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# Perspective taking in children and adults: Equivalent egocentrism but differential correction

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**Abstract**

Children generally behave more egocentrically than adults when assessing another's perspective. We argue that this difference does not, however, indicate that adults process information less egocentrically than children, but rather that adults are better able to subsequently correct an initial egocentric interpretation. An experiment tracking participants' eye movements during a referential communication task indicated that children and adults were equally quick to interpret a spoken instruction egocentrically but differed in the speed with which they corrected that interpretation and looked at the intended (i.e., non-egocentric) object. The existing differences in egocentrism between children and adults therefore seems less a product of where people start in their perspective taking process than where they stop, with lingering egocentric biases among adults produced by insufficient correction of an automatic moment of egocentrism. We suggest that this pattern of similarity in automatic, but not controlled, processes may explain between-group differences in a variety of dual-process judgments.


*Keywords:* Perspective taking; Theory of mind; Automatic and controlled processes; Egocentrism; Egocentric biases; Judgmental correction

Successful social interaction often requires an understanding that others may not interpret the world exactly as we do. Differing motivations, expectations, knowledge, or even visual perspective can lead people to interpret the same event very differently, and a failure to recognize these differences can lead to miscommunication and conflict (e.g., Pronin, Puccio, & Ross, 2002). Unfortunately for social functioning, accurate perspective taking is not a skill with which humans are born, but is a skill that must be developed. Before this development, children tend to believe that their perceptions of the world are accurate reflections of its actual properties and that others will therefore perceive the world as they do. Children younger than 4 years of age, for example, do not distinguish between what they know and what others know (Perner, 1991; Wimmer & Perner, 1983), fail to provide enough information to identify referents in ambiguous communication (Deutsch & Pechmann, 1982; Sonnenschein & Whitehurst, 1984), and rarely distinguish between the way an object appears and its reality (Flavell, 1986).

Clearly these particular egocentric errors are child's play and adults rarely—if ever—commit them. But adults do not appear to outgrow their child-like thinking altogether, as a wide variety of social judgments are still egocentrically biased. Adults, for example, tend to overestimate the extent to which others share their own attitudes and feelings (Krueger & Clement, 1994; Ross, Greene, & House, 1977), believe others have more access to their internal states than others actually do (Gilovich, Savitsky, & Medvec, 1998), use their own knowledge as a guide to others' knowledge (Keysar, 1994), use themselves as a standard when evaluating others (Alicke, 1993; Dunning, Meyerowitz, & Holzberg, 1989) and focus excessively on their own phenomenology or experience when anticipating how they will be evaluated by others (Epley, Savitsky, & Gilovich, 2001; Gilovich, Medvec, & Savitsky, 2000; Kenny & DePaulo, 1993; Savitsky, Epley, & Gilovich, 2001). Although the re-

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search that established these phenomena did not contrast children with adults, it does demonstrate that egocentrism is not merely a passing phase of childhood, but a fact of life.

In this article we seek to explain why egocentric biases in adults are less common than in children—but by no means absent—by comparing the time course of social cognition in children and adults. At least two explanations seem plausible. First, adults may be less egocentric than children because they are less likely to use their own perspective when assessing another's interpretation, and instead rely on an entirely different psychological process for perspective taking. Over time, adults may acquire domain specific theories or prototypes about how other minds work that are applied when adopting another's perspective in much the same way that a person applies a formula when solving math problems (Gopnik & Wellman, 1992; Karniol, 2003). With repeated experience, adults come to learn that their perceptions may differ from others in specific ways. Once those ways are known, they replace theories based on one's own unique perspective. Adults may be less egocentric than children, quite simply, because they tend to apply less egocentric theories when adopting another's perspective (Elkind, 1967; Flavell, 1992; Piaget, 1959).

A second possibility is that adults and children share an automatic egocentric default in perspective taking that adults, over time, become better at correcting when necessary. Adults are less egocentric than children on this account, not because they are less likely to automatically interpret their perceptions egocentrically, but rather because they are better at effortfully correcting that initial interpretation in a subsequent processing stage to accommodate differences between their own perspective and another's perspective. This dual-process account of adult perspective taking suggests that egocentrism isn't outgrown so much as it is overcome each time a person attempts to adopt another's perspective (Nickerson, 1999).

As with other dual-process accounts of human judgment, the automatic default occurs quickly and rapidly whereas the corrective process must be activated by motivation and sustained by attention. As a result, corrections are notoriously incomplete and outcomes consistently biased in the direction of the default or "anchor" (Epley & Gilovich, 2004; Gilbert, 1989; Gilbert & Gill, 2000; Trope & Gaunt, 2000). Egocentric biases are therefore the product of insufficient correction, and the differences in perspective taking between children and adults on this account are a matter of degree, rather than kind.

These two general views of perspective taking make different predictions about the time course of social cognition in children and adults. The theory-driven account suggests that children and adults engage in different mental operations when adopting the perspective of another, with children applying more egocentric theories than adults. The egocentric-correction account, in contrast, suggests that adults and children do not differ in their initial egocentric interpretation, but in the speed and effectiveness with which they overcome that interpretation. Differences in egocentric biases by this correction account are produced by the subsequent ability to correct or modify an egocentric interpretation, not by differences in the initial tendency to make one.

We tested these different predictions by tracking children and adults' eye movements as they completed a perspective taking task. The task was a referential communication game in which participants were directed by an experimental confederate to move objects around an upright array of boxes (see Fig. 1). The participant and confederate—hereafter, the "director"—were seated on opposite sides of the array and the director's (ostensible) task was to instruct the participant to move objects into a new arrangement provided by the experimenter. Some of the objects were occluded from the director's view by a wooden slat but were still observable to the participant, creating a critical difference in their visual perspective. Any egocentric tendency in interpreting the instructions would be evidenced when participants consider objects that are visible only to them—exactly as participants did in previous experiments (Keysar, Barr, Balin, & Brauner, 2000; Keysar, Lin, & Barr, 2003). The inclusion of children in the current experiment moves beyond previous work by directly investigating the etiology of perspective taking differences in children and adults.

On critical trials, the director referred to an ambiguous object from the participant's perspective. Consider the example in Fig. 1. The participant on this trial can see three trucks, but can also see that the director sitting on the other side can only see two. When the director asks the participant to move the small truck, he can only be referring to the truck that is medium sized from the participant's perspective (second row, far left, from the participant's view). But to the extent that participants are even temporarily egocentric, they should automatically consider the hidden, smaller truck as a referent (middle row, far right, from the participant's view).

To evaluate whether participants initially entertained an egocentric interpretation, we recorded the object they moved. More important, we also measured the speed with which their eyes fixated on either the hidden or the intended object. Eye-fixations provide a unobtrusive method for tracking on-line cognition, and is well accepted as a valid indicator of information processing and attention (Rayner, 1998; Tannenhaus, Magnuson, Dahan, & Chambers, 2000; Tannenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1996). Eye movements track linguistic processing while reading (Rayner, 1998), reveal interference between languages among bilinguals (Spivey & Marian, 1999), follow the logical causal sequence in


Fig. 1. Array of objects, including both occluded and mutually observable objects, from the participant's and director's perspective. (The critical instruction from the director on this trial was to "move the small truck above the glue.")

problem-solving tasks and correlate with solution accuracy (Hegarty, 1992; Rozenblit, Spivey, & Wojslawowicz, 2002), and tightly track objects in the environment discussed during the course of conversation (Cooper, 1974; Tannenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995). In addition, guiding visual attention to relevant information during a problem solving task substantially influences reasoning and performance (Grant & Spivey, 2003). Not only do people look at objects about which they are thinking, but they also think about objects at which they are looking. In the current experiments, the speed with which participants fixate their eyes on a target can be interpreted as the speed with which they consider an object as a possible referent (Keysar et al., 2000; Spivey & Tannenhaus, 1998).

Based on previous investigations of perspective taking in both children (Flavell, 1992; Piaget, 1959) and adults (Epley, Keysar, Van Boven, & Gilovich, in press; Keysar et al., 2000), we made three predictions. First, children would make more egocentric reaching errors than adults, replicating much past research demonstrating greater egocentric biases in children than adults. Second, adults and children would *not* differ in the speed with which they initially formed an egocentric interpretation of an instruction (after controlling for baseline differences in looking speed). Third, and most important, adults would be faster to correct this egocentric interpretation and therefore look at the correct object (the mutually observable truck) more quickly. If confirmed, these results would suggest that differences in egocentric biases between children and adults are produced by variance in controlled, rather than automatic, mental processes.

## Method

### *Participants*

Children (13 males and 20 females, mean age = 6.2 years, median age = 5.0 years, range = 4–12 years)[1] and their parents (12 males and 20 females) who were visiting the Children's Museum of Boston participated in exchange for a free pass to the Museum. A larger than usual age range of children was recruited to allow for the possibility of internal analyses within this sample. Four additional children and 5 parents were recruited but did not finish the session, either because they were unwilling to participate ($n = 3$ children), because they were repeatedly distracted ($n = 4$ parents), or because they failed to follow the experimenter's instructions ($n = 1$ child and 1 parent). To retain as much data as possible, all data are analyzed at the level of the individual rather than the pair.[2]

[1] We tried to restrict our recruited sample to those from 4 to 7 years old, and 74% of our sample fell within that range. Of the remaining children, four were 8 years old, one was 9, two were 10, one was 11, and one was 12. Removing these older children somewhat strengthens the results of this experiment, although not meaningfully so. All children are retained for the sake of completeness, and to allow for subsequent analyses across age within the child sample.

[2] Analyzing the data at the level of pair does not diminish the validity of our conclusions in any way. In fact, it increases the significance levels of every relevant test due to the increased power of repeated-measures analyses.

### Apparatus

Participants were instructed by the director to move objects around a $5 \times 5$ upright array of boxes, four of which were occluded from the director's view by a wooden cover but were clearly observable to participants (see Fig. 1). Participants' eye movements were recorded by a Sony DCR-PC9 digital video camera positioned in the center of the second row from the top, focused on the participants' eyes. Both adults and children were propped up on pillows or a small stool, as necessary, to ensure their eyes were level with the camera and centered on the array. This camera was approximately 20 in. from participants' heads and provided 33 ms snapshots of their eye movements. A second video camera located to the participants' left recorded their reaching.

### Procedure

In each session, one parent and (ideally) one child were escorted to a room away from the Museum's main activities and introduced to a male confederate who would be assisting with the experiment as the "director." The experimenter stressed that the director did not know anything about the specific trials to be presented in this session, and was functionally in the same position as the participants themselves.

All participants were told their task was to move objects around a $5 \times 5$ array of boxes as instructed by the director, who would be seated on the opposite side of the array. At the beginning of each trial, objects would be placed in the array and the director given a picture with some of the objects in different positions. The director would instruct participants to move objects from their initial positions in the grid to the final positions in his picture. After learning these details, participants (both the parent and the child simultaneously) performed a practice trial from the director's position to ensure they understood his task and the visual occlusions. The experimenter pointed out the boxes covered by a wooden slat during the practice trial, and that objects behind the slats could not be seen by the director. To make the occlusion especially clear, the director played the role of the participant during this practice trial and committed one egocentric reaching error and was immediately corrected by the experimenter.

Once finished playing the role of the director, the child in each pair was placed in the participants' position. The parent was seated with his or her back to the experimental set-up and asked to wear soundproof earmuffs to ensure that he or she could neither see nor hear their child's session. Children participated first due to the obvious difficulties of isolating them from their parent's session in a similar fashion.

At the beginning of each trial, a black sheet was dropped over the director's side of the array to block his view. The experimenter then placed the objects into the array on the participant's side, raised the sheet, and gave the director a picture of the objects' final positions (from the director's perspective, with hidden boxes occluded). Participants were told to look directly into the camera located in the center of the array before each instruction in order to standardize participants' eye gaze at the beginning of each trial.

Each experimental session consisted of four trials for both the parent and child, and each trial involved four separate instructions to move an object. Within each trial, one critical instruction could refer to only one object from the director's view, but could refer to two objects from the participant's view. For example, the critical instruction in Fig. 1 was "please move the small truck above the glue." The smallest of the 3 trucks in the participant's view was occluded from the director's view, meaning he was actually referring to what appeared to the participants as the medium sized truck. The other three instructions in each trial referred to mutually observable objects.

To increase the generalizability of our results, the four critical instructions contained different forms of ambiguity. Two utilized size ambiguity ("move the small truck" or "move the small candle" could refer to the smaller of two mutually observable objects or the smallest occluded object), one utilized spatial ambiguity ("move the bottom red ring" could refer to one red ring stacked beneath an orange ring or an occluded red ring positioned alone on the bottom row of the display), and one utilized semantic ambiguity ("move the bunny" could refer to either a chocolate "Easter bunny" or an occluded stuffed animal resembling a rabbit). The position of the critical instruction within each trial varied in a predetermined random fashion; it came last (out of 4) in the first trial, third in the second trial, first in the third trial, and second in the last trial.

On each trial, the target and egocentric objects were placed on opposite sides of the camera, making the object of attention and reaching easy to discern. Two raters unaware of our hypotheses coded the eye movements ($r = .77$, $p < .001$) and reaching behavior on the critical trials ($r = .88$, $p < .001$). Because adults and children's behavior can differ in a way that is independent of our manipulation, we used control (filler) trials containing no ambiguous instructions as a baseline measure. Two additional coders coded looking and reaching for trials that were closest to the critical trials, namely either immediately following the critical instruction (on the trial in which the critical instruction was first) or preceding the critical instruction (on the remaining 3 trials;, $r_{(\text{looking})} = .79$, $p < .001$, $r_{(\text{reaching})} = .92$, $p < .001$). The speed with which participants looked at, and reached for, the objects were averaged together between the two coders to create a single composite index, and disagreements on categorical measures were resolved by a 3rd independent rater.

Eye movements and reaches were coded within a temporal window that began at the end of the noun phrase that identified the target (e.g., the small *truck*) and ended when the participant touched an object. A fixation was coded as any eye movement that remained on a target for at least 3 video frames (99 ms).

## Results

We predicted that adults would behave less egocentrically than children—making fewer egocentric reaching errors—but that this difference would emerge only in later stages of information processing. We predicted that adults and children would not differ in their speed to initially interpret an instruction egocentrically, but would differ in their subsequent speed to adjust or correct that interpretation.

### *Reaching*

As expected, children behaved more egocentrically than adults when moving objects around the grid. Although adults committed a sizeable number of egocentric reaching errors, they still committed far fewer reaching errors than children. On the 4 critical instructions in which the director's description could have referred to the hidden object, adults reached for the hidden object less frequently than children ($M$s $= 0.96$ vs. $2.08$, respectively), $t(63) = 4.40$, $p < .001$. Reaching errors among children were also significantly correlated with their age—older children made fewer reaching errors than younger children, $r(31) = -.44$, $p < .05$. These results are consistent with a variety of demonstrations that children behave more egocentrically than adults, and are an important precondition for the following analyses that address differences in the time course of social thought.

### *Looking*

To test our prediction that these differences between children and their parents were produced by a difference in the ability to correct—rather than to make—an egocentric interpretation, we analyzed participants' eye movements across all trials to reveal processing that foreshadows their hand movements. Because these reaction times were positively skewed, all reaction times were logarithmically transformed. All analyses are performed on these transformed variables but untransformed means are presented in the figures to ease interpretation.

Eye movements in filler trials described earlier served as a measure of baseline speed. As can be seen in Fig. 2, adults were generally faster to look at baseline target objects than children, $t(63) = 2.04$, $p < .05$, and older children tended to look more quickly at the target object than younger children, $r(31) = -.35$, $p < .05$. These differences establish an important baseline for our crucial comparisons. If adults are, as predicted, equally quick to form an egocentric interpretation but faster than their children to correct it, then this baseline difference in looking times between adults and children should remain constant on the critical trials in the speed with which participants look at the hidden (i.e., egocentric) object, but the difference in the speed with which children and adults look at the correct (i.e., non-egocentric) object should increase.

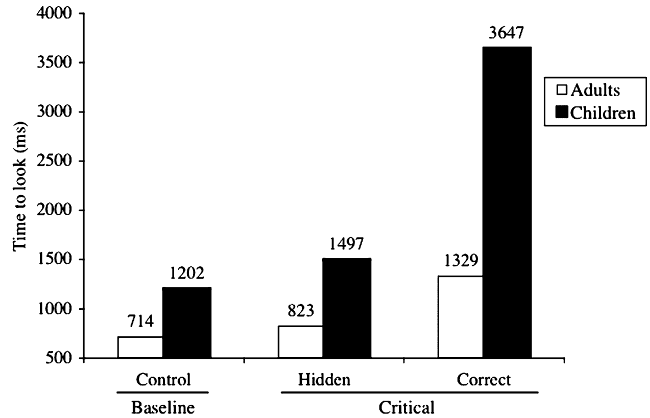


Fig. 2. Mean latency (in milliseconds) from noun offset for children and adults to fixate on the correct and hidden referents.

Of key interest, therefore, was the relative speed with which participants looked at the hidden and correct objects on the critical instructions, controlling for baseline difference in looking times. As shown in Fig. 2, a 2 (Age: adult vs. child) × 2 (Object: hidden vs. correct) mixed model ANCOVA, with looking times on the control trials as a covariate, yielded two main effects. Adults again tended to look at objects more quickly than children, $F(1, 62) = 15.11$, $p < .01$, and participants tended to look at the egocentric hidden object more quickly than the mutually observable correct object, $F(1, 62) = 11.03$, $p < .01$. More important, these main effects were qualified by the predicted interaction, $F(1, 62) = 10.83$, $p < .01$.[3] In fact, after controlling for

[3] Excluding the baseline trials as a covariate and simply performing a 2 (Age: adult vs. child) × 2 (Object: hidden vs. correct) ANOVA with repeated measures on the second factor produces conceptually identical results. Both the main effect for age and object are significant, $F$s$(1, 63) = 20.04$ and $4.38$, respectively, both $p$s $< .05$. More important, these two main effects were qualified by the predicted interaction, $F(1, 63) = 5.28$, $p < .05$. Without correcting for baseline difference in looking times on the critical trials, adults and children differed much less in the speed with which they looked at the hidden object, $t(63) = 1.84$, $p = .07$, than in the speed with which they looked at the mutually observable correct object, $t(63) = 4.70$, $p < .01$.

Table 1
The relationship (for children and adults) between looking at the egocentric hidden object during a critical trial and reaching for the egocentric object

| | Reach | Do not reach |
|---|---|---|
| *Children* | | |
| Look | 51% | 32% |
| Do not look | 1% | 16% |
| *Adults* | | |
| Look | 21% | 61% |
| Do not look | 1% | 17% |

*Note.* Data are the percentage of responses across all critical trials corresponding to each category.

average baseline differences in looking times in the control trials by subtracting them from the average looking times on the critical trials, adults and children did not differ in the speed with which they looked at the egocentric object, $t < 1$, but still differed significantly in the speed with which they looked at the mutually observable object, $t(62) = 4.34$, $p < .001$.

Children and adults also did not differ in their tendency to consider the egocentric object as a potential referent. Nearly all participants looked at the hidden object on at least one of the 4 trials, and children ($M = 83\%$) were no more likely to do so than adults, ($M = 82\%$), $t < 1$. However, Table 1 shows that children were significantly more likely than adults to reach for the egocentric hidden object once they looked at it, ($M$s = 51% and 21%, respectively), $t(63) = 4.91$, $p < .001$. These results demonstrate that adults were no less likely than children to consider the egocentric object as a possible referent, but were much more likely to correct this egocentric consideration and refrain from reaching for the hidden object.

## Discussion

When communicating with others, Piaget argued, it is as if children are "only talking to themselves" (1959, pp. 38). Most adults are better conversationalists because they can recognize that their own perceptions may differ from another's, and can tailor their interactions accordingly. Results from the current study suggest, however, that adults and children may differ less in their egocentric tendencies than it might initially appear. Both adults and children quickly and automatically interpreted the director's instructions egocentrically, and differed only in the speed and effectiveness with which they corrected this interpretation when it was clearly inappropriate. These results suggest that egocentrism isn't outgrown so much as it is overcome each time a person attempts to adopt another's perspective. Far from producing a radical shift in information processing, these results suggest that experience provides adults the ability to talk with others only after recognizing that they are not, in fact, talking to themselves.

The present experiment examined differences in automatic and controlled processes in perspective taking by comparing the time course of information processing between children and adults. The resulting pattern of eye movements is consistent with a dual-process account of adult perspective taking whereby information is initially processed egocentrically and then corrected or adjusted to accommodate differences between one's own perspective and another's perspective. Because people view the world through their own sensory organs, one's own perspective is readily accessible and generated automatically while another's perspective requires additional controlled processing. Adults and children do not appear to differ in the automatic processing of their own perspective but *do* differ in the controlled adjustment required to accommodate another's differing perspective. Egocentric biases diminish but do not disappear because such corrective procedures are not always activated, and when they are, tend to be terminated prematurely.

We report further evidence supporting this dual-process account of adult perspective taking elsewhere in which egocentric biases are increased when participants are under attentional load and thus less able to correct an egocentric interpretation, and decreased when participants are motivated to correct because of financial incentives (Epley et al., in press, see also Gilbert & Gill, 2000). Thus, the egocentric biases are likely to increase whenever the motivation to make an accurate judgment is low, and decrease whenever motivation is high. These findings mimic a variety of other social judgments that have been explained by dual-process accounts including dispositional inference (Gilbert, 2002), comparative ability estimates (Kruger, 1999), preference reversals (Lichtenstein & Slovic, 1971), probability estimates (Plous, 1989; Wright & Anderson, 1989), affective forecasts (Gilbert, Gill, & Wilson, 2002), and retrospection (Fischhoff & Beyth, 1975; Hawkins & Hastie, 1991). Many of the biases commonly associated with these judgments—such as the correspondence bias in dispositional inference—are also increased when the ability to correct is hindered by attentional load (Gilbert, 1989; Gilbert & Gill, 2000; Gilbert et al., 2002) and decreased when the inclination to correct is enhanced by accuracy motivation (D'Agostino & Fincher-Kiefer, 1992). Given the similarities between these apparent dual-process judgments and adult perspective taking, it is possible that a relationship similar to the one we observed between children and adults would be found in these other judgments as well.

More generally, these results raise the interesting possibility that between-group differences in dual-process judgments are more commonly produced by differences in controlled mental processes than by differences in automatic processes. For example, members from collectivistic cultures are less likely than members from individualistic cultures to commit the correspondence bias—to draw inferences about a person's dispositions from behavior that can be explained by situational constraints (Gilbert & Malone, 1995). This cultural difference, however, seems to result from differences in the tendency to correct an automatic dispositional inference rather than in the automatic tendency to make a dispositional inference. Cross-cultural differences in the attribution process occur only when people have the cognitive resources available to engage in situational correction, and disappear when perceivers are under attentional load (Lieberman, Jarcho, & Obayashi, 2004). Similar results have been found with gender differences in sexual versus emotional jealousy—differences that disappear when people are under attentional load, and therefore appear to be the product of differences in controlled mental processes (DeSteno, Bartlett, Braverman, & Salovey, 2002). Whether this pattern of findings represent the rule or the exception in human judgment is a fertile topic for future research.

Although our results clearly suggest that adults are better able to correct an egocentric interpretation, it remains to be seen exactly why this difference exists. One of the hallmarks of effortful cognitive processes is that they become more automatic and less attention-depleting with practice and experience. Even the most effortful of cognitive processes can become more automatic with repeated exposure and experience, and it is likely that a lifetime of correcting an egocentric response to accommodate differing perspectives has made this process more efficient in adults than in children. Once the ability to recognize that others have minds of their own develops around the age of 4 or 5, the ability to apply this knowledge is likely to become more efficient and effortless as a function of practice and experience. Indeed, the older children in our sample were already less likely to commit egocentric reaching errors than our younger children.

Although we expect that children will generally have more difficulty accommodating differing perspectives than adults, it is unlikely that they will have difficulty in all circumstances. In contexts where one's own perspective does not provide an unambiguous interpretation, or when accommodating another's perspective is especially easy, differences between children and adults are unlikely to be observed. In a similar referential task, for example, Nadig and Sedivy (2002) report that children's eye movements start showing some evidence of using perspective information within 560 ms of being instructed to move an object. Although this study did not include a sample of adults, we doubt their eyes would move much faster. The key difference between this study and ours is whether or not one's own perspective provides a clear or ambiguous perception. In our experiment, the hidden (i.e., egocentric) object was generally a better referential fit than the mutually observable object, providing an initial egocentric interpretation that could be corrected or adjusted. In the Nadig and Sedivy experiment, the director's instruction described the hidden and mutually observable object equally well. As a result, an initial egocentric interpretation would not have been successful, and thus there would be no egocentric bias to undo. Difficulties in perspective taking—and corresponding differences between children and adults—are likely to arise when one's own egocentric perception is relatively clear but unique.

In the end, we suggest that the results of our experiment provide an important insight into both the process and development of perspective taking. Although adults appear to be fundamentally less egocentric than children, these commonly observed differences in behavior seem to be produced by differences in the ability to correct an initial egocentric interpretation, rather than differences in the tendency to form one.

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## References

Alicke, M. D. (1993). Egocentric standards of conduct evaluation. *Basic and Applied Social Psychology, 14*, 171–192.

Cooper, R. M. (1974). The control of eye fixation by the meaning of spoken language. A new methodology for the real-time investigation of speech perception, memory, and language processing. *Cognitive Psychology, 6*, 84–107.

D'Agostino, P. R., & Fincher-Kiefer, R. (1992). Need for cognition and the correspondence bias. *Social Cognition, 10*, 151–163.

DeSteno, D., Bartlett, M. Y., Braverman, J., & Salovey, P. (2002). Sex differences in jealousy: Evolutionary mechanism or artifact of measurement? *Journal of Personality and Social Psychology, 83*, 1103–1116.

Deutsch, W., & Pechmann, T. (1982). Social interaction and the development of definite descriptions. *Cognition, 11*, 159–184.

Dunning, D., Meyerowitz, J. A., & Holzberg, A. D. (1989). Ambiguity and self-evaluation: The role of idiosyncratic trait definitions in self-serving assessments of ability. *Journal of Personality and Social Psychology, 57*, 1082–1090.

Elkind, D. (1967). Egocentrism in adolescence. *Child Development, 38*, 1025–1034.

Epley, N., & Gilovich, T. (2004). Are adjustments insufficient? *Personality and Social Psychology Bulletin*.

Epley, N., Keysar, B., Van Boven, L., & Gilovich, T. (in press). Perspective taking as egocentric anchoring and adjustment. *Journal of Personality and Social Psychology.*

Epley, N., Savitsky, K., & Gilovich, T. (2001). Empathy neglect: Reconciling the spotlight effect and correspondence bias. *Journal of Personality and Social Psychology, 83*, 300–312.

Fischhoff, B., & Beyth, R. (1975). "I knew it would happen"—remembered probabilities of once-future things. *Organizational Behavior and Human Performance, 13*, 1–16.

Flavell, J. H. (1986). The development of children's knowledge about the appearance-reality distinction. *American Psychologist, 41*, 418–425.

Flavell, J. H. (1992). Perspectives on perspective taking. In H. Beilin & P. B. Pufall (Eds.), *Piaget's theory: Prospects and possibilities. The Jean Piaget symposium series* (pp. 107–139). Hillsdale, NJ: Erlbaum.

Gilbert, D. T. (1989). Thinking lightly about others: Automatic components of the social inference process. In J. S. Uleman & J. A. Bargh (Eds.), *Unintended thought* (pp. 189–211). New York: Guilford.

Gilbert, D. T. (2002). Inferential correction. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 167–184). Cambridge: Cambridge University Press.

Gilbert, D. T., & Gill, M. J. (2000). The momentary realist. *Psychological Science, 11*, 394–398.

Gilbert, D. T., Gill, M. J., & Wilson, T. D. (2002). The future is now: Temporal correction in affective forecasting. *Organizational Behavior and Human Decision Processes, 88*, 430–444.

Gilbert, D. T., & Malone, P. S. (1995). The correspondence bias. *Psychological Bulletin, 117*, 21–38.

Gilovich, T., Medvec, V. H., & Savitsky, K. (2000). The spotlight effect in social judgment: An egocentric bias in estimates of the salience of one's own actions and appearance. *Journal of Personality and Social Psychology, 78*, 211–222.

Gilovich, T., Savitsky, K., & Medvec, V. H. (1998). The illusion of transparency: Biased assessments of others' ability to read our emotional states. *Journal of Personality and Social Psychology, 75*, 332–346.

Gopnik, A., & Wellman, H. M. (1992). Why the child's theory of mind really is a theory. *Mind and Language, 7*, 145–171.

Grant, E. R., & Spivey, M. J. (2003). Eye movements and problem solving: Guiding attention through thought. *Psychological Science, 14*, 462–466.

Hawkins, S. A., & Hastie, R. (1991). Hindsight: Biased judgments of past events after the outcomes are known. *Psychological Bulletin, 107*, 311–327.

Hegarty, M. (1992). The mechanics of comprehension and comprehension of mechanics. In K. Rayner (Ed.), *Eye movements and visual cognition: Scene perception and reading* (pp. 428–443). New York: Sprinver-Verlag.

Karniol, R. (2003). Egocentrism versus protocentrism: The status of self in social prediction. *Psychological Review, 110*, 564–580.

Kenny, D. A., & DePaulo, B. M. (1993). Do people know how others view them? An empirical and theoretical account. *Psychological Bulletin, 114*, 145–161.

Keysar, B. (1994). The illusory transparency of intention: Linguistic perspective taking in text. *Cognitive Psychology, 23*, 165–208.

Keysar, B., Barr, D. J., Balin, J. A., & Brauner, J. S. (2000). Taking perspective in conversation: The role of mutual knowledge in comprehension. *Psychological Science, 11*, 32–39.

Keysar, B., Lin, S., & Barr, D. J. (2003). Limits on theory of mind use in adults. *Cognition, 89*, 25–41.

Krueger, J., & Clement, R. (1994). The truly false consensus effect: An ineradicable and egocentric bias in social perception. *Journal of Personality and Social Psychology, 65*, 596–610.

Kruger, J. (1999). Lake Wobegon be gone! The "below-average effect" and the egocentric nature of comparative ability judgments. *Journal of Personality and Social Psychology, 77*, 221–232.

Lichtenstein, S., & Slovic, P. (1971). Reversals of preference between bids and choices in gambling decisions. *Journal of Experimental Psychology, 89*, 46–55.

Lieberman, M. D., Jarcho, J. M., & Obayashi, J. (2004). Is culture in our bones? Automatic and controlled attribution processes across cultures. University of California, Los Angeles (Unpublished manuscript).

Nadig, A. S., & Sedivy, J. C. (2002). Evidence of perspective-taking constraints in children's on-line reference resolution. *Psychological Science, 13*(4), 329–336.

Nickerson, R. S. (1999). How we know—and sometimes misjudge—what others know: Imputing one's own knowledge to others. *Psychological Bulletin, 125*, 737–759.

Perner, J. (1991). *Understanding the representational mind*. Cambridge, MA: Bradford Books/MIT Press.

Piaget, J. (1959). *Judgment and reasoning in the child*. Paterson: Littlefield, Adams, & Co.

Plous, S. (1989). Thinking the unthinkable: The effect of anchoring on likelihood estimates of nuclear war. *Journal of Applied Social Psychology, 19*, 67–91.

Pronin, E., Puccio, C., & Ross, L. (2002). Understanding misunderstanding: Social psychological perspectives. In T. Gilovich, D. W. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 636–665). Cambridge: Cambridge University Press.

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin, 124*, 342–372.

Ross, L., Greene, D., & House, P. (1977). The false consensus effect: An egocentric bias in social perception and attribution processes. *Journal of Experimental Social Psychology, 13*, 279–301.

Rozenblit, L., Spivey, M. J., & Wojslawowicz, J. (2002). Mechanical reasoning about gear-and-belt diagrams: Do eye-movements predict performance? In M. Anderson, B. Meyer, & P. Olivier (Eds.), *Diagrammatic representation and reasoning* (pp. 223–240). Berlin: Springer-Verlag.

Savitsky, K., Epley, N., & Gilovich, T. (2001). Is it as bad as we think? Overestimating the impact of our failures, shortcomings, and mishaps. *Journal of Personality and Social Psychology, 81*, 44–56.

Sonnenschein, S., & Whitehurst, G. J. (1984). Developing referential communication: A hierarchy of skills. *Child Development, 55*, 1936–1945.

Spivey, M. J., & Marian, V. (1999). Cross talk between native and second languages: Partial activation of an irrelevant lexicon. *Psychological Science, 10*, 281–284.

Spivey, M. J., & Tannenhaus, M. K. (1998). Syntactic ambiguity resolution in discourse: Modeling the effects of referential context and lexical frequency. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24*, 1521–1543.

Tannenhaus, M. K., Magnuson, J. S., Dahan, D., & Chambers, C. (2000). Eye movements and lexical access in spoken-language comprehension: Evaluating a linking hypothesis between fixations and linguistic processing. *Journal of Psycholinguistic Research, 29*, 557–580.

Tannenhaus, M. K., Spivey-Knowlton, M. J., Eberhard, K. M., & Sedivy, J. C. (1995). Integration of visual and linguistic information in spoken language comprehension. *Science, 268*, 1632–1634.

Tannenhaus, M. K., Spivey-Knowlton, M. J., Eberhard, K. M., & Sedivy, J. C. (1996). Using eye movements to study spoken language comprehension: Evidence for visually mediated incremental interpretation. In T. Inui & J. L. McClelland (Eds.), *Attention and performance XVI: Information integration in perception and communication* (pp. 457–478). Cambridge, MA: MIT Press.

Trope, Y., & Gaunt, R. (2000). Processing alternative explanations of behavior: Correction or integration? *Journal of Personality and Social Psychology, 79*, 344–354.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13*, 103–128.

Wright, W. F., & Anderson, U. (1989). Effects of situation familiarity and incentives on use of the anchoring and adjustment heuristic for probability assessment. *Organizational Behavior and Human Decision Processes, 44*, 68–82.