# Is it a nine, or a six? Prosocial and selective perspective taking in four-year-olds

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**Abstract**

To successfully navigate the complex social world, people often need to solve the problem of perspective selection: Between two conflicting viewpoints of the self and the other, whose perspective should one take? In two experiments, we show that four-year-olds use others' knowledge and goals to decide *when* to engage in visual perspective taking. Children were more likely to take a social partner's perspective to describe an ambiguous symbol when she did not know numbers and wanted to learn than when she knew numbers and wanted to teach. These results were shown in children's own responses (Experiment 1) and in their evaluations of others' responses (Experiment 2). By preschool years, children understand when perspective taking is appropriate and necessary and selectively take others' perspectives in social interactions. These results provide novel insights into the nature and the development of perspective taking.

**Keywords:** social cognition; cognitive development; perspective taking; theory of mind; pedagogy

## Introduction

We all see the world from unique perspectives, forming different perceptions and beliefs and pursuing individual goals. Thus, to effectively interact with others, we often have to juggle various viewpoints and even choose between conflicting perspectives: When my dinner guest asks, "could you pass the plate on the left," should I hand over the one on his left or mine? When a friend in a different time zone says, "I'll call you at 6pm", does she mean 6pm for her, or for me? From ambiguity resolution in conversations to large-scale collaborative efforts, *perspective selection*—deciding whose perspective to take—is a central and pervasive problem in navigating the social world.

Previous research has revealed various benefits of taking another's perspective: it allows people to better understand others' mental states, improves interpersonal and intergroup relations, and even promotes generosity and helping behaviors (see Hodges, Clark, & Myers, 2011 for a review). However, perspective taking is not always necessary; our own perspectives are usually sufficient and even more relevant for many daily tasks such as spatial navigation or goal-directed actions. Moreover, deliberately taking on others' perspectives can be cognitively demanding (Hodges & Klein, 2001; Epley, Morewedge, & Keysar, 2004; Surtees & Apperly, 2012) and may even lead to poorer coordination (Galinsky, Ku, & Wang, 2005; Ku, Wang, & Galinsky, 2015). Because indiscriminately taking others' perspectives can be costly and even counterproductive, we must know *when* perspective taking is called for and employ it selectively in proper contexts.

For instance, imagine you see a number "9" on the table, which looks like a "6" to Emma who is sitting across the table. When Emma asks, "What is the number on the table?" would you say that it is a "nine," or a "six"? There is no inherently correct or incorrect answer to this question; the meaning of the symbol is *perspective-dependent*. Depending on the context, however, it may be more appropriate to answer the question from one perspective than the other. For instance, suppose Emma doesn't know numbers at all and wants to learn from you; then reading it as "nine" from your perspective might mislead her to falsely believe that what appears as "6" to her should be read as "nine." However, if Emma already knows numbers and is simply testing your number knowledge, then taking her perspective to say "six" might be unnecessary; it may even be potentially counter-productive if Emma (the teacher) expects you (the learner) to read the number from your own perspective.

This example illustrates a case in which the appropriate perspective is determined by the communicative context. Importantly, others' goals and knowledge can provide critical information about the nature of context. In this study, we investigate young children's ability to use such information to decide when to take others' perspectives. Decades of developmental research have revealed young children's ability to reason about others' mental states, such as their goals, desires, and beliefs—an ability often labeled "theory of mind" (Wellman, Cross, & Watson, 2001). Even toddlers use others' mental states to flexibly modulate their behaviors in social interactions, such as providing the food that others like rather than what they themselves like (Repacholi & Gopnik, 1997; Doan, Denison, Lucas, & Gopnik, 2015), or offering help or information for those in need (Warneken & Tomasello, 2006; Cortes Barragan & Dweck, 2014; Liszkowski, Carpenter, & Tomasello, 2008). Furthermore, children around age 5 readily consider others' prior goals and knowledge to decide what, and how much, information is appropriate in a given communicate context (Gweon, Shafto, & Schulz, 2014; Gweon, Chu, & Schulz, 2014). These studies suggest children's ability to consider others' mental states to modify their social behaviors.

However, little research has examined whether children can also use others' mental states to solve the perspective-selection problem. Developmental research on perspective taking has traditionally focused on whether children at certain ages are capable of reasoning about others' visual experiences (e.g., Piaget & Inhelder, 1956; Clark, 1997; Moll & Tomasello, 2006). By using tasks that explicitly instructed or clearly suggested children to report what others see, researchers have found that although the sensitivity to others' visual perspectives is present even in infancy (e.g., Luo & Johnson, 2009), the ability to report what others see gradually develops throughout childhood. Importantly, children show varying degrees of success depending on the complexity of the task. For example, around age 2, children can reliably report what object someone else can see (i.e., "Level-1 perspective taking", e.g., Moll et al., 2006), but they cannot decide how another person may see the same object differently until age 3 or even later (i.e., "Level-2 perspective taking", e.g., Moll & Meltzoff, 2011; Flavell et al., 1981). Particularly challenging are tasks that require suppressing one's own visual percepts to deliberately respond from another's conflicting perspective (Moll et al., 2013); in such tasks, even adults are slow and error-prone (e.g., Epley, et al., 2004), as such tasks require a careful deployment of executive resources (Qureshi, Apperly, & Samson, 2010).

The competition between two representations is particularly prominent in the above "9"/"6" example, which provides an ideal setup to test the perspective-selection problem: The perspective-dependent nature of the symbol provides the critical ambiguity, and the relevance of each perspective can only be decided by taking the contexts, such as the communicative partner's mental states, into account. We thus exploit this example[1] to test whether children use others' goals and epistemic states to decide when to take others' perspectives. Importantly, unlike prior studies that explicitly specified the perspective people should take when judging similar stimuli (e.g., Surtees, Samson, & Apperly, 2016), we embedded our ambiguous task in a pedagogical interaction to examine the effect of communicative contexts.

Motivated by recent studies showing children's ability to consider others' mental states to select what information to communicate (e.g., Gweon et al., 2014a; 2014b), we hypothesized that children would consider others' goals and epistemic states to decide whose perspective to take in a social interaction. We targeted four-year-olds because prior research on this age group has found reliable above-chance performance in Level-2 perspective taking tasks that require suppressing one's own representation to report what another person sees (Masangkay et al., 1974; Moll et al, 2013).

We predicted that even four-year-olds would show prosocial and selective perspective taking, spontaneously adopting another person's point of view to describe the ambiguous symbol when it would yield benefits to the other person. In Experiment 1, we looked at children's responses (i.e., reading the number from self-perspective or other-perspective) in a dyadic interaction. In Experiment 2, we examined children's evaluations of others who responded used different perspectives to answer the same question.

[1] We have also considered other stimuli with similar perspective-dependent property (e.g., up/down arrows, "u"/"n", convex/concave curves as mouths on a happy/sad face). The numbers were the most accessible symbols for our target age group (4-year-olds).

# Experiment 1

In Experiment 1, we asked children to directly respond to the puppet Emma's question, "What is the number on the table?" Across two conditions, we manipulated Emma's apparent goals and knowledge. We predicted that children would be more likely to report "six" from Emma's perspective when she didn't know numbers and wanted to learn from them (the "Puppet-Learner" condition) compared to when she already knew numbers and was testing the child's knowledge (the "Puppet-Teacher" condition).

## Method

**Participants** Forty 4-year-old children were randomly assigned to the Puppet-Learner (9 boys, 11 girls, *M (SD)* = 4.52 (.35) yrs) or the Puppet-Teacher condition (9 boys, 11 girls, *M (SD)* = 4.48 (.21) yrs). Children were recruited from a university preschool (*N*=22) or a local children's museum (*N*=18). An additional 11 children were excluded for: Not knowing numbers "6" and "9" and failing to learn during the number-pretest session (*N*=4; see Procedure), reading aloud the number before hearing the critical test question (*N*=4), answering from both perspectives (*N*=2), or failing to follow task instructions (*N*=1).

**Materials** A plastic cutout of number "6" in Arial Narrow font (3 × 5.5 inches) was used for the number pretest (see Procedure). For the practice trial and the test trial, we used two laminated photographs (8.5 × 11 inches): The Practice Photo showed a puppet (Emma) looking at an orange on a table; the Number Photo showed her looking at a number "6" laid flat on the table, which would be a "9" to the participant (Fig. 1). The puppet was gazing at the object in both photos, a gesture shown to trigger a moderate level of visual perspective taking (Zhao, Cusimano & Malle, 2015, 2016).

**Procedure** The experiment took place in a quiet, separate room. All children sat at a table across from the experimenter. If children's parents or siblings were in the testing room, they were asked to sit outside the children's visual field and not intervene during the procedure.

*Number pretest*. The experimenter held the number "6" upright and asked the child what number it was. After the child correctly answered "six", she rotated the number to show "9" and asked what number it was. If the child gave an incorrect answer to either question, the experimenter provided the correct answer and repeated the question. Once the child correctly identified both numbers, the experimenter said, "the same thing can be seen as both a 'six' and a 'nine'! How cool is that!"

*Practice trial*. The experimenter then placed the Practice Photo on the table and introduced the puppet in the photo as "Emma". Then she impersonated Emma using a voice distinct from her own (while avoiding eye contact with the child): "Look at that! It is my favorite fruit! I have a question for you: what is the fruit on the table?" All children answered this question correctly.

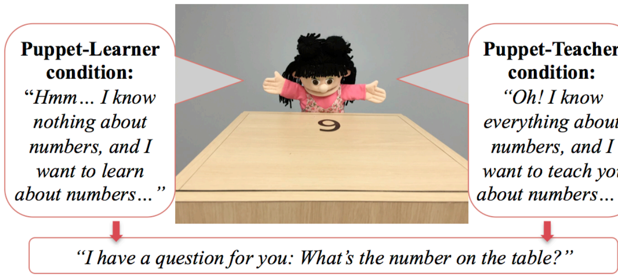


***Figure 1.*** The Number Photo of the test trial in Experiment 1 (in the middle), and Emma's lines in the "Puppet-Learner" and the "Puppet-Teacher" conditions.

*Test trial.* The experimenter placed the Number Photo on the table and continued to impersonate Emma. In the Puppet-Learner condition, Emma said: *"I know nothing about numbers, and I want to learn about numbers."* In the Puppet-Teacher condition, she said: *"I know everything about numbers, and I want to teach you about numbers."* Then she asked an identical question across conditions: *"I have a question for you. What's the number on the table?"*

After the test trial, all but three children received the questions "What does this number look like from your side?" and "What does this number look like from Emma's side?" The latter question resembles the kind of questions used in previous research to gauge participants' perspective-taking ability upon explicit request (e.g. Flavell et al., 1981).

### Results and Discussions

Consistent with our prediction, children were significantly more likely to take Emma's visual perspective and report "six" in the Puppet-Learner condition (14 of 20, 70%, 95% CI: 47.37-89.65%) than in the Puppet-Teacher condition (5 of 20, 25%, 95% CI: 7.41-45.45%; $p$ = .006, Fisher's exact. See Fig. 2). When explicitly requested to take Emma's perspective, the proportions of children who accurately reported "six" were nevertheless comparable (67% and 63% in the Puppet-Learner and the Puppet-Teacher conditions, respectively). Similarly, accuracy rates were also indistinguishable when they were explicitly instructed to respond from their own perspective (61% and 68%, $p$ = .74).

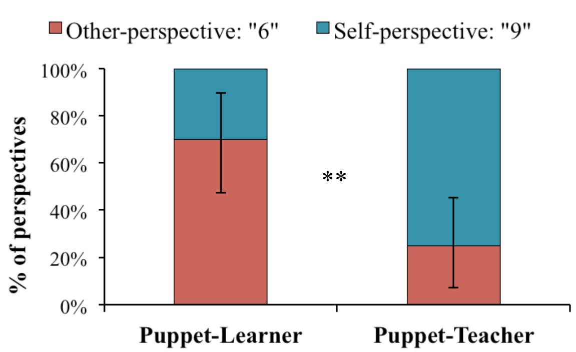


***Figure 2.*** Results from Experiment 1. Vertical black lines show 95% confidence intervals bootstrapped from the data.

These results suggest that children solved the perspective-selection problem by taking into account Emma's goal to teach or to learn and her number knowledge. Specifically, as teachers in the Puppet-Learner condition, children were more likely to describe the number from her perspective. Given that many four-year-olds still struggled with taking specific perspectives even upon explicit instructions, the proportion of children who spontaneously took Emma's perspective in the Puppet-Learner condition is impressive.

In Experiment 2, we sought another way to test our hypothesis. Prior work suggests that children evaluate informants based on the quality of information they provided, preferring those who provide accurate, complete information over those who provide inaccurate, incomplete information (e.g., Koenig & Harris, 2005, Gweon et al., 2014b). Here we asked whether children also evaluate others' perspective-taking decisions using Emma's goals and knowledge. As in Experiment 1, we hypothesized that children would prefer the informant who took Emma's perspective only when she did not know numbers and wanted to learn about numbers.

## Experiment 2

### Method

**Participants** Forty 4-year-old children were randomly assigned to the Puppet-Learner condition (6 boys, 14 girls, *M (SD)* = 4.53 (.22) yrs) or the Puppet-Teacher condition (8 boys, 12 girls, *M (SD)* = 4.53 (.30) yrs). They were recruited either at a university preschool (*N*=8) or at a local children's museum (*N*=32). An additional 14 children participated but were excluded due to inconsistent responses (*N*=6; see Procedure), not knowing numbers "6" and "9" and failing to learn them during the number-pretest session (*N*=3), not completing the procedure (*N*=3), endorsing both informants as correct (*N*=1), and sibling interference (*N*=1).

**Materials** A cutout of number "6" ("9" if rotated) was used. In addition to the "Emma" puppet, "Bert & Ernie" puppets appeared in the practice trial, and two nearly identical puppets (only differing in their hair colors) were used in the test trial. As in Experiment 1, Emma was standing behind the table and facing the participant; the informants appeared on the other side of the table, facing away from (and thus sharing the same viewpoint with) the participant. We recorded audio tracks of puppets' voices separately and overlaid them on the video images during postproduction. All videos lasted 30 seconds and were played on a Macbook Pro in the experiment. To help children focus on the screen, we placed the laptop inside a "viewing box"—a tightly fitting box around the laptop (approximately 13 ×10 × 10 inches) with a front opening for watching videos.

**Procedure** The *number pretest trial* was identical to that in Experiment 1 except that the child and the experimenter sat on the same side of the table.

*Practice trial*. The experimenter invited the child to watch "a show about Emma and her friends". Similar to the Practice Photo in Experiment 1, the Practice Video showed Emma looking at the orange and asking what fruit was on the table. Bert appeared from the lower-left corner of the screen and said, "I know what it is. It's a banana!" and disappeared. Then Ernie appeared from the lower-right corner and said, "I know what it is. It's an orange!" and disappeared. Both puppets then reappeared simultaneously, and the experimenter asked, "Now, who did a better job answering Emma's question? The guy on this side (while tapping on the left side of the box), or the guy on this side (while tapping on the right side of the box)?" If children pointed to the screen to indicate their choice instead of tapping, the experimenter repeated the tapping instruction to avoid any ambiguity in coding their choices. All children answered this question correctly.

*Test trial.* Similar to the Number Photo in Experiment 1, the Number Video showed Emma looking at the number "9/6" on the table. In both the Puppet-Learner and the Puppet-Teacher conditions, Emma's lines were identical to Experiment 1 (shown in Figure 1), ending with the critical question: "I have a question for you: What number is on the table?" As in the Practice Video, two puppets appeared and disappeared in sequence; one puppet said, "I know what it is. It's a six!", while the other puppet said, "I know what it is. It's a nine!" (order of "six" and "nine" counterbalanced) Both puppets appeared again at the end of the video, and the experimenter asked, "Who did a better job answering Emma's question?" As in the practice trial, children were asked to tap on the side of the box to indicate their choice. If a child could not answer, the experimenter repeated the video and her question. After the children made their choice by tapping, the experimenter tapped on the same side and asked, "What did this guy say?" This question served as a memory check, and those ($N$=6) who provided inconsistent responses (e.g., tapped to endorse the guy who answered "six" but believed he said "nine") were dropped from analysis.

Similar to Experiment 1, the experimenter also asked "What does this number look like from your side?" and "What does this number look like from Emma's side?" All but four children received these questions.

### Results and Discussion

We hypothesized that children in the Puppet-Learner condition would be more likely to prefer the informant who took Emma's perspective to respond (i.e., "it's a six!") than children in the Puppet-Teacher condition. As predicted, their preferences for informants differed significantly across conditions—while 60% of children in the Puppet-Learner condition believed the perspective-taking informant did a better job (12 of 20, 95% CI: 36.86-80.95%), only 15% in the Puppet-Teacher condition thought so (3 of 20, 95% CI: 0-33.33%), $p$ = .004, Fisher's exact test (see Fig. 3).

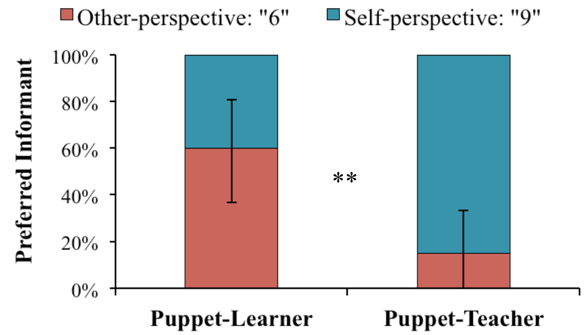


***Figure 3.*** Results from Experiment 2. Vertical black lines show 95% confidence intervals bootstrapped from the data.

In addition, when explicitly asked to report the number from Emma's perspective, children had similar accuracy rates in both conditions (62% and 70%, $p$ = .33). Their accuracy rates were also almost identical when instructed to respond from their own perspective (69% and 75%, $p$ = .48).

Experiment 2 showed that 4-year-olds were able to evaluate the appropriateness of other agents' perspective-taking responses based on the social context; in particular, the requester's mental states were critical for determining which perspective was more relevant and appropriate. Rather than always preferring the informant who engaged in perspective taking, children preferred the informant who answered from Emma's perspective when, and only when, Emma indicated her lack of number knowledge and her intention to learn. Such results are consistent with children's own perspective-selection decisions in Experiment 1.

## General Discussion

People perceive the world through their own eyes. However, in everyday interactions with others, they also encounter perspectives that differ from their own. Therefore, people often need to decide which perspective is more relevant in a given social interaction; even though taking the other' perspective is effortful, such effort may be worthwhile when the situation calls for it. Across two studies, we demonstrated that 4-year-olds took into account another's mental states to flexibly and selectively engage in visual perspective taking. In Experiment 1, they responded to their social partner's question by reading an ambiguous symbol either from their own viewpoint or from the partner's viewpoint depending on the partner's goals and epistemic states. In Experiment 2, they showed a similar understanding when evaluating other agents' responses.

This research generates novel insights into the nature and the development of perspective taking and suggests possible directions for future work. To start with, these results reveal previously undocumented perspective-selection ability in preschoolers: While prior research focused primarily on whether, or at what age, children demonstrated perspective-taking competencies upon explicit request, we provide evidence that four-year-olds showed considerable levels of spontaneous perspective taking even without explicit instructions. Furthermore, their perspective taking was *selective*: Instead of indiscriminately taking others' viewpoint, they did so only when the other "wanted to learn" (i.e., showed a need or interest). Because the proportion of children who took Emma's perspective in the Puppet-Learner condition might have been bounded by the proportion of children who would be able to report the number from Emma's view upon explicit request, it would be worthwhile to compare our results with explicit perspective-taking performance in an independent group of 4-year-olds ("What number does Emma see?"), as well as with results from adults who would have little trouble with perspective taking. Both studies are currently underway.

Our findings pose further questions on *how* children make such astute decisions about when (and when not) to take others' perspectives. Given accumulating evidence on preschooler's impressive inferential capacities in prosocial, pedagogical contexts (e.g., Gweon et al., 2014a), we speculate that children reason about the consequences of their options for both themselves and others to decide whose perspective to take. For example, if Emma is ignorant about numbers, taking her perspective would yield the benefit of correctly informing her, whereas using the egocentric perspective is likely to mislead her. In contrast, when Emma is already knowledgeable about numbers, there is no apparent benefit from taking her perspective; in fact, it is pragmatically more reasonable to answer from their own perspective. Indeed, a handful of children explained their decisions along this line (although we did not solicit verbal justification). However, it is also possible that the majority solved the problem of perspective selection using a simpler heuristic or norm acquired from their own experiences, such as "teachers usually take students' perspectives."

Our research also expands the phenomenon of visual perspective taking by highlighting its social nature. Because researchers have traditionally considered visual perspective taking as a perceptual and spatial ability (e.g. Piaget et al., 1956), relatively few theories or experimental investigations have questioned *why* humans engage in perspective taking at all. Recent work has started to examine how social cues from another person, such as goal-directed behaviors, may influence people's perspective-taking tendency (Tversky & Hard, 2009; Zhao et al., 2015). We extend this line of research in the context of dyadic interactions and demonstrate that even young children consider social information when engaging in visual perspective taking and use it to serve prosocial functions.

Understanding others' perceptions of the physical world is inherently tied to understanding their beliefs, desires, and intentions (Flavell, 2004). Thus, "visual" perspective taking may not depend on a fundamentally different capacity from "social" perspective taking in a broader, abstract sense (c.f. Moll & Kadipasaoglu, 2013). Although our research utilizes a visual perspective-taking task in the sense that children reason about what another sees, success in this task also requires thinking and reasoning from another's perspective. For future work, we hope to further study whether people might show selective and prosocial perspective taking regardless of the apparent visual, mental, or social nature of the task. Finally, note that we used both the social partner's goals (e.g., wanting to learn about numbers) and her epistemic states (e.g., knowing nothing about numbers) to reveal her mental states. In real-world pedagogical contexts, the presence of one mental state (either goal or knowledge) usually implies the presence of the other; nonetheless, teasing apart the roles of each of these mental states (e.g., by embedding them in other social contexts) would be an interesting direction for future research.

Both in everyday situations and in educational practices, perspective taking is generally considered desirable and beneficial for facilitating social interactions. This has led prior researchers to focus primarily on whether, and at what ages, children can accurately take others' perspectives. Our results highlight the importance of investigating when children take others' perspectives, and what information may support such inferences. We hope that our work generates more future research to explore this broad topic. Such research will not only clarify the use of perspective taking in everyday life, but also provide an opportunity to better understand failures of perspective taking in real-world contexts. By identifying situations where people naturally engage in perspective taking, researchers, educators, and practitioners may also find opportunities to create favorable conditions for people to exercise their critical perspective-taking skills.

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## References

Clark, E. V. (1997). Conceptual perspective and lexical choice in acquisition. *Cognition*, *64*, 1–37.

Cortes Barragan, R., & Dweck, C. S. (2014). Rethinking natural altruism: Simple reciprocal interactions trigger children's benevolence: Fig. 1. *Proceedings of the National Academy of Sciences*, *111*(48), 17071–17074.

Doan, T., Denison, S., Lucas, C. G., & Gopnik, A. (2015). Learning to reason about desires: An infant training study. *Proceedings of the 37th Annual Conference of the Cognitive Science Society*, 578–583.

Epley, N., Morewedge, C. K., & Keysar, B. (2004). Perspective taking in children and adults: Equivalent egocentrism but differential correction. *Journal of Experimental Social Psychology*, *40*(6), 760–768.

Flavell, J. H. (2004). Chapter 1 Development of Knowledge about Vision. In D. T. Levin (Ed.), *Thinking and Seeing: Visual Metacognition in Adults and Children* (pp. 13–36). Cambridge, MA: MIT Press.

Flavell, J. H., Everett, B. A., Croft, K., & Flavell, E. R. (1981). Young children's knowledge about visual-perception – Further evidence for the level 1–level 2 distinction. *Developmental Psychology*, 17, 99–103.

Galinsky, A. D., Ku, G., & Wang, C. S. (2005). Perspective-Taking and Self-Other Overlap: Fostering Social Bonds and Facilitating Social Coordination. *Group Processes & Intergroup Relations*, *8*(2), 109–124.

Gweon, H., Chu, V., & Schulz, L. E. (2014). To give a fish or to teach how to fish? Children weigh costs and benefits in considering what information to transmit. In *Proceedings of the 36th Annual Conference of the Cognitive Science Society*, 559-564.

Gweon, H., Shafto, P. & Schulz, L. E. (2014). Children consider prior knowledge and the cost of information both in learning from and teaching others. In *Proceedings of the 36th Annual Conference of the Cognitive Science Society,* 565-570.

Hodges, S. D., Clark, B, & Myers, M. W. (2011). Better living through perspective taking. In Biswas-Diener, R. (Ed.), *Positive Psychology as a Mechanism for Social Change* (193-218). Dordrecht, The Netherlands: Springer Press.

Hodges, S. D., & Klein, K. J. K. (2001). Regulating the costs of empathy: the price of being human. The Journal of Socio-Economics, 30(5), 437–452.

Koenig, M., & Harris, P. L. (2005). Preschoolers Mistrust Ignorant and Inaccurate Speakers, *76*(6), 1261–1277.

Ku, G., Wang, C. S., & Galinsky, A. D. (2015). The promise and perversity of perspective-taking in organizations. *Research in Organizational Behavior*.

Lin, S., Keysar, B., & Epley, N. (2010). Reflexively mindblind: Using theory of mind to interpret behavior requires effortful attention. *Journal of Experimental Social Psychology*, *46*(3), 551–556.

Liszkowski, U., Carpenter, M., & Tomasello, M. (2008). Twelve-month-olds communicate helpfully and appropriately for knowledgeable and ignorant partners. *Cognition*, *108*(3), 732–739.

Luo, Y., & Johnson, S. C. (2009). Recognizing the role of perception in action at 6 months. *Developmental Science*, 12(1), 142–149.

Masangkay, Z. S., McCluskey, K. a, McIntyre, C. W., Sims-Knight, J., Vaughn, B. E., & Flavell, J. H. (1974). The early development of inferences about the visual percepts of others. *Child Development*, *45*(2), 357–366.

Moll, H., & Kadipasaoglu, D. (2013). The primacy of social over visual perspective-taking. *Frontiers in Human Neuroscience*, *7*(September), 558.

Moll, H., & Meltzoff, A. N. (2011). How Does It Look ? Level 2 Perspective-Taking at 36 Months of Age, *82*(2), 661–673.

Moll, H., Meltzoff, A. N., Merzsch, K., & Tomasello, M. (2013). Taking versus confronting visual perspectives in preschool children. *Developmental Psychology*, *49*(4), 646–654.

Moll, H., & Tomasello, M. (2006). Level 1 perspective-taking at 24 months of age. British Journal of *Developmental Psychology,* 24(3), 603–613.

Piaget, J., & Inhelder, B. (1956). *The child's conception of space.* London, England: Routledge & Kegan Paul.

Qureshi, A. W., Apperly, I. A., & Samson, D. (2010). Executive function is necessary for perspective selection, not Level-1 visual perspective calculation: evidence from a dual-task study of adults. *Cognition*, *117*(2), 230–236.

Repacholi, B. M., & Gopnik, a. (1997). Early reasoning about desires: evidence from 14- and 18-month-olds. *Developmental Psychology*, *33*(1), 12–21.

Sabbagh, M. A., & Baldwin, D. A. (2001). Learning words from knowledgeable versus ignorant speakers: links between preschoolers' theory of mind and semantic development. *Child Development*, *72*(4), 1054–1070.

Slaughter, V. & Repacholi, B. (2003). Introduction: Individual differences in theory of mind: What are we investigating?. In B. Repacholi and V. Slaughter (Ed.), *Individual Differences in Theory of Mind: Implications for Typical and Atypical Development* (pp. 1-12). New York: Psychology Press.

Surtees, A. D. R., & Apperly, I. A. (2012). Egocentrism and automatic perspective taking in children and adults. Child Development, 83(2), 452–60.

Surtees, A., Samson, D., & Apperly, I. (2016). Unintentional perspective-taking calculates whether something is seen, but not how it is seen. *Cognition*, *148*, 97–105.

Tomasello, M., Dweck, C., Silk, J., Skyrms, B., & Spelke, E. (2009). *Why we cooperate*. Cambridge, MA: MIT Press.

Tversky, B., & Hard, B. M. (2009). Embodied and disembodied cognition: spatial perspective-taking. *Cognition*, *110*(1), 124–129.

Warneken, F., & Tomasello, M. (2006). Altruistic Helping in Human Infants and Young Chimpanzees. *Science*, *311*(5765), 1301–1303.

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: the truth about false belief. *Child Development*, *72*(3), 655–84.

Zhao, X., Cusimano, C., & Malle, B.F. (2015). In search of triggering conditions for spontaneous visual perspective taking. *Proceedings of the 37th Annual Conference of the Cognitive Science Society*, 2811-2816.

Zhao, X., Cusimano, C., and Malle, B. F. (2016). Do people spontaneously take a robot's visual perspective? In *HRI '16: Proceedings of the Eleventh Annual ACM/IEEE International Conference on Human-Robot Interaction, Christchurch, New Zealand* (pp. 335-342). Piscataway, NJ: IEEE Press.