described above for the previous 3 scenarios.

In response to these questions, 100% of participants appropriately chose the character with typical vision to find the missing object when visual input was available (i.e., with light), and 81% appropriately reported that the character should use their eyes to find the missing object. Thus, children in this sample were capable of following these types of stories, and they were inclined to call upon the character with typical vision (because of their eyes) when visual input was available. These questions will not be considered further.

Results

I conducted analyses to explore several, pre-registered questions (https://aspredicted.org/7X2_6SQ) pertaining to children's intuitions about the strength of people's other senses. Given the number of measures, I will present the analyses in sections parallel to the sections above.

These are preliminary findings with approximately half of my pre-registered, final sample. Given this, I will present all preliminary findings *except* for patterns in children's open-ended reasoning; I did not feel I could sufficiently construct a coding system to capture children's responses with only half the final sample. Thus, children's open-ended reasoning will not be considered any further in this dissertation.

Sensory Ratings – Self

First, I was interested in how children ages 5-10 years rate the strength of their *own* senses. To analyze this, I used a 2-way ANOVA of participants' Age (3; between-subjects) X Sensory Ability Type (5: vision, hearing, smell, taste, touch; within-subjects). This analysis revealed a significant main effect of Ability Type, $F(4, 52) = 3.31$, $p < .05$, $\eta^2_p = .20$. Post-hoc analyses show that vision ($M = 3.80$, $SE = .12$), taste ($M = 3.70$, $SE = .12$), and touch ($M = 3.81$, $SE = .12$) were rated similarly, and ratings of hearing ($M = 3.53$, $SE = .10$) and smell ($M = 3.49$, $SE = .12$) were similar. Ratings of vision and touch were significantly stronger than ratings of hearing and smell, *p*'s < .05. In comparisons against '3' (the midpoint of the scale), all of these ratings were significantly stronger than average (vision: $t(57) = 6.70$, $p < .001$; hearing: $t(57) = 5.38$, $p < .001$; smell: $t(57) = 4.10$, $p < .001$; taste: $t(57) = 5.86$, $p < .001$; touch: $t(57) = 6.78$, $p < .001$). There was no significant main effect of Age ($F(2, 55) = .76$, $p = .76$, $\eta^2_p = .01$), or significant interaction of Age X Ability Type ($F(8, 106) = .53$, $p = .83$, $\eta^2_p = .04$).

Thus, children rated the performance of all five of their own senses as significantly stronger than "most kids their age", with ratings of their vision, taste, and touch as the strongest.

Sensory Estimates – Other

Next, I conducted analyses to explore children's intuitions about the strength of persons' other senses (hearing, smell, taste, touch) when told about a deficit in persons' vision (i.e., could not see at all). Specifically, I was interested in how these intuitions vary across development (5-10 years of age). In accordance with my pre-registered data analysis plan, I first explored how participants' sensory estimates varied with a 3-way-mixed ANOVA of participants' Age (3; between-subjects) X characters' Visual Ability (2: no vision vs. typical/okay vision; within-subjects) X Sensory Ability Type (5: vision, hearing, smell, taste, touch; within-subjects). This analysis revealed significant effects of Visual Ability ($F(1, 55) = 36.77$, $p < .001$, $\eta^2_p = .40$), Ability Type ($F(3.18, 174.70) = 52.01$, $p < .001$, $\eta^2_p = .49$), Ability Type x Age ($F(6.35, 174.70) = 2.75$, $p < .05$, $\eta^2_p = .09$) and Visual Ability X Ability Type ($F(3.27, 55) = 37.42$, $p < .001$, $\eta^2_p = .41$). Mauchly's tests indicated that assumptions of sphericity had been violated (Ability Type: $\chi^2(9) = 25.17$, $p < .01$, Visual Ability X Ability Type: $\chi^2(9) = 27.49$, $p < .01$), so Greenhouse-Geiser corrections are reported for results involving these variables.

As I did in Study 2A, I next conducted five separate mixed-effects ANOVAs, one per estimate of each of the ability types, to help interpret this complex set of findings.

Vision

First, I conducted a 2-way mixed ANOVA of Visual Ability (2: no vision vs. typical/okay vision; within-subjects) X Age (3; between-subjects) for participants' sensory performance estimates of *vision*. This analysis revealed a significant effect of Visual Ability: $F(1, 55) = 2026.97$, $p < .001$, $\eta^2_p = .97$. Visual performance was rated as significantly stronger for characters who had typical/okay vision ($M = 3.00$, $SE = .04$) than characters who had no vision ($M = 1.00$, $SE = .00$). These findings essentially serve as a manipulation check, as this was the information I provided children about characters' visual performance. There was no significant effect of Age: $F(2, 55) = .60$, $p = .56$, $\eta^2_p = .02$, or interaction of Visual Ability X Age: $F(2, 55) = .60$, $p = .56$, $\eta^2_p = .02$.

Hearing

Next, I conducted the same 2-way mixed ANOVA of Visual Ability (2: no vision vs. typical/okay vision; within-subjects) X Age (3; between-subjects) for participants' sensory estimates of *hearing*. This analysis also revealed a significant effect of Visual Ability: $F(1, 55) = 4.06$, $p = .05$, $\eta^2_p = .07$. Hearing performance was rated as significantly stronger for characters who had typical/okay vision ($M = 3.21$, $SE = .11$) than characters who had no vision ($M = 2.82$, $SE = .18$). The estimated hearing ability of characters with no vision was not significantly different from the scale midpoint (3.00), $t(57) = 1.00$, $p = .32$. Thus, there was a subtle halo effect on estimates of characters' hearing. There was no significant effect of Age: $F(2, 55) = 2.15$, $p = .13$, $\eta^2_p = .07$, or interaction of Visual Ability X Age: $F(2, 55) = .93$, $p = .40$, $\eta^2_p = .03$.

Smell, Taste, and Touch

As in Study 2A, I will present the remaining three ANOVAs together for the sake of conciseness and clarity. I ran the same 2-way mixed ANOVA of Visual Ability (2: no vision vs. typical/okay vision; within-subjects) X Age (3; between-subjects) for participants' sensory estimates for *smell, taste, and touch.* I found significant main effects of Visual Ability for estimates of smell: $F(1, 55) = 5.37$, $p < .05$, $\eta^2_p = .09$, and taste: $F(1, 55) = 8.11$, $p < .01$, $\eta^2_p = .13$. There was no significant main effect of touch: $F(1, 55) = .68$, $p = .41$, $\eta^2_p = .01$. For smell and taste, the patterns looked similar to estimates of hearing performance; participants estimated characters' senses of smell and taste as significantly stronger when characters had typical vision (smell: $M = 3.28$, $SE = .11$; taste: $M = 3.37$, $SE = .10$) than when characters had no vision (smell: $M = 2.90$, $SE = .17$; taste: $M = 2.96$, $SE = .17$). Estimates of characters' senses of smell and taste for characters with no vision did not different significantly from the scale midpoint (3.00); smell: $t(57) = .59$, $p = .56$, taste: $t(57) = .24$, $p = .81$. Thus, halo effects existed but were subtle in children's estimates of characters' smell and taste.

I found a main effect of Age only for children's estimations of characters' sense of touch, $F(2, 55) = 5.26$, $p = .01$, $\eta^2_p = .16$. Children ages 7-8-years ($M = 3.71$, $SE = .18$) estimated characters' touch as significantly stronger than 5-6-year-olds ($M = 2.83$, $SE = .21$), $p < .01$, and marginally higher than 9-10 year-olds ($M = 3.14$, $SE = .24$), $p = .06$. There were no significant differences between 5-6- and 9-10-year-olds ($p = .34$). More central to my research questions, I found a significant interaction of Visual Ability X Age for estimations of taste only, $F(2, 55) = 3.87$, $p < .05$, $\eta^2_p = .12$. Post-hoc analyses reveal that 5-6-year-olds estimated the strength of characters' taste as significantly stronger for characters with typical vision ($M = 3.56$, $SE = .17$) than characters with no vision ($M = 2.61$, $SE = .30$), $p < .001$. No significant differences were found for 7-8-year-olds ($p = .57$) or 9-10-year-olds ($p = .61$). There were no other significant effects (smell: Age: $F(2, 55) = 1.24$, $p = .30$, $\eta^2_p = .04$; Visual Ability X Age: $F(2, 55) = .46$, $p = .64$, $\eta^2_p = .02$; taste: Age: $F(2, 55) = 2.11$, $p = .13$, $\eta^2_p = .07$).

In sum, children's estimates of characters' senses of hearing, smell, and taste were stronger for characters with typical vision versus no vision, reflecting halo effects. However, effect sizes were generally small and estimates for characters with no vision did not significantly differ from the scale midpoints (i.e., "average"), signaling that these halo effects were modest. A unique developmental trend was found in children's estimates of characters' sense of touch: a strong halo effect was found for the youngest children (5-6 years), but no halo effect was found for older children.

Character Selection

I was also interested in investigating who children prefer to ask for help, a character with a visual deficit or a typically-sighted person, when an object must be located but visual cues for the object are not available (i.e., in the dark). On average, children selected the character with typical/okay vision (versus the character with a visual deficit) for 2.40 of the 3 scenarios. To evaluate age-related patterns in participants' selection of the character with a visual deficit, I conducted a 1-way ANOVA comparing the three age groups.[3] This analysis revealed significant differences in children's selection of the character with no vision across age groups, $F(2, 55) = 6.19$, $p < .01$. As depicted in Figure 8, 9–10-year-olds selected the characters with no vision significantly more than 5-6- and 7-8-year-olds selected those characters, *p*s < .05. In comparisons against chance (1.50), 5-6-year-olds and 7-8-year-olds significantly preferred the typical/okay character (5-6-year-olds: $t(16) = 4.07$, $p < .001$; 7-8-year-olds: $t(25) = 4.94$, $p < .001$), whereas 9-10-year-olds showed no preference for the character with typical/okay vision vs. the character with no vision in their requests for help, $t(13) = .43$, $p = .67$.

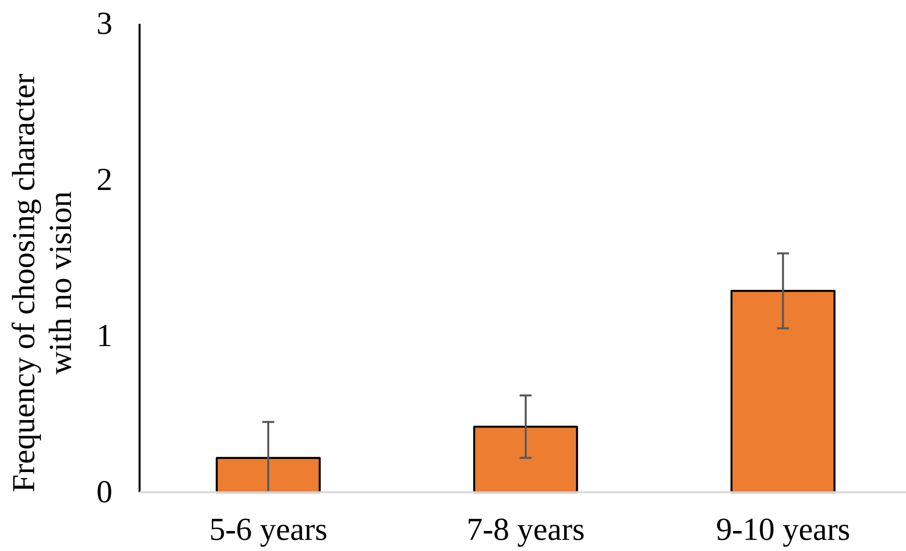


Figure 8. Children's selection of persons to help find missing objects when persons had a visual deficit. There were 3 scenarios where selection took place, so individual frequencies of choosing could range from 0 to 3. Error bars represent +/ one standard error from the mean.

[3] I pre-registered a 2-way-mixed ANOVA of participants' Age (3; between-subjects) X Visual Ability (2: no vision vs. typical/okay vision; within-subjects), but later realized that this analysis is not appropriate given the forced-choice nature of this measure.

In sum, children generally chose the character with typical/okay vision to help locate an object vs. the character with no vision, even though the helping task did not require visual abilities at all (i.e., visual cues for the object were not available). These findings support the presence of a negative halo effect in children's preferences for help; children may have inferred the existence of other diminished abilities in the characters with no vision, and thus, selected the character with typical vision to help. The only children who did not demonstrate this pattern were the oldest children (9-10-year-olds), who demonstrated no preference between the two characters.

Sensory-Specification Judgments

Finally, I planned to conduct exploratory analyses to evaluate which of the five senses children most frequently mentioned to account for *how*—among the five senses--their chosen characters would find a missing object. Although children could pick more than one sense per scenario, I will analyze just children's first selection in the following, exploratory analyses.

Table 2 depicts children's mentioning of each of 5 senses across the 3 scenarios, split-up by age group. Across age groups, children mentioned "touch" more than any other sense, for 1.62 of the 3 scenarios. Children next mentioned hearing and seeing the most, followed by sense of smell. Children never mentioned taste.

Table 2

Children's average sensory specification judgments, by age

Age Group	SEEING		HEARING		SMELL		TASTE		TOUCH	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
5-6	**.94**	1.11	**.22**	.43	**.22**	.43	**.00**	.00	**1.61**	1.04
7-8	**.23**	.71	**.69**	.79	**.31**	.55	**.00**	.00	**1.77**	1.07
9-10	**.43**	.94	**.86**	1.03	**.36**	.50	**.00**	.00	**1.36**	1.28
Total	**.50**	.94	**.59**	.80	**.29**	.50	**.00**	.00	**1.62**	1.11

To evaluate these patterns in greater detail, I conducted 4 separate 1-way ANOVAs that included age as a between-subjects factor. Because no children selected “taste”, taste was not included in any further analyses. The ANOVAs showed significant, age-related trends in sensory specification judgments for “seeing”: $F(2, 55) = 3.37$, $p < .05$ and “hearing”: $F(2, 55) = 3.15$, $p = .05$, but not “sense of smell”: $F(2, 55) = .30$, $p = .74$, or “touch”: $F(2, 55) = .63$, $p = .54$. For “seeing,” 5-year-olds mentioned seeing to account for how characters would find the missing objects significantly more than 7-year-olds, $p < .05$. There were no significant differences between 5- and 9-year-olds ($p = .25$) or 7- and 9-year-olds ($p = .79$). For mention of “hearing”, there was a marginal difference between the oldest and youngest children, with 9-year-olds mentioning hearing to account for how characters would find the missing object more than 5-year-olds, $p = .06$. There were no significant differences between 5- and 7-year-olds ($p = .12$) or 7- and 9-year-olds ($p = .79$).

In sum, children across age groups mentioned “touch” more than any other sense as the modality with which characters would find missing objects in the dark, followed by hearing, seeing, and smell. Developmental trends existed in children’s mentioning of seeing and hearing, but not senses of smell or touching, with the youngest children (5-year-olds) most likely to mention seeing, and the oldest children (9-year-olds) most likely to mention hearing. It is worth noting that many children still mentioned that characters should use their eyes to find the missing objects, even though they were explicitly told that the characters could *not* use their eyes to find the missing objects. Exploration of children’s open-ended reasoning will likely provide more insight into this effect, but I share preliminary thoughts in more depth, below.

Discussion

Study 2 was designed to investigate how children and adults reason about the sensory acuity of disabled persons with sensory deficits. One way in which they might reason about this is via compensatory effects, where other senses would be strengthened in the presence of a sensory deficit. Another way they might reason about this is via halo effects, where other senses would be diminished in the presence of a sensory deficit. In Study 2A, I investigated these effects in adults, and in Study 2B, I investigated these effects in children ages 5-10 years. Fascinatingly, these effects show up in the opposite direction across the course of development. Study 2A provides strong evidence that adults' reasoning about sensory acuity is driven by intuitions about compensatory effects, for persons with both severe and moderate seeing and hearing deficits; compensatory intuitions were strongest for persons with severe seeing deficits. Exploratory analyses to account for the role of experience in adults' intuitions produced limited evidence of experience with popular media, self- or close family/friends' visual deficits, self- or close family/friends' hearing deficits, or relevant coursework (e.g., neuroscience or psychology) as a driving force, at least in the way I measured them. Preliminary findings from Study 2B suggest that children's reasoning about intra-sensory dynamics is instead influenced by halo effects, though patterns in the oldest age group (9 – 10 years of age) suggest that compensatory effects may emerge at the upper end of this age range, or shortly after. Below, I discuss the findings of both studies in greater depth, integrate them with existing literature, and consider limitations and future directions.

In Study 2A, strong compensatory effects were found for *two* levels of seeing and hearing impairments ("0" – total impairment; "25" – moderate impairment). Participants had intuitions that visual impairments would result in particularly strong hearing abilities, and that hearing impairments would result in particularly strong visual abilities. Compensatory effects were also found for levels of smell, taste, and touch, but these effects were weaker than for vision and hearing. As discussed earlier, past research has consistently found vision and hearing to be valued the most among the five primary senses, and vision loss and hearing loss to be rated the first and second worst quality of life outcomes (Brown et al., 2018; Enoch et al., 2019; Scott et al., 2016). My findings in Study 2A support the value traditionally placed on vision and hearing. Perhaps, the driving force in persons' strong intuitions about heightened senses in persons with vision or hearing loss *is* this value– persons might like to believe that if they experienced vision or hearing loss, that a heightening of other senses would make this experience less life-altering.

A somewhat opposing perspective can be found in the study of persons' afterlife beliefs. Scholars have generally agreed that judgments of what persists into the afterlife (vs. gets left behind on Earth) depends on the mechanisms (biological, psychobiological, perceptual, desire, emotional, and epistemic) themselves (Bering & Bjorklund, 2004; Astuti & Harris, 2008). Bering and Bjorklund (2004) explored judgments about the various mechanisms above - persons seem to believe in a "knowing, believing, mindful spirit that has shed its biology proper" (Bering & Bjorklund, 2004, p. 230). In other words, desire, emotional and epistemic mechanisms were judged the most likely to pass onto the afterlife (vs. biological, psychobiological, and perceptual (vision and hearing)). "Simulation constraint theory" (Bering, 2002; Bering, 2006) could be one way to explain these differences. The theory posits that some states are easy to imagine being without (biological/physical/psychobiological), while others are difficult to imagine (mental/cognitive states: desire, emotional, epistemic), with the difficulty defined by response latencies in participants' reasoning -- how long it took participants to respond to questions about each of these states persisting (or not) into the afterlife. Overall, participants required more time to reason that difficult to imagine states did not persist into the afterlife than they did for easy to imagine states (Bering, 2002), saying that these easy to imagine states were "physical things" or "functions of the body," whereas the difficult to imagine states were "spiritual things" (Bering, 2002). Future research should work to remediate these discrepancies between the apparent value persons' place on vision and hearing on Earth and the lack of value persons seem to place on vision in the afterlife; though an emphasis on vision has been found in some afterlife belief systems, such as ancient Egyptian mythology (Wikipedia contributors, 2024).

In Study 2B, modest halo effects existed in children's estimates of characters' hearing, taste, and sense of smell when characters had visual deficits. Motivated by past research on halo effects (e.g., Dion, 1973; Marble & Boseovski, 2020), I had predicted that 5-10-year-old children might take characters' seeing deficits and infer that other senses are also diminished via a negative halo effect. The findings of study 2B provide some, but not total, support for this prediction. Study 2B consisted of multiple measures to capture children's intuitions about intra-sensory dynamics. The first set of measures, children's estimates of others' sensory performance, allows for the most direct comparison to my adult sample in Study 2A, specifically, to adults' sensory estimates for characters with level "0" vision (i.e., can't see at all). Children estimated *average* levels of hearing, smell, and touch in characters with no vision. Adults, on the other hand, estimated that alternate senses (hearing, smell, and taste) of characters with no vision would be much stronger (~80) than the average person, where "99" is the strongest possible sensory performance.

Study 2B included an additional measure to capture children's intuitions about sensory acuity in persons with visual deficits - children's character selection – and these findings provide a somewhat different outlook. Children's choosing of a character with no vision (vs. a character with typical vision) to help find a missing object in the dark (where vision is not usable) would provide support for the influence of compensatory effects on intuitions about sensory acuity in disabled persons. Children's choosing of a character with typical vision (vs. a character with no vision) would provide support for the influence of negative halo effects, where children reason that other senses of a character with no vision are also diminished, and thus, would not be effective. While the youngest two age groups (5-6 and 7-8 years of age) almost never selected the character with no vision, providing strong support for the presence of halo effects, there was a significant shift in the oldest age group – the oldest children (9 – 10 years) showed no preference between the typically-sighted character and the character with no vision. While I cannot conclude that character selection in the oldest children supports compensatory effects (yet), it does not support halo effects, either (unlike the youngest two age groups).

Exploratory data on which senses children said characters of their choosing would use to find missing objects in the dark raises one potential limitation of Study 2B that could diminish findings in support of compensatory effects – approximately 13-20% of children across the 3 scenarios stated that the characters would use their *eyes* to find the missing object, even though I explicitly told children that characters could *not* use their eyes to find the missing object (because it was dark). Given the overwhelming success of the manipulation check (with no children failing), these findings give pause. Anecdotal observation suggests that many of these children generated their own reasons for why characters should still be able to see in the dark, despite telling them otherwise. For example, a child might say, "some light might still come through those windows, and they could see". This sort of reasoning could drive children across age groups to pick the typical character to help locate a missing object, influencing findings in support of adult-like compensatory effects. Further analysis of the final sample, including children’s open-ended reasoning, is likely to provide additional insight.

In sum, Study 2 of this dissertation was the first of its kind (to the best of my knowledge) to directly test for a widespread belief about the existence of compensatory effects in persons with sensory disabilities such as blindness of deafness. Findings with adults strongly supported this belief (about compensatory effects) in persons with severe visual impairments, especially. Preliminary findings with children ages 5-10 years largely provided support for an alternate belief, driven by negative halo effects. Across age groups, children never rated alternate senses of blind characters significantly higher than average, and children younger than 9-10 years of age consistently selected characters with typical vision to help find missing objects in the dark where vision was unavailable as a resource. The oldest children (9-10 years) appeared to trend toward adult-like thinking by demonstrating no preference in their choosing between characters with visual deficits or typically-sighted characters. Such findings may spur additional research with older children to pinpoint where in development these strong, adult-like intuitions about sensory performance and compensation manifest.

CHAPTER 4

General Discussion

Studies 1 and 2 of this dissertation make different, novel contributions to an understudied, yet very important, area of research: children's concepts of disabilities and disabled persons. Study 1 investigated 5-to-9-year-olds' evaluations of and reasoning about physical and cognitive accommodations for children with physical (walking) or cognitive (learning) disabilities. Study 1 contributes to existing research on children's fairness evaluations of disadvantageous resource distributions (i.e., another gets more than the self), specifically, equity-based resource distributions (i.e., accommodations address inequities caused by the existence of disabilities). As well, Study 1 contributes to work on children's concepts of "need vs. want" with respect to common disabilities and the restrictions they place on behavior. My findings in Study 1 suggest that school-age children feel quite neutrally about accommodations, until around 9-years of age, when they begin to evaluate these accommodations as fair. But age does not tell the whole story, as children of any age who reasoned about an accommodation with references to "need" (i.e., physical, cognitive limitations, or other limitations) were more likely to evaluate accommodations as fair, as opposed to children who made references to characters' motives (i.e., negative traits/motivates, or likes/wants). Study 1's findings may have implications for how teachers describe or teach typically-developing children about the purpose of accommodations for students with disabilities.

Study 2 contributes to existing research on halo effects, and relatively limited research on children's and adults' concepts of compensatory effects. Study 2A's findings suggest that adults' reasoning about the sensory acuity of persons with severe or moderate visual or hearing deficits is strongly driven by intuitions about compensation – adults estimate alternate senses of blind or deaf persons as far stronger than the average person. Study 2B's findings paint an opposite picture in young children, providing strong support for the influence of halo effects, except for in the oldest children (9-10 years of age). I am cautious to make any conclusions about the study's impact without analyzing the full sample, but preliminary findings may have implications for harvesting late-elementary children's (9-10-year-olds') intuitions about neurodiversity and exceptionalities.

Study 1 aimed to investigate children's evaluations of accommodations for persons with physical and cognitive disabilities. Descriptions of these disabilities were modified from Granata et al. (2022), where physical and auditory disabilities were concrete and deficit-based (e.g., "This boy's/girl's legs don't work. They can't get out of their chair and move around if they want to. They can't run around the playground. They can't walk to the front of the classroom to ask the teacher questions if they need help"). This way of describing disability has advantages for internal validity in ensuring that children, especially young children, have no confusion about the degree to which a disability affects the body – if legs are described as "not working," then even young children (participants in Granata et al. (2022) were as young as 4 years of age) can feasibly make inferences about the role of the disability in movement-related behaviors. But there are limitations to these descriptions, the biggest being lower external validity. As educational inclusion for children with disabilities continues to increase and social models of disability increasingly join medical models of disability (Dirth & Branscombe, 2019), these descriptions quickly become outdated. Thus, I adapted disability descriptions in Study 1 to increase external validity, specifically by describing a character with a walking disability as "walking differently" rather than not being able to walk at all. Study 2, on the other hand, described characters' visual disabilities as concrete and deficit-based (i.e., "can't see/hear at all”); it was incredibly important given the nature of the study that adults and children understood the strength of characters’ abilities with as little room for speculation as possible. For example, children in Study 2B needed to understand that the characters with no vision truly could not see anything at all, thus, making the difference in visual ability between the character with no vision and the character with typical vision as distinct as possible. In reality, many blind people can see patterns in light, or make out some outlines or shapes – this lowers external validity in Study 2.

The unique strengths and weaknesses of this dissertation are rooted in the *models* with which children reason about disabilities. Menendez and Gelman (under review) identify gaps in the developmental literature regarding *essentialist models* of disability and *illness models* of disability. They define illness models as framing disability as a departure from “normal”, requiring medical intervention, and communicable via contact with others. This model might especially be primed in medical contexts or when disabilities are referred to as diseases (e.g., mental illness); it might even be a preference of persons who do not consider their disability an important part of their identity. Menendez and Gelman identify that little is known about the effects of illness models of disability on children’s beliefs, behaviors, and attitudes, hypothesizing multiple negative effects of reasoning about disability in this way and calling for future research to directly explore these effects.

Robertson and Jaswal (2024) argue that framing disabilities in terms of external, social structures that impact disabled children’s lives is uncommon in published literature. In their theoretical piece, they introduce important considerations for why disability descriptions more aligned with medical models only paint one picture of children’s concepts of disability; I agree that this is a much-needed perspective in the field and has critical implications for future work.

There are many reasons, as Roberston and Jaswal point out, to suspect that presenting disabilities to children using a social model would improve children's attitudes towards, beliefs about, and inclusion of persons with disabilities. Accommodations in Study 1, for example, could easily be introduced using a social model instead of a medical model – e.g., "The hallways are built for walkers, not people who use wheelchairs. The hallways get crowded at recess-time. Tom, who uses a wheelchair, goes to recess before all the other kids in his class." Similarly, discussion of how blind persons navigate their environments, relevant in Study 2B, could be introduced via a social model instead of a medical model – e.g., "The school gym is built for people who can see, not people who can't see. There are sometimes things on the floor or in the way that a person who can't see could trip on and get hurt. So, some people who can't see get really good at listening or feeling for things in the way." Importantly, as conveyed by both Roberston and Jaswal (2024) and Menendez and Gelman (under review), children's models of disability are not necessarily mutually exclusive, and there may be advantages for different models. Certain models may be more appropriate to introduce or reinforce at different points in development, a possibility that additional research can investigate.

At the beginning of this dissertation, I argued that studying concepts of disability can and should be done outside of the potential for societal implications. In the area of human abilities/capabilities, studying disability concepts expands on how children reason about the limitations and adaptability of human abilities and the non-obvious; both studies in this dissertation contribute to this area, but especially Study 2. Additionally, life with a disability often elicits moral, conventional, pragmatic, and personal violations, as well as issues of fairness, with mental states, (specifically, motives) critical in accounting for the role of disability in these violations – Study 1's investigation of children fairness evaluations of accommodations contributes directly here. In conclusion, empirical motivation to study concepts of disability is just as strong as the potential societal impact, and recent work demonstrates this.

References

"Avatar: The Last Airbender and Legend of Korra" (2012). https://en.wikipedia.org/wiki/The_Legend_of_Korra

Alicke, M. D., & Govorun, O. (2005). The better-than-average effect. *The self in social judgment*, *1*, 85-106.

Astuti, R., & Harris, P. L. (2008). Understanding mortality and the life of the ancestors in rural Madagascar. *Cognitive science*, *32*(4), 713-740. doi:10.1080/03640210802066907.

Baird, J. A., & Astington, J. W. (2004). The role of mental state understanding in the development of moral cognition and moral action. *New directions for child and adolescent development*, *2004*(103), 37-49. doi:10.1002/cd.96

Ball, C. L., Smetana, J. G., & Sturge-Apple, M. L. (2017). Following my head and my heart: Integrating preschoolers' empathy, theory of mind, and moral judgments. *Child Development*, *88*(2), 597-611. doi:10.1111/cdev.12605

Bernhardi, R. V., Bernhardi, L. E. V., & Eugenín, J. (2017). What is neural plasticity? *The plastic brain*, 1-15.

Bering, J. (2002). Intuitive conceptions of dead agents' minds: The natural foundations of afterlife beliefs as phenomenological boundary. *Journal of Cognition and Culture*, *2*(4), 263-308.

Bering, J. M. (2006). The folk psychology of souls. *Behavioral and brain sciences*, *29*(5), 453-462. doi:10.1017/S0140525X06009101.

Bering, J. M., & Bjorklund, D. F. (2004). The Natural Emergence of Reasoning About the Afterlife as a Developmental Regularity. *Developmental Psychology, 40*(2), 217–233. doi:10.1037/0012-1649.40.2.217

Blake, P. R., McAuliffe, K., & Warneken, F. (2014). The developmental origins of fairness: The knowledge–behavior gap. *Trends in cognitive sciences*, *18*(11), 559-561. doi:10.1016/j.tics.2014.08.003.

Blake, P. R., McAuliffe, K., Corbit, J., Callaghan, T. C., Barry, O., Bowie, A., ... & Warneken, F. (2015). The ontogeny of fairness in seven societies. *Nature*, *528*(7581), 258-261. doi:10.1038/nature15703.

Blake, P. R., & McAuliffe, K. (2011). "I had so much it didn't seem fair": Eight-year-olds reject two forms of inequity. *Cognition*, *120*(2), 215-224. doi:10.1016/j.cognition.2011.04.006

Brown, G. C., Brown, M. M., & Sharma, S. (2018). The five senses: a patient preference-based comparative analysis. *Clinical Research in Ophthalmology*, *1*(1), 1-8. https://asclepiusopen.com/clinical-research-in-ophthalmology/volume-1-issue-1/6.php

Carey, S. (1985). Are children fundamentally different kinds of thinkers and learners than adults. *Thinking and learning skills*, *2*, 485-517.

Centers for Disease Control and Prevention (2020). *Disability and Health Overview*. https://www.cdc.gov/ncbddd/disabilityandhealth/disability.html

Conant, S., & Budoff, M. (1982). The development of sighted people's understanding of blindness. *Journal of Visual Impairment & Blindness, 76*(3), 86-90. doi:10.1177/0145482X8207600302.

Conant, S., & Budoff, M. (1983). Patterns of awareness in children's understanding of disabilities. *Mental Retardation*, *21*(3), 119. https://eric.ed.gov/?id=EJ289761.

Conrad, J. A. (2020). On intellectual and developmental disabilities in the United States: A historical perspective. *Journal of Intellectual Disabilities*, *24*(1), 85-101. doi:10.1177/1744629518767001

Cushman, F., Sheketoff, R., Wharton, S., & Carey, S. (2013). The development of intent-based moral judgment. *Cognition*, *127*(1), 6-21. doi:10.1016/j.cognition.2012.11.008

Dahl, A., & Kim, L. (2014). Why is it bad to make a mess? Preschoolers' conceptions of pragmatic norms. *Cognitive Development*, *32*, 12-22. doi:10.1016/cogdev.2014.05.004

Daredevil: Series, Marvel Comics (1964). https://www.marvel.com/comics/characters/1009262/daredevil

Dion, K., Berscheid, E., & Walster, E. (1972). What is beautiful is good. *Journal of personality and social psychology*, *24*(3), 285.

Dion, K. K. (1973). Young children's stereotyping of facial attractiveness. *Developmental Psychology*, *9*(2), 183. doi:10.1037/h0033731

de Carvalho, L. V., Áfio, A. C. E., Junior, J. C. R., de Almeida Rebouças, C. B., & Pagliuca, L. M. F. (2014). Advances in health promotion for people with disabilities and the laws of Brazil. *Health*, *6*(18), 2365. doi:10.4236/health:2014.618272

DeJesus, J. M., Rhodes, M., & Kinzler, K. D. (2014). Evaluations versus expectations: Children's divergent beliefs about resource distribution. *Cognitive science*, *38*(1), 178-193. doi:10.1111/cogs.12093

Diamond, K. E., & Hestenes, L. L. (1996). Preschool children's conceptions of disabilities. *Topics in Early Childhood Special Education, 16*(, 458-475. doi:10.1177/027112149601600406

Diamond, K. E., Hong, S. Y., & Tu, H. (2008). Context influences preschool children's decisions to include a peer with a physical disability in play. *Exceptionality*, *16*(3), 141-155. doi:10.1080/09362830802198328

Diamond, K. E., & Hong, S. Y. (2010). Young children's decisions to include peers with physical disabilities in play. *Journal of Early Intervention*, *32*(3), 163-177. doi:10.1177/1053815110371332

Diamond, K. E., & Kensinger, K. R. (2002). Vignettes from sesame street: Preschooler's ideas about children with down syndrome and physical disability. *Early Education and Development, 13,* 409-422. doi:10.1207/s15566935eed1304_5

Dirth, T. P., & Branscombe, N. R. (2019). Recognizing ableism: A social identity analysis of disabled people perceiving discrimination as illegitimate. *Journal of Social Issues*, *75*(3), 786-813. doi:10.1111.josi.12345

Eagly, A. H., Ashmore, R. D., Makhijani, M. G., & Longo, L. C. (1991). What is beautiful is good, but…: A meta-analytic review of research on the physical attractiveness stereotype. *Psychological bulletin, 110*(1), 109. doi:10.1037/0033-2909.110.1.109

Echelbarger, M., & Gelman, S. A. (2023). Children's evaluations of scarce (and abundant) resources: When does the "why" matter?. *Cognitive Development, 66,* 101312. doi:10.1016/j.cogdev.2023.101312

Elenbaas, L. (2019). Against unfairness: Young children's judgments about merit, equity, and equality. *Journal of Experimental Child Psychology, 186,* 73-82. doi:10.1016/j.jecp.2019.05.009

Enoch, J., McDonald, L., Jones, L., Jones, P. R., & Crabb, D. P. (2019). Evaluating whether sight is the most valued sense. *JAMA ophthalmology*, *137*(11), 1317-1320. doi:10.1001/jamaophthalmol.2019.3537

Forgas, J. P., & Laham, S. M. (2016). Halo effects. In *Cognitive illusions* (pp. 286-300). Psychology Press.

Flavell, J. H. (2004). *Development of knowledge about vision*. na.

Flavell, J. H., Shipstead, S. G., & Croft, K. (1978). Young children's knowledge about visual perception: Hiding objects from others. *Child Development*, 1208-1211. doi:10.2307/1128761

Flavell, J. H., Shipstead, S. G., & Croft, K. (1980). What young children think you see when their eyes are closed. *Cognition*, *8*(4), 369-387. doi:10.1016/0010-0277(80)90001-3.

Geraci, A., & Surian, L. (2011). The developmental roots of fairness: Infants' reactions to equal and unequal distributions of resources. *Developmental science*, *14*(5), 1012-1020. doi:10.1111/j.1467-7687.2011.01048.x

Göckeritz, S., Schmidt, M. F., & Tomasello, M. (2014). Young children's creation and transmission of social norms. *Cognitive Development*, *30*, 81-95. doi:10.1016/j.cogdev.2014.01.003.

Gottfried, G. M., Gelman, S. A., & Schultz, J. (1999). Children's understanding of the brain: From early essentialism to biological theory. *Cognitive Development*, *14*(1), 147-174. doi:10.1016/S0885-2014(99)80022-7

Granata, N., Wiebe, M., & Lane, J. D. (2022). Children's judgments of and reasoning about people with disabilities who produce norm violations. *Journal of Experimental Child Psychology*. doi:10.1016/j.jecp.2021.105318.

Granata, N., & Lane, J. D. (2023). Investigating the efficacy of prescribed labeling practices: Conceptualizing persons with disabilities. *Group Processes & Intergroup Relations*, doi:10.1177/13684302231157990

Hardecker, S., Schmidt, M. F., Roden, M., & Tomasello, M. (2016). Young children's behavioral and emotional responses to different social norm violations. *Journal of Experimental Child Psychology*, *150*, 364-379. doi:10.1016/j.jecp.2016.06.012

Hebble, P. W. (1971). The development of elementary school children's judgment of intent. *Child Development*, 1203-1215. doi:10.2307/1127804.

Huckstadt, L. K., & Shutts, K. (2014). How young children evaluate people with and without disabilities. *Journal of Social Issues*, *70*(1), 99-114. doi:10.1111/josi.12049.

Inagaki, K., & Hatano, G. (1990). Development of explanations for bodily functions. In *32nd annual convention of the Japanese Association of Educational Psychology, Osaka [in Japanese]*.

Inagaki, K., & Hatano, G. (1993). Young children's understanding of the mind-body distinction. *Child development*, *64*(5), 1534-1549. doi:10.1111/j.1467-8624.1993.tb02969.x

The IRIS Center. (2010, Rev. 2018). *Accommodations: Instructional and testing supports for students with disabilities.* Retrieved from https://iris.peabody.vanderbilt.edu/acc/

Johnson, C. N., & Wellman, H. M. (1980). Children's developing understanding of mental verbs: Remember, know, and guess. *Child development*, 1095-1102. doi:10.2307/1129549

Johnson, C. N., & Wellman, H. M. (1982). Children's developing conceptions of the mind and brain. *Child development*, 222-234. doi:10.2307/1129656

Josephs, M., Kushnir, T., Gräfenhain, M., & Rakoczy, H. (2016). Children protest moral and conventional violations more when they believe actions are freely chosen. *Journal of Experimental Child Psychology*, *141*, 247-255. doi:10.1016/j.jecp.2015.08.002

Killen, M., Mulvey, K. L., Richardson, C., Jampol, N., & Woodward, A. (2011). The accidental transgressor: Morally-relevant theory of mind. *Cognition*, *119*(2), 197-215. doi:10.1016/j.cognition.2011.01.006.

Lalvani, P. (2015). Disability, stigma and otherness: Perspectives of parents and teachers. *International Journal of Disability, Development and Education*, *62*(4), 379-393. doi:10.1080/1034912X.2015.1029877

Lane, J. D., Wellman, H. M., & Evans, E. M. (2010). Children’s understanding of ordinary and extraordinary minds. *Child Development*, *81*, 1475-1489. doi:10.1111/j.1467-8624.2010.01486.x

Litman, L. (n.d.). Strengths and limitations of mechanical turk. CloudResearch. https://www.cloudresearch.com/resources/blog/strengths-and-limitations-of-mechanical-turk/

Lucca, K., Pospisil, J., & Sommerville, J. A. (2018). Fairness informs social decision making in infancy. *PloS one*, *13*(2). doi:10.1371/journal.pone.0192848

Lyon, T. D., & Flavell, J. H. (1993). Young children's understanding of forgetting over time. *Child Development*, *64*(3), 789-800. doi:10.1111/j.1467-8624.1993.tb02943.x

Mandalaywala, T. M., Ranger-Murdock, G., Amodio, D. M., & Rhodes, M. (2019). The nature and consequences of essentialist beliefs about race in early childhood. *Child development*, *90*, e437-e453. doi:10.1111/cdev.13008.

Marble, K. E., & Boseovski, J. J. (2020). Content counts: A trait and moral reasoning framework for children's selective social learning. *Advances in child development and behavior, 58*, 95-136. doi:10.1016/bs.acdb.2020.01.004

Martinez, C. (2022). *Disability statistics in the US: looking beyond figures for an accessible and inclusive society*. Inclusive City Maker. Retrieved from: https://www.inclusivecitymaker.com/disability-statistics-in-the-us/.

McAuliffe, K., Blake, P. R., Steinbeis, N., & Warneken, F. (2017). The developmental foundations of human fairness. *Nature Human Behaviour, 1*(2), 0042. doi:10.1038/s41562-016-0042.

Melis, A. P., Call, J., & Tomasello, M. (2010). 36-month-olds conceal visual and auditory information from others. *Developmental Science*, *13*(3), 479-489. doi:10.1111/j.1467-7687.2009.00892.x

Menendez, D. & Gelman, S. A. (under review). Genes vs. germs: children’s biological causal models of disability.

Mitchell, M. (2008). Using the media to teach disability stereotypes. *The Review of Disability Studies: An International Journal, 4*(4), 24–32.

Moll, H., Carpenter, M., & Tomasello, M. (2014). Two-and 3-year-olds know what others have and have not heard. *Journal of Cognition and Development*, *15*(1), 12-21. doi:10.1080/15248372.2012.710865

Moore, C., Gilbert, C., & Sapp, F. (1995). Children's comprehension of the distinction between want and need. *Journal of child language*, *22*(3), 687-701 doi:10.1017/S030500090001000X

National Center for Education Statistics. (2023). Students with Disabilities. *Condition of Education.* U.S. Department of Education, Institute of Education Sciences. Retrieved June 25, 2023 from https://nces.ed.gov/programs/coe/indicator/cgg

National Center on Birth Defects and Developmental Disabilities (2022). *CDC's work on developmental disabilities.* Centers for Disease Control and Prevention. https://www.cdc.gov/ncbddd/developmentaldisabilities/about.html.

Nelson, J. A. (2000). The Media role in building the disability community. *Journal of Mass Media Ethics*, *15*(3), 180-193. doi:10.1207/S15327728JMME1503-4

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological review*, *84*(3), 231. doi:10.1037/0033-295X.84.3.231

Nowicki, E. A. (2007). Children's beliefs about learning and physical difficulties. *International Journal of Disability, Development and Education*, *54*(4), 417-428. doi:10.1080/10349120701654647

Nucci, L. (1981). Conceptions of personal issues: A domain distinct from moral or societal concepts. *Child development*, 114-121. doi:10.2307/1129220

O'Neill, D. K., & Chong, S. (2001). Preschool children's difficulty understanding the types of information obtained through the five senses. *Child Development*, *72*(3), 803-815. doi:10.1111/1467-8624.00316.

O'Neill, D. K., & Gopnik, A. (1991). Young children's ability to identify the sources of their beliefs. *Developmental psychology*, *27*(3), 390. doi:10.1037/0012-1649.27.3.390

Peele, M. M., Gill, C., & Wainscott, S. (2020). Progress in education of children with disabilities in Zambia. *Perspectives of the ASHA Special Interest Groups*, *5*(6), 1820-1827. doi:10.1044/2020_PERSP-20-00034

Pillow, B. H. (1993). Preschool children's understanding of the relationship between modality of perceptual access and knowledge of perceptual properties. *British Journal of Developmental Psychology*, *11*(4), 371-389. doi:10.1111/j.2044-835X.1993.tb00610.x

Pramling, I. (1988). Developing children's thinking about their own learning. *British journal of educational psychology*, *58*(3), 266-278. doi:10.1111/j.2044-8279.1988.tb00902.x

Pratt, C., & Bryant, P. (1990). Young children understand that looking leads to knowing (so long as they are looking into a single barrel). *Child development*, *61*(4), 973-982. doi:10.1111/j.1467-8624.1990.tb02835.x

Price, C. L., Ostrosky, M. M., & Mouzourou, C. (2016). Exploring representations of charcters with disabilities in library books. *Early Childhood Education Journal, 44,* 563-572. doi: 10.1007/s10643-015-0740-3

Richards, D. D., & Siegler, R. S. (1986). Children's understandings of the attributes of life. *Journal of Experimental Child Psychology*, *42*(1), 1-22. doi:10.1016/0022-0965(86)90013-5

Rizzo, M. T., Elenbaas, L., Cooley, S., & Killen, M. (2016). Children’s recognition of fairness and others’ welfare in a resource allocation task: Age related changes. *Developmental psychology*, *52*(8), 1307. doi:10.1037/dev0000134

Robertson, Z. S. & Jaswal, V. K. (2024). Barriers to inclusion: Incorporating the social model in the study of children’s understanding of disability. *Cognitive Development, 70,* 101435. doi:10.1016/j.cogdev.2024.101435

Ronfard, S., Bartz, D. T., Cheng, L., Chen, X., & Harris, P. L. (2018). Children's developing ideas about knowledge and its acquisition. *Advances in Child Development and Behavior, 54*, 123-151. doi:10.1016/bs.acdb.2017.10.005.

Sargent, Z., & Jaswal, V. K. (2022). “It's okay if you flap your hands”: Non‐autistic children do not object to individual unconventional behaviors associated with autism. *Social Development*, *31*(4), 1211-1230. doi:10.1111/sode.12600

Schwartz, Blue, McDonald, Giuliani, Weber, Seirup, Rose, Elkis-Albuhoff, Rosenfeld & Perkins (2010) Dispelling stereotypes: promoting disability equality through film, Disability & Society, 25:7, 841-848. doi:10.1080/09687599.2010.520898

Scott, A. W., Bressler, N. M., Folkes, S., Wittenborn, J. S., & Jorkasky, J. (2016). Public attitudes about eye and vision health. *JAMA ophthalmology*, *134*(10), 1111-1118. doi:10.1001/jamaophthalmol.2016.2627

Shatz, M., Wellman, H. M., & Silber, S. (1983). The acquisition of mental verbs: A systematic investigation of the first reference to mental state. *Cognition*, *14*(3), 301-321. doi:10.1016/0010-0277(83)90008-2

Smetana, J. G. (1981). Preschool children's conceptions of moral and social rules. *Child development*, 1333-1336. doi:10.2307/1129527

Smetana, J. G., Rote, W. M., Jambon, M., Tasopoulos-Chan, M., Villalobos, M., & Comer, J. (2012). Developmental changes and individual differences in young children's moral judgments. *Child development*, *83*(2), 683-696. doi:10.1111/j.1467-8624.2011.01714.x

Smith, C. E., Blake, P. R., & Harris, P. L. (2013). I should but I won't: Why young children endorse norms of fair sharing but do not follow them. *PloS one*, *8*(3). doi:10.1371/journal.pone.0059510

Smith, C. E., & Warneken, F. (2016). Children's reasoning about distributive and retributive justice across development. *Developmental Psychology, 52*(4), 613–628. doi:10.1037/a0040069

"Sneakers" (1992). https://www.imdb.com/title/tt0105435/

Tisak, M. S., & Turiel, E. (1988). Variation in seriousness of transgressions and children's moral and conventional concepts. *Developmental Psychology*, *24*(3), 352. doi:10.1037/0012-1649.24.3.352

Tsiantis, J., Diareme, S., Giannakopoulou, D., & Soumaki, E. (2006). Progress in intellectual disabilities services in Greece: diagnostic, educational and vocational services. *Journal of Intellectual Disabilities*, *10*(2), 99-104. doi:10.1177/1744629506064007

Wang, Z. (2010). *Mindful learning: Children's developing theory of mind and their understanding of the concept of learning* (Doctoral dissertation, University of Pennsylvania).

Ware, L. (2001). Writing, Identity, and the Other: Dare We Do Disability Studies? *Journal of Teacher Education*, *52*(2), 107–123. doi:10.1177/0022487101052002003

Wellman, H. M. (2014). *Making minds: How theory of mind develops*. Oxford University Press.

Wellman, H. M., & Johnson, C. N. (1979). Understanding of mental processes: a developmental study of" remember" and" forget". *Child Development*, 79-88. doi:10.2307/1129044

Wellman, H. M., & Lempers, J. D. (1977). The naturalistic communicative abilities of two-year-olds. *Child Development*, 1052-1057. doi:10.2307/1128359

Wikipedia contributors. (2024, February 4). Eye of Ra. In *Wikipedia, The Free Encyclopedia*. Retrieved 02:35, February 19, 2024, from https://en.wikipedia.org/w/index.php?title=Eye_of_Ra&oldid=1203078324

Wiebe, M., Granata, N., & Lane, J. D. (2022). Children's attributions of knowledge and trustworthiness to persons with disabilities. *Cognitive Development*, *61*, 101143. doi:10.1016/j.cogdev.2021.101143

Williamson, R. A., Brooks, R., & Meltzoff, A. N. (2015). The sound of social cognition: Toddlers' understanding of how sound influences others. *Journal of Cognition and Development*, *16*(2), 252-260. doi:10.1080/15248372.2013.824884

Wimmer, H., Hogrefe, G. J., & Perner, J. (1988). Children's understanding of informational access as source of knowledge. *Child development*, 386-396. doi:10.2307/1130318

Appendix A

Study 1 Participant Exposure to Persons with Disabilities as Reported by Caregivers

“How often is your child around children with disabilities in his or her classroom or school?”		
	Frequency	Percent
Never	11	9%
Rarely	57	46.7%
Often	35	28.7%
Very Often	16	13.1%
Sub-total	119	97.5%
Missing	3	2.5%
Total	122	100%

“How often does your child interact with people with disabilities outside of the classroom setting?”		
	Frequency	Percent
Never	8	6.6%
Rarely	81	66.4%
Often	23	18.9%
Very Often	6	4.9%
Sub-total	118	96.7%
Missing	4	3.3%
Total	122	100%

“Do you or other caregivers read books or stories to your child about how to treat different types of people; for example, stories about children with disabilities?”		
	Frequency	Percent
No	56	45.9%
Yes	61	50.0%
Sub-total	117	95.9%
Missing	5	4.1%
Total	122	100%

“Over the past year, how many days has your child spent in-person, in classroom (as opposed to remote/online) in a given week?”		
	Frequency	Percent
0 days	5	4.1%
1 day	5	4.1%
2 days	7	5.7%
3 days	4	3.3%
4 days	3	2.5%
5 days	90	73.8%
7 days	1	0.8%
Sub-total	115	94.3%
Missing	7	5.7%
Total	122	100%

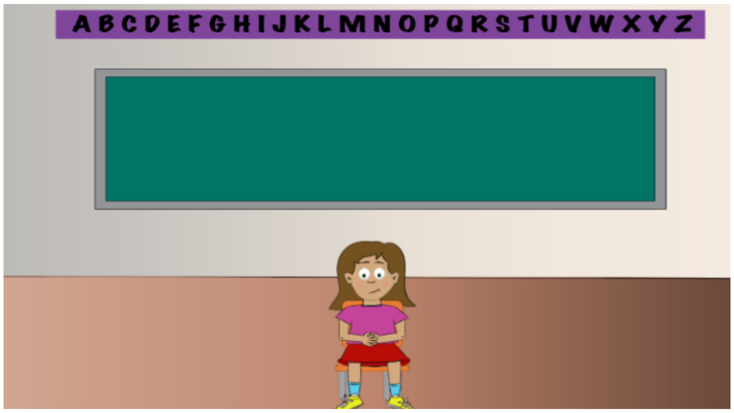
“Over the past year, if your child has attended school primarily in-person, have they eaten lunch in the cafeteria?”		
	Frequency	Percent
Yes	91	74.6%
No	23	18.9%
Sub-total	114	93.4%
Missing	8	6.6%
Total	122	100%

“Over the past year, if your child has attended school primarily in-person, have they attended outdoor recess?”		
	Frequency	Percent
Yes	109	89.3%
No	5	4.1%
Sub-total	114	93.4%
Missing	8	6.6%
Total	122	100%

Appendix B

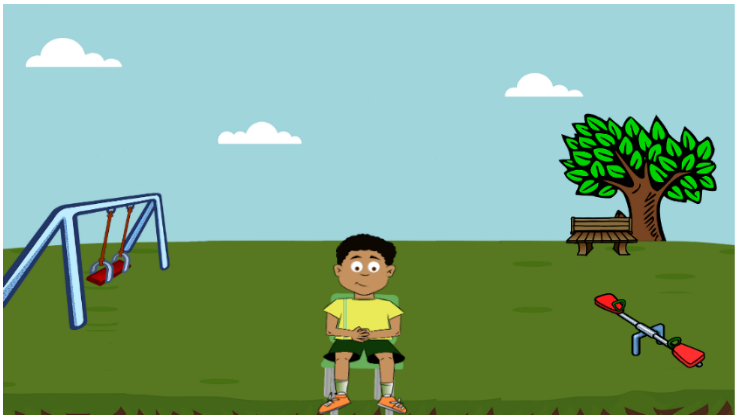
Study 1 Example Scenario Introductory Graphics

Classroom Scene



Characters were presented to children (in random order) using this scene for the "Classwork", "Reading Time", "Computer", "Headphones", "Adult Help", "Snacks", and "Books" scenarios (see Appendix D for specific scenarios). Characters were gender-matched to the participant.

Outdoor Playground Scene



Characters were presented to children (in random order) using this scene for the "Outside Playtime" and "Soccer" scenarios (see Appendix D for specific scenarios). Characters were gender-matched to the participant.

Appendix C

Table C1. Accommodation scenarios presented to children in Study 1 pre-testing

	N	Mean	Std. Deviation
Less Classwork (Cognitive)	**30**	**0.10**	**0.31**
Outside First (Physical)	**30**	**0.30**	**0.47**
Soccer with hands (Physical)	**30**	**0.17**	**0.38**
Help from adult (Cognitive)	**30**	**0.23**	**0.43**
Books carried (Physical)	**30**	**0.27**	**0.45**
Computer instead of paper (Cognitive)	**30**	**0.33**	**0.48**
Extra time on test	30	0.47	0.51
Elevator instead of stairs	30	0.60	0.50
Desk instead of sitting on carpet	30	0.77	0.43
Headphones worn in class	30	0.50	0.51
Extra breaks in class	30	0.37	0.49
Lunch First	30	0.43	0.50
Extra snacks in class	18	0.28	0.46
Chair special and comfy	18	0.33	0.49
Physical Accommodations average	**30**	**0.24**	**0.29**
Cognitive Accommodations average	**30**	**0.22**	**0.31**

Note: In pre-testing, 30 children were presented 14 scenarios in which typically-developing characters performed different accommodation-related behaviors (e.g., doing less classwork) to determine which accommodations children evaluated as unfair. Children indicated that each scenario was unfair (coded 0) or fair (coded 1). The six scenarios bolded at the top are the scenarios that were retained in the final version of the study; these scenarios are additionally labeled as "physical" or "cognitive" accommodations. Average scores for these physical and cognitive accommodations are presented at the bottom of the table. Two of these scenarios ("Extra snacks in class" and "Chair special and comfy") were added partway through data collection (just in the case we could not find enough "unfair" scenarios out of the original 12); thus there are 18 responses for those two scenarios.

Table C2. Accommodation scenarios presented to children in full study (Study 1)

	N	Mean	Std. Deviation
Less Classwork (Cognitive)	**121**	**0.46**	**0.50**
Outside First (Physical)	**122**	**0.41**	**0.49**
Soccer with hands (Physical)	**121**	**0.52**	**0.52**
Help from adult (Cognitive)	**121**	**0.58**	**0.49**
Books carried (Physical)	**122**	**0.48**	**0.50**
Computer instead of paper (Cognitive)	**121**	**0.66**	**0.47**
Physical Accommodations average	**121**	**0.47**	**0.50**
Cognitive Accommodations average	**121**	**0.57**	**0.49**

Note: In the full study, 122 children were presented 6 focal scenarios in which characters with physical or cognitive disabilities performed different accommodation-related behaviors (e.g., doing less classwork) to determine which accommodations children evaluated as unfair. Children indicated that each scenario was unfair (coded 0) or fair (coded 1). Three "filler" scenarios were not analyzed and, thus, are not presented here. Average scores for these physical and cognitive accommodations are presented at the bottom of the table. Participants could choose to skip responding to individual scenarios; thus, for some scenarios above, only 121 children responded.

Appendix D

Study 1 scenarios in which children evaluated the fairness of physical, cognitive, or “filler” accommodations for characters with physical or cognitive disabilities. Approximately half of the participants received scenarios in the order below, and half received scenarios in the reverse order.

1. Classwork: “Every day in the classroom you see that Jamie/Johnny does less classwork than you and all the other kids in the class.” (**Cognitive Accommodation**)

2. Reading Time: “Every day in the classroom you see that Daisy/David sits at her/his desk during reading time when you and all the other kids sit on the carpet.” (**Filler**).

3. Outside Playtime: “Every day in the classroom you see that Susie/Steven always goes outside for playtime before you and all the other kids.” (**Physical Accommodation**).

4. Computer: “Every day in the classroom you see that Molly/Matthew uses a computer to read books in class when you and all the other kids use paper books” (**Cognitive Accommodation**).

5. Headphones: “Every day in the classroom you see that Tori/Theo always wears headphones during class when you and all the other kids wear nothing on your heads” (**Filler**).

6. Soccer: “Every day on the playground you see that Mary/Mikey plays soccer with his/her hands at recess when you and all the other kids play with just your feet” (**Physical Accommodation**).

7. Adult Help: “Every day in the classroom you see that Lily/Liam has an adult sit next to her/him and help her/him with their classwork when you and all the other kids work alone” (**Cognitive Accommodation**).

8. Snacks: “Every day in the classroom you see that Rachel/Randy has extra snacks in class when you and all the other kids do not” (**Filler**).

9. Books: “Every day in the classroom you see that Maddy/Michael has another kid carry her/his books for him when you and all the other kids carry their own” (**Physical Accommodation).**

Appendix E

Coding Scheme for Open-ended Responses in Study 1

Category	Description	Examples	IRR%
Physical or Cognitive Limitation	Mention of physical (walking) or cognitive (learning) capabilities	*"Because his legs/brain."* *"He can't walk that fast."* *"Mind gets tired."*	93.51
Other Limitation	Mentions limitation not related to physical or cognitive capabilities	*"Eyes don't work."* *"Maybe she can't grip paper very well."* *"He's not strong."*	93.98
Protagonist's Need	Mentions "need" or bad consequences if need is not met. Can be specific to a physical or cognitive capability	*"Needs practice from an adult to help him out."* *"He needs more time."* *"She needs extra help because she doesn't remember most things."*	97.22
Desire	Mention of protagonist's preference	*"Because he doesn't want to do his work."* *"Because it's fun…"* *"Because she likes being goalie and goalies use their hands."*	97.68
Protagonist's Negative Social Traits/Motives	Mention of protagonist's negative social traits or motives	*"Because he's lazy."* *"He likes to cheat."* *"His teacher usually yells at him and he gets in trouble."*	98.14
Difficult Task	Mention of the task being difficult without mention of a physical or cognitive limitation	*"Her homework is bigger/a lot more."* *"Because it's hard to work with a pencil."* *"Because they (the books) might be too heavy."* *"Might have a different assignment."*	95.83

Rule *permitted* or Authority *permitted/preferred*	Mentions permission via a rule or authority figure	*"The teacher tells her to."* *"Teacher feels bad for her."* *"Maybe she's the line leader."* *"He is probably the goalie."*	97.22
Protagonist's Lack of Knowledge	Protagonist is unaware of critical knowledge – unrelated to a physical or cognitive limitation	*"She/he doesn't know how…"* *"He is not listening."* *"Because he doesn't pay attention."*	97.68
Mention of neutral fact from our descriptions	These are the neutral facts we gave children in the descriptions	*"Because he was watching a lot of TV and that causes lack of focus."* *"Because he eats cereal every day."* *"He lives in a city and there's no fields."*	99.1
Other	Information not coded in the above categories. *Does not include "I don't know" responses or non-answers*	*"She goes to school early."* *"Because he's not smart."* *"To make a goal."*	88.89

Appendix F

Study 1 Model 4 (final model) STATA output, for regression predicting accommodation evaluations from references to characters' needs.

```
.                 mixed Fairnessforscenario i.ReasonNeedAny i.Disability i.Accommodation c.Age_years_cent ///
>         Disability#Accommodation ///
>  Accommodation#ReasonNeedAny ///
> || ID:

Performing EM optimization ...

Performing gradient-based optimization:
Iteration 0:   Log likelihood = -223.21199
Iteration 1:   Log likelihood = -223.21199

Computing standard errors ...

Mixed-effects ML regression                         Number of obs     =     726
Group variable: ID                                  Number of groups  =     122
                                                    Obs per group:
                                                                  min =       4
                                                                  avg =     6.0
                                                                  max =       6
                                                    Wald chi2(6)      =   34.62
Log likelihood = -223.21199                         Prob > chi2       =  0.0000
```

Fairnessforscenario	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
1.ReasonNeedAny	.0964403	.0361039	2.67	0.008	.0256779	.1672027
Disability						
Cognitive	.0200748	.0478813	0.42	0.675	-.0737708	.1139204
1.Accommodation	.0773927	.0453653	1.71	0.088	-.0115216	.1663071
Age_years_cent	.0432019	.0131275	3.29	0.001	.0174724	.0689313
Disability#Accommodation						
Cognitive#1	.0913055	.0445975	2.05	0.041	.0038959	.178715
Accommodation#ReasonNeedAny						
1 1	-.1112322	.0475811	-2.34	0.019	-.2044896	-.0179749
_cons	.4017442	.0427478	9.40	0.000	.31796	.4855284

Random-effects parameters	Estimate	Std. err.	[95% conf.	interval]
ID: Identity				
var(_cons)	.038627	.0068884	.027233	.0547881
var(Residual)	.0871747	.005018	.0778742	.097586

```
LR test vs. linear model: chibar2(01) = 107.97          Prob >= chibar2 = 0.0000
```

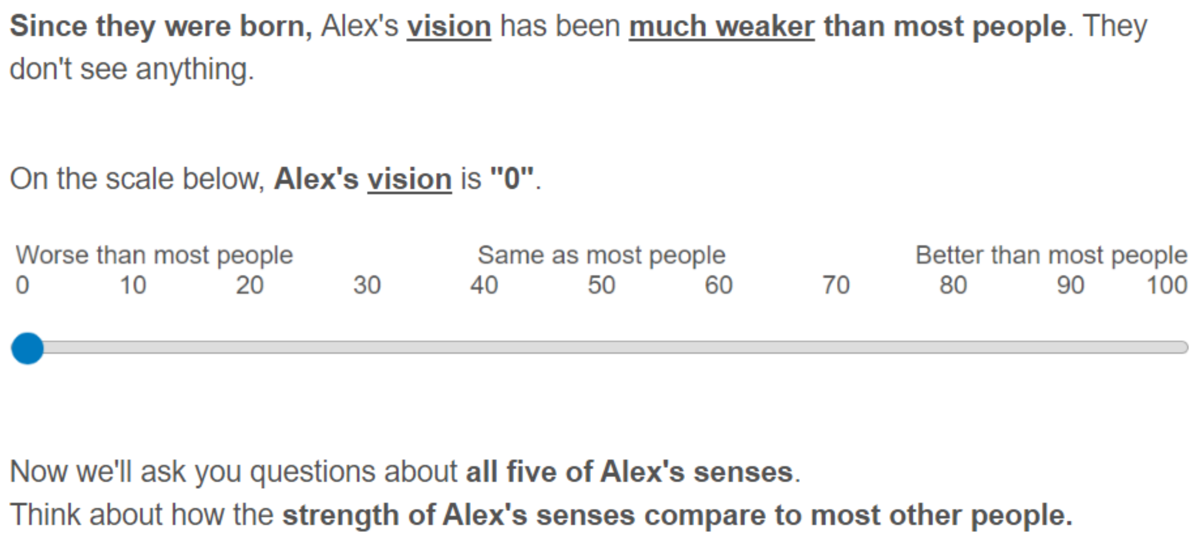
Appendix G

Study 1 Model 4 (final model) STATA output for regression predicting accommodation evaluations from references to characters' motives.

```
.       mixed Fairnessforscenario i.ReasonMotive Disability Accommodation c.Age_years_cent ///
>       Disability#Accommodation ///
>       || ID:
note: 2.Disability#0.Accommodation omitted because of collinearity.
note: 2.Disability#1.Accommodation omitted because of collinearity.

Performing EM optimization ...

Performing gradient-based optimization:
Iteration 0:  Log likelihood = -222.38632
Iteration 1:  Log likelihood = -222.38632

Computing standard errors ...

Mixed-effects ML regression                     Number of obs     =    726
Group variable: ID                              Number of groups  =    122
                                                Obs per group:
                                                              min =      4
                                                              avg =    6.0
                                                              max =      6
                                                Wald chi2(5)      =  36.39
Log likelihood = -222.38632                     Prob > chi2       = 0.0000

-------------------------------------------------------------------------------------------
     Fairnessforscenario | Coefficient  Std. err.      z    P>|z|     [95% conf. interval]
-------------------------+-----------------------------------------------------------------
          1.ReasonMotive |  -.1216986   .0398611    -3.05   0.002     -.199825   -.0435723
              Disability |   .0020868   .0471494     0.04   0.965    -.0903243    .0944978
           Accommodation |   .1084645   .0304917     3.56   0.000     .0487018    .1682271
          Age_years_cent |   .0422817   .0130449     3.24   0.001     .0167141    .0678493
                         |
Disability#Accommodation |
              Physical#1 |  -.1128807   .0438353    -2.58   0.010    -.1987963   -.0269651
             Cognitive#0 |          0  (omitted)
             Cognitive#1 |          0  (omitted)
                         |
                   _cons |   .4825909   .0754162     6.40   0.000     .3347779    .6304039
-------------------------------------------------------------------------------------------


------------------------------------------------------------------------------
  Random-effects parameters  |   Estimate   Std. err.     [95% conf. interval]
-----------------------------+------------------------------------------------
ID: Identity                 |
                  var(_cons) |   .0383873   .0068472      .0270618    .0544525
-----------------------------+------------------------------------------------
               var(Residual) |   .0870243   .0050083      .0777415    .0974155
------------------------------------------------------------------------------
LR test vs. linear model: chibar2(01) = 107.81          Prob >= chibar2 = 0.0000
```

Appendix H

Study 2A example of how information about persons' varying sensory abilities and accompanying scale depictions appeared to adults on Qualtrics. In this example, the character Alex had a visual ability of "0", so "0" is marked on the scale.



Since they were born, Alex's **vision** has been **much weaker than most people**. They don't see anything.

On the scale below, **Alex's vision** is **"0"**.

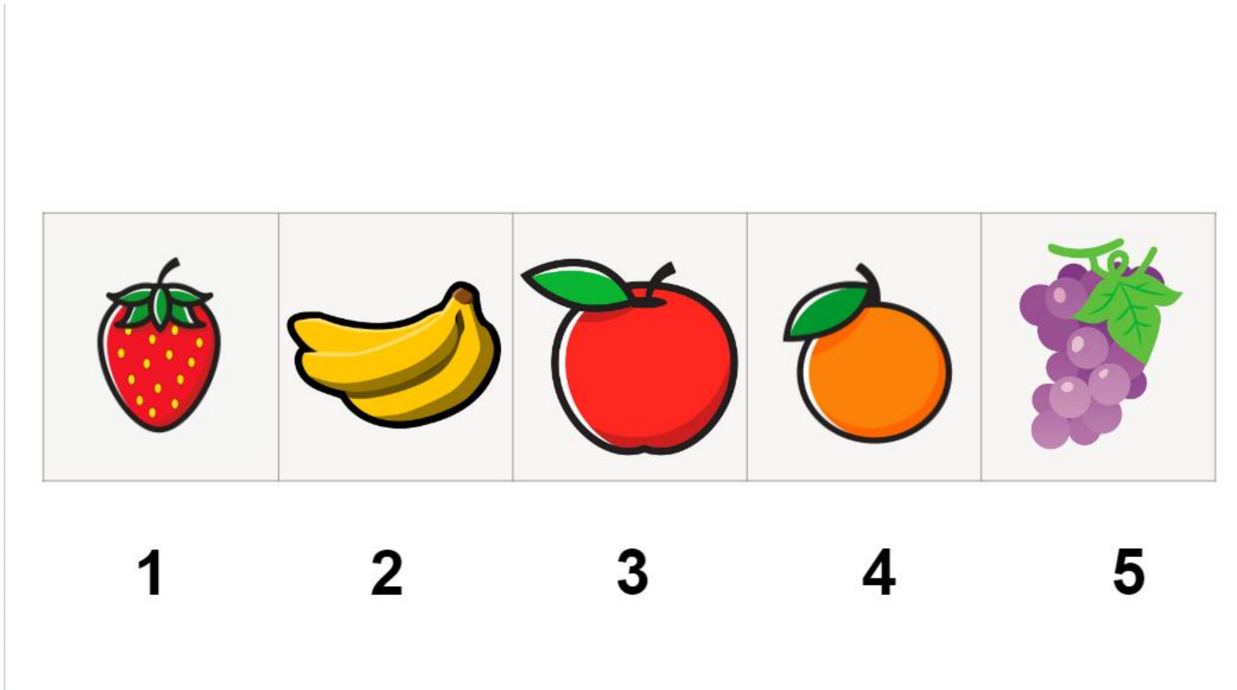
Worse than most people — Same as most people — Better than most people

0 10 20 30 40 50 60 70 80 90 100

Now we'll ask you questions about **all five of Alex's senses**.
Think about how the **strength of Alex's senses compare to most other people.**

Appendix I

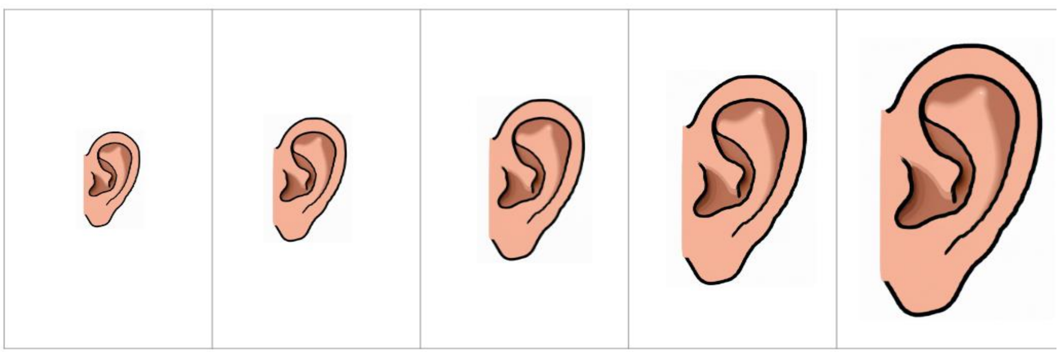
The warm-up exercise children completed to begin getting familiar with the scale in Study 2B. Children were asked to identify which number the strawberry is (“1”), and which fruit number 4 is (“the orange”).



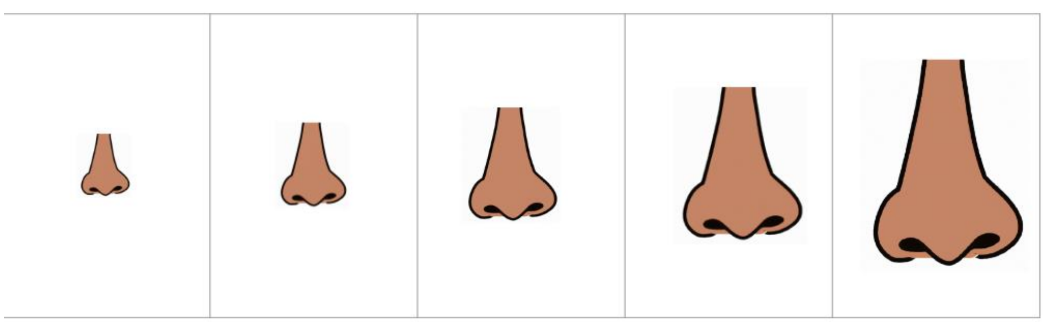
Appendix J

Scales seen and used by children to communicate varying levels of performance in the five senses (seeing, hearing, smelling, taste, and touch) in Study 2B. “1” meant a person “could not see/hear/smell/taste/touch anything at all”, and “5” meant a person “could see/hear/smell/taste/touch super, super good” (see Appendix K for full descriptions).

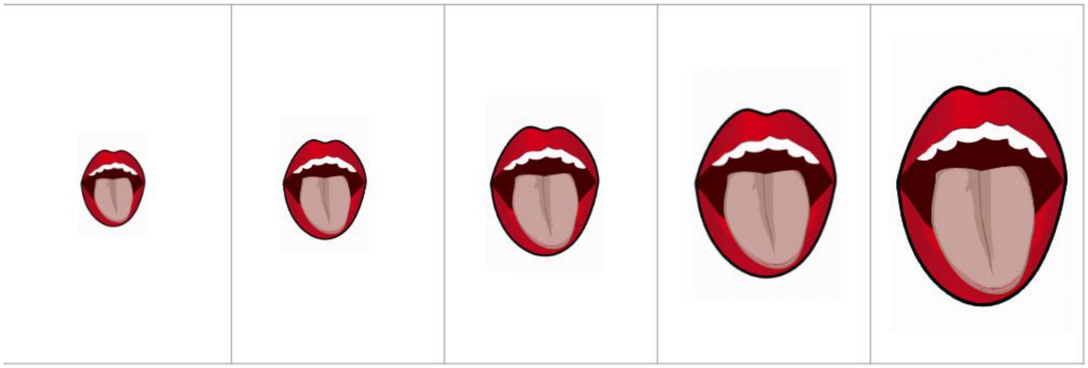
1 2 3 4 5



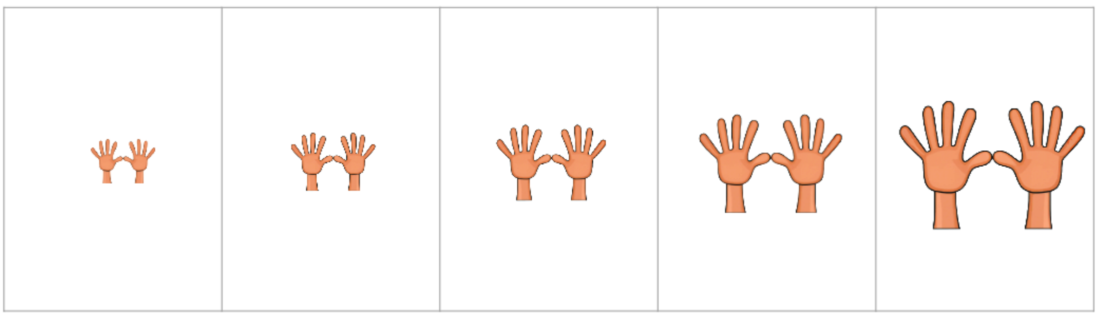
1 2 3 4 5



1 2 3 4 5



1 2 3 4 5



1 2 3 4 5

Appendix K

Full descriptions that accompanied the scales in Study 2B representing varying performance in the five senses (see Appendix J for scales).

SEEING:

These pictures are about *seeing*. The smallest eye [point] means someone can't see *anything at all*. The next one [point] means someone can see a *little*. The eye in the middle [point] means someone's eyes are okay—they see as good as most kids your age. The next one [point] means someone can see *very* good. And the biggest eye [point] means someone can see super, *SUPER* good.

HEARING:

This picture is about *hearing*. The smallest ear [*point*] means someone can't hear *anything at all*. The next one [*point*] means someone can hear a *little*. The ear in the middle [*point*] means someone's ears are okay – they hear as good as most kids your age. The next one [*point*] means someone can hear *very* good. And the biggest ear [*point*] means someone can hear super, *SUPER* good.

SMELL:

This picture is about *smelling*. The smallest nose [*point*] means someone can't smell *anything at all*. The next one [*point*] means someone can smell a *little*. The nose in the middle [*point*] means someone's nose is okay – they can smell as good as most kids your age. The next one [*point*] means someone can smell *very* good. And the biggest nose [*point*] means someone can smell super, *SUPER* good.

TASTE:

This picture is about *tasting*. The smallest mouth [*point*] means someone can't taste *anything at all*. The next one [*point*] means someone can taste a *little*. The mouth in the middle [*point*] means someone's mouth is okay – they can taste as good as most kids your age. The next one [*point*] means someone can taste *very* good. And the biggest mouth [*point*] means someone can taste super, *SUPER* good."

TOUCH:

This picture is about *touching*. When we touch something, we *feel* with our hands - feeling with your hands is like when you feel something super *soft*, or super *scratchy*. The smallest hands [point] means someone can't feel *anything at all*. The next one [point] means someone can feel a *little*. The hands in the middle [point] means someone's hands are okay – they can feel as good as most kids your age. The next one [point] means someone can feel *very* good. And the biggest hands [point] means someone can feel super, *SUPER* good."

Appendix L

In Study 2B children heard three stories in which an object goes missing and needs to be found. Scenarios #1 and #3 came at the beginning or end of the protocol depending on the order the child was randomly assigned to receive.

Scenario #1: "Ball" scenario

One day at school, [Chris/Christine and Henry/Hannahs]'s class was playing in the gym for indoor recess! The class was playing with a *fuzzy*, yellow tennis ball.

Suddenly, a construction worker at the school makes all the lights go out by accident! Another kid is surprised and drops the ball. No one can see *anything at all* in the dark! **They can't use their eyes to find the ball.**

Scenario #2: "Bear" scenario

One weekend, the school went on a camping field trip! It was almost time for bed and all the kids were getting into their bunk beds to sleep. Suddenly, one kid bumps into the light switch and turns off the lights!

The boy/girl in the top bunk bed is surprised and drops their *old and stinky* stuffed bear. No one can see *anything at all* in the dark! **They can't use their eyes to find the bear.**

Scenario #3: "Bunny" scenario

One day at school, the principal surprised the whole school with a magic show! The magician does lots of tricks, including making a bunny appear out of a hat. Suddenly, the lights go out from a thunderstorm!

The bunny gets scared and runs away, *making a little sound like "bawk, bawk, bawk".* No one can see *anything at all* in the dark! **They can't use their eyes to find the bunny.**