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The exposure advantage: Early exposure to a multilingual environment promotes effective communication

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Abstract

Early language exposure is essential to developing a formal language system, but may not be sufficient for communicating effectively. To understand a speaker's intention, one must take the speaker's perspective. Multilingual exposure may promote effective communication by enhancing perspective taking. We tested children on a task that required perspective taking to interpret a speaker's intended meaning. Monolingual children failed to interpret the speaker's meaning dramatically more often than bilingual children and children who were exposed to a multilingual environment but were not bilinguals themselves. Children who were merely exposed to a second language performed as well as bilingual children, despite having lower executive function scores. Thus, communicative advantages may be social in origin, and not due to enhanced executive control. For millennia, multilingual exposure has been the norm. Our study shows that such an environment may facilitate the development of perspective-taking tools that are critical for effective communication.

Keywords

bilingualism; social cognition; communication; cognitive development

Throughout human history, exposure to multiple languages has been the norm, not the exception (Hamers & Blanc, 2000; Werker & Beyers-Heinlein, 2008). As illustration, India alone currently has 1,576 languages, with approximately 900 in active use (Office of the Registrar General & Census Commissioner, India, 2011). China has hundreds of dialects, and both Europe and Africa have overlapping linguistic communities. Over half of the world's population is multilingual, and many more are regularly exposed to linguistic diversity (Grosjean, 2010). In short, exposure to multiple languages is, and has been, an integral part of human development for millennia. Exposure to diverse linguistic environments provides experience not only in learning languages, but also in understanding others' perspectives: Children in multilingual environments routinely have the opportunity to track who speaks which language, who understands which content, and who can converse with whom. This raises the intriguing possibility that early multilingual exposure may

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facilitate the development of social-cognitive tools that are important for effective communication.

Though communication is critical to nearly every facet of human social life, communicating effectively is difficult. Effective communication requires complex coordination of mental states, intentions, and common knowledge (Sperber et al., 2010). While speech is often ambiguous, people overestimate their ability to communicate effectively (Keysar & Henley, 2002). Listeners are typically unaware that their own egocentric biases can prevent them from taking the minds of others into account (Apperly et al., 2010; Epley, Morewedge, & Keysar, 2004; Glucksberg & Krauss, 1967; Keysar, Barr, Balin, & Brauner, 2000). Resulting misunderstandings and misinterpretations have noteworthy and deleterious consequences, including exacerbating interpersonal and intergroup conflict (Pronin, Puccio, & Ross, 2002). Therefore, it is crucial to understand the conditions necessary for the development of effective communication and the root causes of miscommunication.

While early exposure to a language is essential to its later mastery (Newport, 1990), communicating effectively takes more than mastering a language. We propose that early exposure to multiple languages could set the stage for the development of effective communication. Exposure to speakers of diverse languages provides children with social experiences that diverge sharply from those of monolingual children. Regardless of their own proficiency, children in multilingual environments have extensive practice in understanding others' linguistic perspective. Language also serves as a robust cue to social group membership (Giles & Billings, 2004; Kinzler, Dupoux, & Spelke, 2007), so monitoring others' language usage may provide children with information about people's perspectives, social relationships and communicative goals.

Because bilinguals mentally represent multiple languages and select or inhibit linguistic systems, bilingualism may confer cognitive benefits, such as the development of executive function (e.g., Bialystok & Martin, 2004; cf. Duñabeitia et al., 2014). Past studies have also revealed evidence of bilingual advantages in tasks that relate to social processes, such as theory of mind (Kovacs, 2009; Rubio-Fernandez & Glucksberg, 2012), and mental rotation that requires spatial perspective taking (Greenberg, Bellana, & Bialystok, 2013). These bilingual advantages have been uniformly attributed to bilinguals' superior executive function. Here, we investigate an idea that is independent of executive function. We evaluate the possibility that early multilingual exposure may confer unique social communicative skills that do not require actually speaking multiple languages.

Our proposal, thus, is about the social consequences of growing up in a multilingual versus monolingual environment, rather than the impact of being bilingual per se. We propose that routine exposure to people who speak different languages provides children with a formative communication environment that is fundamentally different from that experienced by monolingual children. Exposure to diverse socio-linguistic environments could grant children with a profound understanding of differences between people's perspectives, naturally enhancing their communicative abilities. Such diverse language experiences may facilitate early development and expression of effective interpersonal communication. To evaluate this possibility, we compared children from diverse and monolingual language environments in their ability to effectively understand another person's intended meaning in a social communication task.

Method

Participants

Seventy-two four- to six-year-old children (Mean age = 5.42 years; range = 4.03–6.88 years) were recruited for the study. All children were recruited from a Psychology Research database subject pool and live in the greater Chicago area. Participants received a small gift for participating, and parents received a travel reimbursement. Seven additional children participated but were not included in the final sample because of experimenter error (*N*=1), failing to complete the tasks (*N*=3), or failing to follow instructions (*N*=3). Our final sample included 24 children in each of three language groups: Monolinguals (*M* = 5.33 years; range: 4.04–6.88 years), Exposures (*M* = 5.42 years; range: 4.04–6.63 years), and Bilinguals (*M* = 5.42 years; range: 4.03–6.70 years). We chose to include 24 children in each language group as it allowed us to fully counterbalance the design. Children were classified into language groups based on parental report. Parents received a list of possible language categories and were asked to classify their child's language experience (see SOM). Children were included in the Monolingual group if a parent reported that their child heard and spoke only English and had little experience with other languages. Children were included in the Exposure group if a parent reported that their child was primarily an English-speaker, but had some regular but limited exposure to another language. Children were included in the Bilingual group if a parent reported that their child was exposed to two languages on a regular basis and was able to speak and understand both languages.

Participants' parents also provided demographic information about their child and their family. To control for potential co-variation, we collected information on maternal education and family income, which did not differ systematically across language groups. Similar numbers of children in each group had mothers with at least a Bachelor's degree (75% of Monolinguals, 75% of Exposures, and 71% of Bilinguals; $F(2,69) < 1$), and average family income[1] was not different across groups (Monolinguals, $M = 6.6$, Exposures, $M = 6.4$, Bilinguals, $M = 6.2$; $F(2,68) < 1$; see SOM Tables S1 and S2 for additional demographic information).

Procedure

To test our hypothesis, we presented native English-speaking 4- to 6-year-old children with a social communication task that required taking an interlocutor's perspective. Participants sat across the table from a confederate (the "director") who asked them to move objects around a 4 × 4 grid. Four grid squares were occluded, allowing the participant, but not the director, to see their contents. The director wore black matte sunglasses throughout the task and was instructed to maintain her eye gaze towards the center of the grid when giving instructions, in order to avoid unintentionally leading the child towards the target object with her gaze.

[1]Income was reported on a scale. All groups spanned the range of scores (1= < $15,000; 9= >$150,000)

To ensure that participants understood the task and had experience with what the director is able to see, all subjects first completed a practice trial from the director's side of the table. In this trial, an experimenter helped the participant give instructions to move objects and the director followed instructions. On two occasions, the director intentionally committed egocentric errors and moved an object that was occluded from the participant's view. The experimenter then asked the participant if the object the confederate moved was correct, and guided the participant to repeat the instruction. On the second attempt the director moved the correct object. After completing the practice trial, the experimenter asked the confederate and participant to switch locations, and confirmed that the participant understood who could see which objects.

After the practice trial, participants received a total of twelve instructions over four different grid set-ups. Each of the four grids featured one critical test instruction that was ambiguous: the instruction could refer to a mutually visible target object, or to a distracter object that was visible only from the child's egocentric perspective. To succeed, participants had to take the director's perspective and choose the mutually visible target rather than the distracter, which was hidden from the director's view. For example, in Fig. 1, the critical instruction was: "I see a small car. Can you move the small car under the spoon?" Because the director specifically said that she was talking about the car that she could see, the target of the instructions to "move the small car" must be the smallest car that both participant and director could see, and not the distracter, a smaller sized car, which was occluded from the director's view.

On all trials, a coder noted whether the participant moved the requested object. During the task, participants' eye gaze was recorded by a video camera centered on top of the grid that was angled towards participants and was approximately 16 inches from the participants' heads. Another video camera was located behind the participant to record the movement of objects on the grid. A reliability coder used the eye gaze video to determine whether the participant looked right or left immediately after hearing each instruction, and the second video to determine whether the participant selected the final object from the right or the left side. This was later recoded into looks and reaches to either the target or distracter, as target and distracter items were always placed on opposite lateral sides of the grid and were counterbalanced across the grid set ups. The reliability coder was unaware of the lateral location of the target and the distracter, and was uninformed about the language background of the participant.

In addition to the social communication task, we assessed participants on the Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 2007), which measures verbal ability, the Dimensional Change Card Sort (DCCS; Zelazo, 2006), which measures executive function, the non-verbal visual-spatial intelligence component of the Kaufman Brief Intelligence Test (KBIT-2; Kaufman & Kaufman, 2004), which measures fluid intelligence; and a second short task assessing visual perspective taking[2].

[2]Children sat across from the experimenter with a glass frame between them. Children were asked to draw a letter "C" on the glass with a dry-erase marker. Then, they had up to three tries to draw a shape that looked like a "C" to the experimenter. Differences were in the predicted direction, but many participants (n= 17) failed to draw the original letter "C" correctly, so we do not analyze the data.

Results

We first evaluated whether children in the three language groups had a comparable ability to understand language. Vocabulary scores were not significantly different across language groups (PPVT-4: Monolinguals: M = 115.4, Exposures: M = 110.5, Bilinguals: M = 110.5; $F(2,66) < 1$), suggesting that proficiency in English was comparable. In addition, all children were able to follow the director's instructions in the absence of a distracter: Performance on unambiguous trials was high across the board (Mean accuracy: Monolinguals 99.5%; Exposures: 99.0%; Bilinguals: 99.5%).

To evaluate children's ability to take the director's perspective in order to understand her intended meaning, we analyzed the test trials and found a dramatic difference. While the majority of Exposure (63%) and Bilingual (58%) children identified the target on all four trials, only a minority of Monolingual children were able to perform at that level (21%) (χ^2 (2, N = 72) = 10.14, p = .006, φ = 0.38). The average percentage of correct target selection demonstrated that Exposure and Bilingual children regularly took the director's perspective (Mean = 76% & 77%, respectively), while Monolingual children were at chance in selecting between the target and the distracter (Mean = 50%; $F(2,69) = 4.77$, p = .01, η^2 = 0.123). Bilinguals and Exposures were significantly more likely than Monolinguals to choose the target ($t(46) = 2.81$, p = .007, d = 0.83; $t(46) = 2.51$, p = .016, d = 0.74, respectively), while the performance of Bilingual and Exposure children did not differ ($t(46) = 0.072$, p = .94, d = 0.02; See Fig. 2).

To analyze performance on test trials while controlling for potential co-variation, we ran a quasibinomial logistic regression with the following predictors: Language group (Monolingual, Exposure, Bilingual), gender (Male, Female), maternal education (Bachelor's degree, no Bachelor's degree), DCCS score, age (in months), income level, PPVT-4 score and KBIT-2 score. There was a significant overall effect of language group (Likelihood Ratio $\chi^2(2)$=6.64, p = .036; see Table S3 for additional details). The Exposure group and the Bilingual group both significantly outperformed the Monolingual group (Exposure: β = 1.27, t = 2.13, p = .037, 95% CI for odds ratio (1.08–11.69); Bilingual: β = 1.22, t = 2.07, p = .042, 95% CI for odds ratio (1.04–10.97)). Critically, no other factors were significant predictors of performance on the test trials (see Table S3 for additional details). Thus, monolingual children were less able than children who were exposed to another language to interpret the director's intended meaning. This demonstrates that early multilingual exposure enhances the development of effective interpersonal communication abilities.

To further evaluate participants' performance, we considered their patterns of looking as well as their reaching. Although looking towards an object typically precedes reaching for it (Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995), a participant's initial gaze does not necessarily dictate her final reach. Indeed, past research has demonstrated that adults made fewer reaching errors than children in a similar social communication task, but adults and children were equally likely to have egocentric first looks (Epley et al., 2004). Thus, while the ability to correct initial egocentrism improved over development, an initial tendency toward egocentrism remained constant. So, we evaluated whether Bilingual and

Exposure children outperformed Monolingual children in their ability to recover from an initial egocentric first look and to reach correctly.

There are two ways that a final object choice can differ from the initial look towards an object. First, after looking at the distracter, a child could recover from her egocentrism and reach for the target ("recovery"). Alternatively, the child could first look at the target but eventually make a mistake and reach for the distracter ("incorrect switching"). If these possibilities occur at equal rates, this would reflect the contribution of random noise to performance. In contrast, higher rates of recovery compared to incorrect switching would suggest active successful perspective taking. Bilingual and Exposure children rate of recovery was much higher than their rate of incorrect switching (Bilinguals: 57% recovery vs. 9% incorrect switch, χ^2 (1, N = 92) = 25.64, $p < .01$, $\phi = 0.53$; Exposures: 54% recovery vs. 9% incorrect switch, χ^2 (1, N = 92) = 21.86, $p < .01$, $\phi = 0.49$). In contrast, Monolinguals showed similar levels of recovery and incorrect switching (37% recovery vs. 30% incorrect switch, χ^2 (1, N = 85) = 0.42, $p = .52$, $\phi = 0.07$; Fig. 3). Therefore, while Bilingual and Exposure children's looking and reaching pattern suggest actively taking the director's perspective, Monolingual children's looking and reaching pattern shows no evidence of active perspective taking.

Even more impressively, Bilingual and Exposure children were less egocentric from the outset: They had fewer egocentric first looks than Monolingual children (38% and 42% of trials versus 57%, respectively; χ^2 (2, N = 262) = 6.99, $p = .03$, $\phi = 0.16$; Fig. 4). To analyze children's initial looking behavior while controlling for potential covariation, we ran another quasibinomial logistic regression with the same predictors as our first model. There was a significant overall effect of language (Likelihood Ratio $\chi^2(2)=8.53$, $p= .014$; see Table S4 for additional details). The Exposure group and Bilingual group both had significantly fewer egocentric first looks than the Monolingual group (Exposure: $\beta = 0.78$, t = 2.13, p = .038, 95% CI for odds ratio (1.04–4.58); Bilingual: $\beta = 1.03$, t = 2.66, p = .010, 95% CI for odds ratio (1.29–6.02)). No other factors were significant predictors of children's initial looking behavior (see Table S4 for additional details).

These results indicate that Bilingual and Exposure children were spontaneously more attuned to the perspective of the speaker, which is particularly intriguing since initial egocentrism may not decrease throughout the lifespan (Epley et al., 2004). Bilingual and Exposure children's fewer spontaneous egocentric looks may have important consequences for interpersonal communication across development, whereby exposure to diverse language environments could lead to a fundamentally different interpretation of communicative intentions.

Although we proposed that the enhanced communication skills we discovered are due to social experiences, one might question whether our findings are due instead to enhanced executive function. Mentally representing multiple languages and routinely selecting or inhibiting the appropriate linguistic system may increase executive functioning abilities (e.g. Bialystok, Craik, Green, & Gollan, 2009; Bialystok, 1999; Costa, Hernández, Costa-Faidella & Sebastián-Gallés, 2009; but see Antón et al., 2014 and Duñabeitia, et al., 2014). These cognitive benefits may emerge as early as infancy (Brito & Barr, 2012; Kovacs & Mehler,

2009) and persist across the lifespan (Bialystok, Craik, Klient, & Viswanthan, 2004; Rubio-Fernandez & Glucksberg, 2012). Thus, if exposure to another language enhances executive function, differences in executive function could conceivably account for our findings if they allow participants to inhibit their own perspective and attend to the director's perspective.

Our data, however, show that potential cognitive differences cannot account for the differences in children's social communication abilities that we discovered. As described above, the cognitive factors we measured (DCCS and KBIT-2 scores) were not significant predictors of children's performance in the social communication task, and differences in children's performance across language groups held even when controlling for these factors. In addition, we replicated previous findings suggesting that bilingual children may outperform monolingual children on cognitive tasks (DCCS: Bilinguals, $M = 2.3$, Monolinguals, $M = 2.0$, $t(46) = 1.90$, $p = .063$, $d = 0.56$; KBIT-2: Bilinguals, $M = 112.7$, Monolinguals, $M = 103.4$, $t(45) = 2.05$, $p = .046$, $d = 0.61$). But we also observed that Bilingual children outperformed Exposure children on both tasks (DCCS: Exposure $M = 1.9$, $t(46) = 2.48$, $p = .017$, $d = 0.73$; KBIT-2: Exposure $M = 101.2$, $t(45) = 2.05$, $p = .046$, $d = 0.61$), and that the performance of Exposure and Monolingual children did not differ (DCCS: $t(46) = 0.68$, $p = .50$, $d = 0.20$; KBIT-2: $t(44) = 0.54$, $p = .60$, $d = 0.16$). Differences in performance across language groups held when controlling for maternal education, income and gender (DCCS: Wald χ^2=8.53, p=.014; KBIT: Wald χ^2=8.61, p=.014). While Bilingual children demonstrated cognitive advantages over Monolingual children, Exposure children did not. Critically, Exposure children were just as successful as Bilingual children at the social communication task, despite having lower executive function scores. Thus, differences in cognitive abilities cannot explain our findings that both the Bilingual and Exposure children outperformed Monolingual children at social perspective-taking.

Discussion

A purely monolingual environment is not common in human societies. We demonstrated that the more prevalent environment, which exposes children to multilingual experiences, may provide important tools for effective communication. It is possible that the vast human experience with multilingual exposure may have promoted the development of subtle and unique mental tools that facilitate communication.

Our discovery opens up a host of interesting questions. What exactly are the communication tools that a multilingual environment provides, what aspects of a diverse sociolinguistic environment afford communicative success, and what facilitates the acquisition of communicative skills across the lifespan? One possibility is that diverse language exposure at any point in life could aid people in effectively interpreting others' communicative intent. Alternatively, to yield communicative benefits, children might need to be exposed to multiple languages before they become entrenched in an egocentric way of interpreting their social world. Future research testing the malleability of interpersonal communication skills across development will elucidate the scope of the "early exposure" effect. If multilingual exposure indeed benefits effective communication, then miscommunication might be reduced through active exposure of young children to varied linguistic environments.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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References

Apperly IA, Carroll DJ, Samson D, Humphreys GW, Qureshi A, Moffitt G. Why are there limits on theory of mind use? Evidence from adults' ability to follow instructions from an ignorant speaker. The Quarterly Journal of Experimental Psychology. 2010; 63(6):1201–1217.10.1080/17470210903281582 [PubMed: 19838912]

Antón E, Duñabeitia JA, Estévez A, Hernández JA, Castillo A, Fuentes LJ, Davidson DJ, Carreiras M. Is there a bilingual advantage in the ANT task? Evidence from children. Frontiers in Psychology. 2014; 5(398)10.3389/fpsyg.2014.00398

Bialystok E. Cognitive complexity and attentional control in the bilingual mind. Child Development. 1999; 70(3):636–644.10.1111/1467-8624.00046

Bialystok E, Martin MM. Attention and inhibition in bilingual children: Evidence from the dimensional change card sort task. Developmental Science. 2004; 7(3):325–339.10.1111/j.1467-7687.2004.00351.x [PubMed: 15595373]

Bialystok E, Craik FIM, Green DW, Gollan TH. Bilingual Minds. Psychological Science in the Public Interest. 2009; 10(3):89–129.10.1177/1529100610387084 [PubMed: 26168404]

Bialystok E, Craik FIM, Klein R, Viswanathan M. Bilingualism, Aging, and Cognitive Control: Evidence From the Simon Task. Psychology and Aging. 2004; 19(2):290–303.10.1037/0882-7974.19.2.290 [PubMed: 15222822]

Brito N, Barr R. Influence of bilingualism on memory generalization during infancy. Developmental Science. 2012; 15(6):812–816.10.1111/j.1467-7687.2012.1184.x [PubMed: 23106735]

Costa A, Hernández M, Costa-Faidella J, Sebastián-Gallés N. On the bilingual advantage in conflict processing: now you see it, now you don't. Cognition. 2009; 113:135–49. [PubMed: 19729156]

Dunn, LM.; Dunn, LM. Peabody picture vocabulary test. 4. Circle Pines, MN: American Guidance Service; 2007 p.

Duñabeitia JA, Hernández JA, Antón E, Macizo P, Estévez A, Fuentes LJ, Carreiras M. The inhibitory advantage in bilingual children revisited: Myth or reality? Experimental psychology. 2014; 61(3):234.10.1027/1618-3169/a000243 [PubMed: 24217139]

Epley N, Morewedge CK, Keysar B. Perspective taking in children and adults: Equivalent egocentrism but differential correction. Journal of Experimental Social Psychology. 2004; 40(6):760–768.10.1016/j.jesp.2004.02.002

Giles, H.; Billings, A. Language attitudes. In: Davies, A.; Elder, E., editors. The handbook of applied linguistics. Oxford, UK: Blackwell; 2004. p. 187-209.

Glucksberg S, Krauss RM. What do people say after they have learned how to talk? Studies of the development of referential communication. Merrill-Palmer Quarterly of Behavior and Development. 1967; 13(4):309–316.

Greenberg A, Bellana B, Bialystok E. Perspective-taking ability in bilingual children: Extending advantages in executive control to spatial reasoning. Cognitive Development. 2013; 28(1):41–50.10.1016/j.cogdev.2012.10.002 [PubMed: 23486486]

Grosjean, F. Bilingual: Life and Reality. Cambridge, MA: Harvard University Press; 2010.

Hamers, JF.; Blanc, MHA. Bilinguality and Bilingualism. Cambridge University Press; 2000.

Kaufman, AS.; Kaufman, NL. Kaufman Brief Intelligence Test. 2. Circle Pines, MN: AGS Publishing; 2004.

Keysar B, Henly AS. Speakers' overestimation of their effectiveness. Psychological Science. 2002; 13(3):207–212.10.1111/1467-9280.00439 [PubMed: 12009039]

Keysar B, Barr DJ, Balin JA, Brauner JS. Taking Perspective in Conversation: The Role of Mutual Knowledge in Comprehension. Psychological Science. 2000; 11(1):32–38.10.1111/1467-9280.00211 [PubMed: 11228840]

Kinzler KD, Dupoux E, Spelke ES. The Native Language of Social Cognition. Proceedings of the National Academy of Sciences of the United States of America. 2007; 104(30):12577–12580.10.1073/pnas.0705345104 [PubMed: 17640881]

Kovács ÁM. Early bilingualism enhances mechanisms of false-belief reasoning. Developmental Science. 2009; 12(1):48–54.10.1111/j.1467-7687.2008.00742.x [PubMed: 19120412]

Kovács ÁM, Mehler J. Cognitive Gains in 7-Month-Old Bilingual Infants. Proceedings of the National Academy of Sciences of the United States of America. 2009; 106(16):6556–6560.10.1073/pnas.0811323106 [PubMed: 19365071]

Newport EL. Maturational constraints on language learning. Cognitive Science. 1990; 14(1):11–28.10.1207/s15516709cog1401_2

Office of the Registrar General & Census Commissioner, India. Ministry of Home Affairs. 2011. www.censusindia.gov.in

Pronin, E.; Puccio, C.; Ross, L. Understanding misunderstanding: Social psychological perspectives. In: Gilovich, T.; Griffin, D.; Kahneman, D., editors. Heuristics and biases: The psychology of intuitive judgment. New York: Cambridge University Press; 2002. p. 636-665.

Rubio-Fernández P, Glucksberg S. Reasoning about other people's beliefs: Bilinguals have an advantage. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2012; 38(1): 211–217.10.1037/a0025162

Sperber D, Clément F, Heintz C, Mascaro O, Mercier H, Origgi G, Wilson D. Epistemic vigilance. Mind & Language. 2010; 25(4):359–393.10.1111/j.1468-0017.2010.01394.x

Tanenhaus MK, Spivey-Knowlton MJ, Eberhard KM, Sedivy JC. Integration of visual and linguistic information in spoken language comprehension (June, pg 1632, 1995). Science. 2005; 307(5711): 851–851.10.1126/science.7777863 [PubMed: 15705828]

Werker JF, Byers-Heinlein K. Bilingualism in infancy: first steps in perception and comprehension. Trends in Cognitive Sciences. 2008; 12(4):144–151.10.1016/j.tics.2008.01.008 [PubMed: 18343711]

Zelazo PD. The Dimensional Change Card Sort (DCCS): a method of assessing executive function in children. Nature Protocols. 2006; 1(1):297–301.10.1038/nprot.2006.46 [PubMed: 17406248]

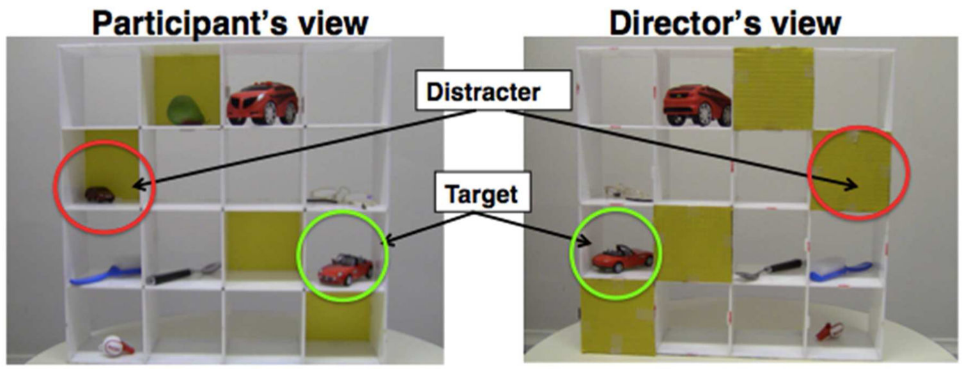

Figure 1.
Social communication task from the participant's view and the director's view.

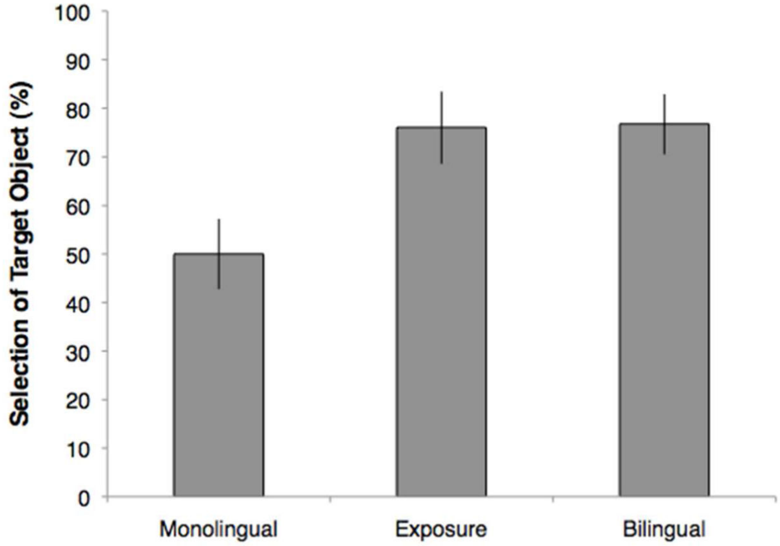

Figure 2.
Percentage of trials on which participants correctly identified the target. Error bars indicate SEM.

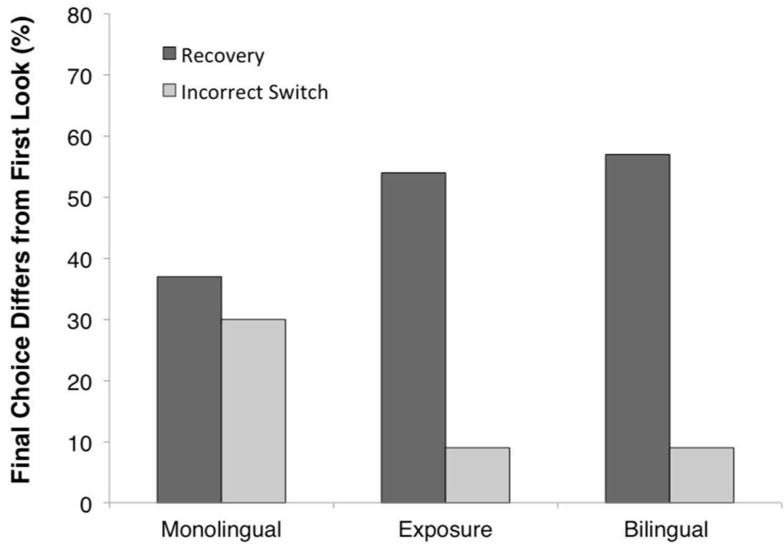

Figure 3.
Percentage of trials on which participants first looked at one object then moved the other object. Recovery represents looking at the distracter then moving the target. Incorrect Switch represents looking at the target then moving the distracter. More recovery than incorrect switch trials suggest active successful perspective taking.

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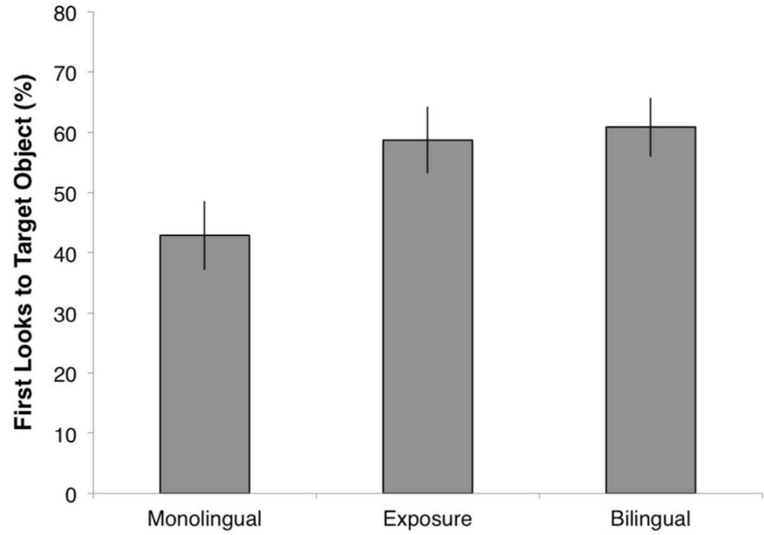

Figure 4.
Percentage of trials on which participants looked first at the target. Error bars indicate SEM.