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# Exploring the Differences Between Bilinguals and Monolinguals in Non-Communicative Spatial Perspective-Taking Tasks

## Shira Yellin - Case Western Reserve University

### BIOGRAPHY

Shira Yellin is a fourth year student at Case Western Reserve University. She is in a dual degree program, and will earn both a Bachelor of Arts degree in Cognitive Science and a Master of Arts degree in Bioethics. She is involved in CWRU Emergency Medical Services, and hopes to have a career as an emergency medicine physician.

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## Introduction

While there is much evidence to demonstrate that bilinguals have an advantage in certain types of cognitive tasks, social scientists have long been debating how far this advantage extends. This study seeks to determine if a bilingual advantage is present in spatial perspective-taking tasks that do not involve communication. Perspective-taking is part of a broader category of cognition known as theory of mind (ToM) (Baron-Cohen, Tager-Flusberg, & Cohen, 2000). ToM includes the mental tasks of keeping someone else's beliefs in mind, and the spatial tasks of taking someone's perspective based on their physical location. Bilinguals have been shown to outperform monolinguals in both mental and spatial ToM tasks. Tversky and Hard (2009) showed that individuals will sometimes take another person's perspective, even if they are not directly communicating with another person. Their original study did not take into account the participants' language status (i.e. monolingual or bilingual). This study seeks to extend the work of Tversky and Hard to determine if bilinguals are more likely than monolinguals to forgo their own perspective.

## Literature Review

### Theory of Mind

ToM refers to the ability to understand that different people have different mental states. Mental states include thoughts, beliefs, ideas, and knowledge (Pylyshyn, 1978). One hallmark of ToM is the ability to distinguish one's own mental state from another's (Keysar, Lin, & Barr, 2003). Wimmer and Perner (1983) tested the development of this ability in children using the story of Maxi and his chocolate. Researchers used a paper cut-out of a child to represent Maxi. In this story, Maxi placed a bar of chocolate into a cupboard labeled X. When Maxi left the room, represented by the cut-out being removed from view, the children were told that his mother had moved the

chocolate from cupboard X to a different cupboard, Y. This was shown with the researcher moving the chocolate from one box to another on a wall that had been set up for the experiment. Participants were then asked where Maxi would look for the chocolate when he returned. Individuals who possess ToM will understand that even though they know the chocolate is in cupboard Y, Maxi still believes that it is in cupboard X so he will look there for the chocolate. In other words, individuals with ToM are able to consider Maxi's false beliefs and understand that he has different knowledge than they do. Participants without a developed ToM will say that Maxi will look in cupboard Y, since they know that this is where the chocolate is, and cannot understand that Maxi has a different set of knowledge than what they know to be reality. A meta-analysis of studies conducted on ToM acquisition confirms that it develops around the age of four (Wellman, Cross, & Watson,

*"...even though adults have ToM, they do not automatically use it."*

2001). Once children develop ToM, they are able to use this ability throughout their lives. However, even though adults have ToM, they do not automatically use it. This means that they still make mistakes when attempting to adopt another person's perspective (Keysar et al., 2003). In a 2003 study, Keysar et al. used a box array setup in which some squares in the array were occluded from the director, the individual running the experiment, and other squares were visible to both the director and the participant. In this case, the participant believed the director was also participating in the study. An example of such a setup can be seen in Figure 1. One of the occluded slots contained a roll of tape in a paper bag. The participant knew the contents of the bag and that the director did not know the contents of the bag. During the experiment, the director gave a critical instruction to "move the tape,"

referring to a cassette tape that both the director and participant could see. However, 71% of participants attempted to move the paper bag by grabbing or reaching for it in at least one of the four critical trials.

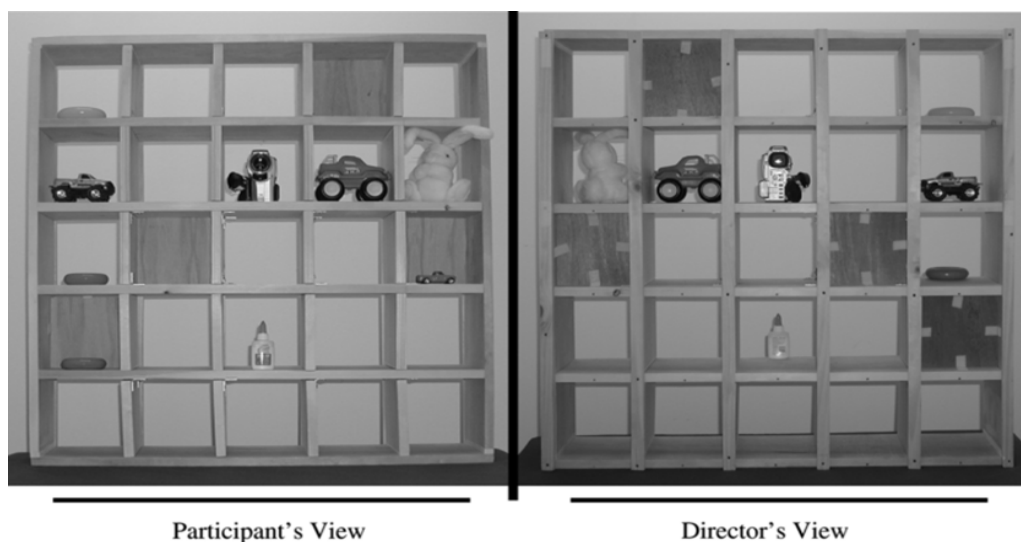
Epley, Morewedge, and Keysar (2004) furthered this line of research by using a similar procedure to directly compare adults and children. They found that both adults and children had the same initial egocentric tendency to look at objects that only they could see. This is because, even as adults, individuals still use their own knowledge as a guide to understanding the knowledge of others (Keysar, 1994). However, the adults were able to more quickly correct their initial egocentric observation and look toward the mutually observable object. These results further bolster the idea of egocentric primacy, and support the claim that adults overcome egocentrism each time they take another person's perspective, rather than becoming less egocentric overall (Shelton & McNamara, 1997; Nickerson, 1999).

ToM is an important ability for adults to have as it allows them to understand another person's behavior. Additionally, having ToM allows individuals to act cooperatively and altruistically because they understand the needs of others (Moore & Frye, 1991). Failure to em-

ploy ToM causes different interpretations of situations, leading to miscommunication and conflict (Pronin, Puccio, & Ross, 2002). Due to the importance of ToM in social interactions, it is necessary to gain a better understanding of what causes someone to use their ToM. Schober (1995) found that when someone is asked where an object is, their answer often favors the perspective of the person who asked. These scenarios involve direct communication between two people.

*"...both adults and children had the same initial egocentric tendency to look at objects that only they could see."*

Tversky and Hard (2009), on the other hand, wanted to study the likelihood that an individual would take another's perspective, even if they were not communicating with that person. They showed participants one of three photos of a table with a bottle and a book (Figure 2). In one photo, there was a person reaching for a book. In the second photo, there was a person looking at the book. In the third photo, there was no person. Participants saw the photo as part of a set of unrelated questionnaires. All participants, re-



**Figure 1.** An example of a box array setup where some objects seen by the participant cannot be seen by the director (Epley, Morewedge, & Keysar, 2004).

ardless of condition, were asked the same question: “In relation to the bottle, where is the book”? The researchers found that when shown one of the first two photographs, participants were significantly more likely to take the person’s perspective, compared to the photo that had no person. However, there was no significant difference in perspective-taking between the two scenes with a person in them. Our study builds upon Tversky and Hard’s findings, adding a condition for bilingual individuals, as there is much research to support that bilinguals have an advantage when faced with ToM tasks.

### Bilingual advantage

Much research has been done to show that bilinguals have advantages on a number of different ToM tasks. Bilinguals are believed to have an advantage in both spatial and mental tasks. One type of task in which bilinguals outperform their monolingual counterparts is appearance-reality tasks, wherein an object is purposely made to look like something else as with the sponge-rock task. In this task, children saw a sponge painted to look like a rock. Most children believed it to be a rock until they felt it and noticed that it was a sponge. The experimenter then asked them what another observer who had not touched the object would think it is (Bialystok & Senman, 2004). In a similar experiment, bilinguals were more likely than monolinguals to correctly answer the experimenter’s question (Goetz, 2003). Additionally, bilinguals have been found to

perform better in unexpected transfer tasks as in the aforementioned story of Maxi and his chocolate (Kovacs, 2009). Bilinguals also have an advantage in global reaction times on conflict resolution tasks (Donnelly, Brooks, & Homer, 2015). Most relevant to our study, researchers have shown a bilingual advantage in perspective-taking tasks (Greenberg, Bellana, & Bialystok, 2013). In this study, children were shown an array of four blocks of different colors. An owl, acting as an observer, then appeared at one of three positions, 90°, 180°, or 270° from the child’s view of the blocks. Children were asked to choose, from four points of view provided by the researchers, how the owl saw the blocks (Figure 3). The results showed that bilinguals outperformed monolinguals in determining the correct answer for all three positions.

In addition to research on the evidence of a bilingual advantage, there are also studies which seek to determine the cognitive basis for the advantage. The three most robust lines of research focus on metalinguistic awareness, inhibitory control (i.e., the ability to ignore distracting information), and sociolinguistic competence. Metalinguistic awareness, or the awareness of properties of language, is increased in children who are bilingual (Cummins, 1978). This confers many advantages to bilinguals such as the ability to make syntactic judgments and a greater sensitivity to feedback in communication tasks (Galambos & Goldin-Meadow, 1990; Ben-Zeev, 1997). Additionally, bilinguals are more aware

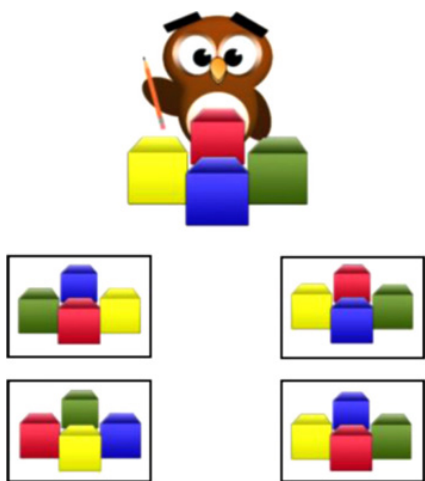


**Figure 2.** The three photos that Tversky and Hard used in their experiment for the three different conditions: reaching (a), looking (b), and no person (c) (Tversky & Hard, 2009).

of the arbitrary nature of the connection between words and referents (Ianco-Worrall, 1972). The utility of this line of research lies in investigating the connection between the bilingual advantage, metalinguistics and metarepresentation.

ToM tasks are related to metarepresentation, which is the idea that the same object can be represented in different ways by the same person or different people (Doherty 2000; Flavell, Green, & Flavell, 1986). Bilinguals are accustomed to the idea of metarepresentation through their metalinguistic awareness. Being able to express the same thought in different ways shows children that there are different ways of representing language (Vygotsky, 1962). Because bilingual children are aware of the idea of dual representation in language, they are theoretically more suited to outperforming monolinguals in ToM tasks, which require the knowledge that one thing can be perceived in different ways (Goetz, 2003).

By virtue of speaking more than one language, bilinguals develop greater inhibitory control, which aids in their performance on ToM tasks. Inhibitory control involves focusing on relevant information and ignoring competing or distracting information (Bialystok, 2006).



**Figure 3.** Children have to choose which picture correctly shows what the blocks would look like from the owl's point of view (Greenberg et al., 2013).

*“Being able to express the same thought in different ways shows children that there are different ways of representing language.”*

There are two levels of inhibitory control in which bilinguals engage: the higher level involves selecting one language and inhibiting the other, and the lower level involves activating lexical forms for the selected language and inhibiting the competing forms in the non-selected language (Green, 1998). Bilinguals have many opportunities to practice these skills, and if this practice helps bilinguals with their general ability to focus on necessary information, then it would stand to reason that bilinguals would have an advantage in inhibitory control over monolinguals (Paap & Greenberg, 2013). In fact, bilinguals have been shown to have greater control over their selective attention (Bialystok, 1999). Inhibitory control is related to performance on false-belief tasks in which bilinguals have an advantage (Carlson & Moses, 2001). Bialystok and Codd (1997) further explain that inhibitory control is most useful in situations where there are salient distractions, conflicting representations, or ambiguity. These factors are generally present in ToM tasks, suggesting that bilinguals with greater inhibitory control would outperform monolinguals, who have not developed these skills to the same extent.

One final line of research suggests that the bilingual advantage arises from an individual's sociolinguistic competence because bilingual children need to be aware that their partner may not speak all of the languages that they do (Genesee, Boivin, & Nicoladis, 1996). Even children as young as one and two years old make language choices depending on the language their interlocutor speaks, and bilingual children rarely make mistakes in selecting what language to use in a particular situation (Lanza, 1992; De Houwer, 1990). Further, bi-

lingual children have been found to use their mother's native language when speaking to their mother and their father's native language when speaking to their father. This occurs even if both parents are in the room and conversing with the child (Genesee, Nicoladis, & Paradis, 1995). These situations show that bilingual children understand that different people have different perceptions. This benefits bilinguals in ToM tasks because they are more aware than monolinguals that people can have different mental states (Goetz, 2003).

In addition to the different theories on the origin of bilingual advantage, there is also debate as to whether or not a person's spoken language and cultural origin affects their ToM development. Some researchers believe that ToM development is universal and that it develops similarly across cultures (Leslie, Friedman, & German, 2004; Sabbagh, Xu, Carlson, Moses, & Lee, 2006; Tardif & Wellman, 2000; Vinden, 1999; Callaghan et al., 2005; Liu, Wellman, & Tardif, 2008). With these two different theories come many studies to support each side. One study showed that Chinese subjects performed better than American subjects in perspective-taking tasks as they were less likely to fixate on privileged objects (Wu & Keysar, 2007). Researchers hypothesized this result was due to Chinese collectivist culture, in which individuals put the needs of their in-group, such as their family or community, above that of their own (Wu & Keysar 2007; Hofstede, 1983). It has also been shown that Chinese and Western participants have equivalent egocentric interference, but Chinese participants were able to quickly and ef-

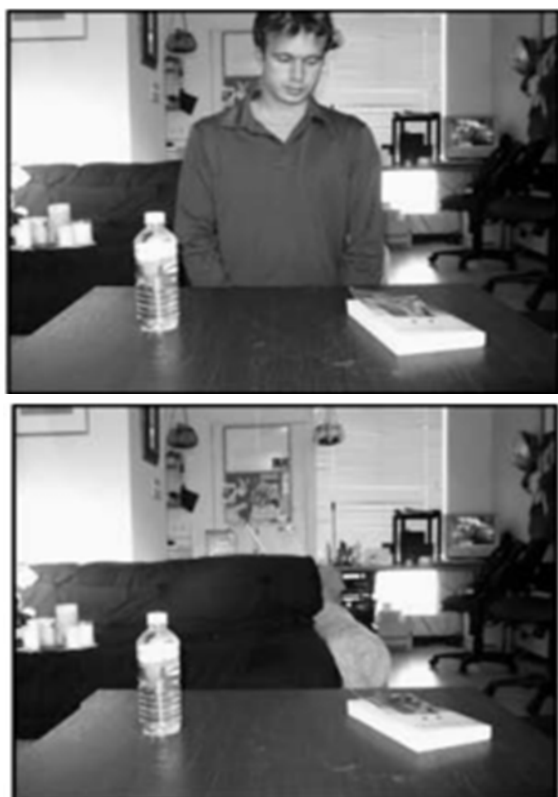
*“Even children as young as one and two years old make language choices depending on the language their interlocutor speaks...”*

fectively suppress this interference (Wu, Barr, Gann, & Keysar, 2013). One study took a group of English-Mandarin bilinguals and primed them with either Chinese, Western, or neutral photographs of nature (e.g., a photo of Superman for Western priming). They found that within the primed group of individuals, those who experienced Western priming made more errors in following a director's instructions to move objects in a boxed array in which some boxes were only visible to the participant (Luk, Xiao, & Cheung, 2012).

*“...even if being a monolingual from a collectivist culture conferred an advantage ... the idea of a bilingual advantage would still hold.”*

Supporting the opposing theory, Mainwaring, Tversky, Ohgishi, and Schiano (2003) found that Japanese and American participants were similar in their perspective-taking. They used the addressee's perspective if the addressee had the higher cognitive burden and tried to use landmarks or cardinal directions if available. Goetz (2003) compared English monolinguals, Mandarin monolinguals, and English-Mandarin bilinguals on ToM tasks to ensure that neither monolingual group had the same advantage as bilinguals. She found that both monolingual groups had the same performance on the tasks and that both were outperformed by the bilingual group. Currently, both theories have robust empirical support, and no consensus has been reached on whether ToM development is constant across cultures.

Based on the current literature, there are still unanswered questions regarding the scope of the bilingual advantage. Research on culture as a confounding variable shows one area in which there is still ambiguity. More explicit-



**Figure 4.** (a) Scene used in the “person” surveys. (b) Scene used in the “no person” surveys. (Tversky & Hard, 2009)

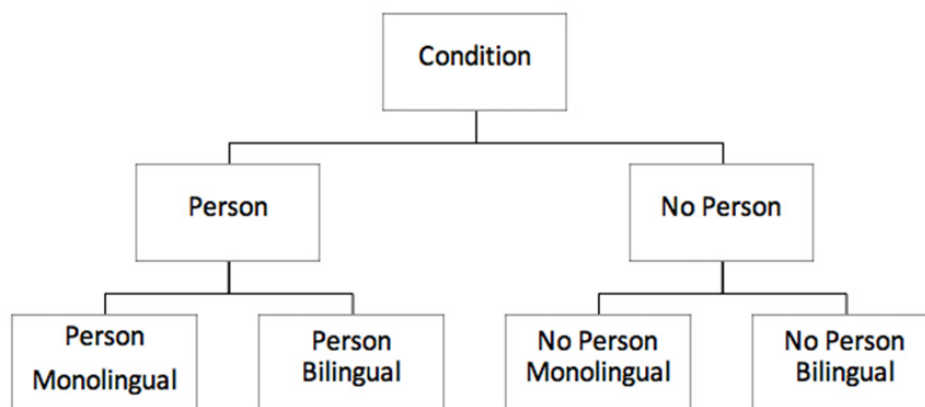
ly, all of these studies focus on bilinguals who speak English and an East-Asian language. This means that researchers have only been focusing on bilinguals with strong connections to a collectivist culture; even if being a monolingual from a collectivist culture conferred an advantage over monolinguals from

individualistic cultures, the idea of a bilingual advantage would still hold from these results. There are many bilinguals who speak languages that are not tied to a specific culture, such as Spanish, or languages that are tied to individualistic cultures. For this reason, studies on the bilingual advantage can still be conducted despite the unanswered question of the role of culture. Other areas that require further study include the effects of bilingualism on mental versus spatial tasks and on communicative versus non-communicative tasks. While this experiment will not be able to fully explore all of these areas, it will explore an area that has not yet been studied in depth, the effect of bilingualism on non-communicative spatial perspective-taking tasks in bilinguals from a non-collectivist culture. This study seeks to discover if bilinguals from a non-collectivist culture are more likely than monolinguals to adopt the other’s perspective even when not communicating with the other person, and not explicitly asked to take their perspective into account.

## Methods

### Surveys

Participants completed one of four surveys. For all surveys, participants were shown an image (Figure 4) and asked the question, “In relation to the book, where is the bottle”? Two



**Figure 5.** Diagram showing the four different surveys utilized in the study.



of the surveys had photographs that showed an individual sitting at the table with the book and bottle, facing the participant (Figure 4(a)). The other two surveys showed the same table and room but without another person (Figure 4(b)). Within each set of two surveys, one other survey created with questions specific to monolinguals and the other with questions specific to bilinguals. Therefore, the four surveys were classified as follows: person monolingual, person bilingual, no person monolingual, and no person bilingual (Figure 5).

In the surveys for monolingual individuals, participants were asked questions about other languages they may speak to confirm their monolingualism. In the surveys for bilingual participants, bilingualism was confirmed by having the participants translate from Spanish to English and respond to a question asking if they have been speaking both English and Spanish since early childhood.

## Participants

A total of 691 responses to the four surveys were recorded via Amazon's Mechanical Turk (MTurk). MTurk was used to collect data as internet surveys in general have been shown to be consistent with data collected from traditional methods (Gosling, Vazire, Srivastava, & John, 2004). Additionally, MTurk specifically is useful for obtaining high-quality data both quickly and inexpensively (Buhrmester, Kwang, & Gosling, 2011).

The bilingual-specific survey was conducted on individuals who are bilingual in English and Spanish. Spanish was chosen because it is one of the most convenient languages to target for translation in MTurk as there are many Spanish-speaking workers who provide quick and accurate translations (Pavlick, Post, Irvine, Kachaev, & Callison-Burch, 2014). Another reason Spanish was chosen is due to its lack of association to one specific culture. Spanish is spoken in many countries with various cultures, which mitigates any potential

cultural bias. Had the study been conducted with bilinguals whose language is spoken mainly in one country, such as China, it would have been unclear whether the bilingual advantage was influenced by collectivist Chinese culture as some studies have suggested (Wu & Keysar, 2007).

## Exclusion criteria

Responses were excluded if survey responses satisfied any of the enumerated criteria.

- Monolingual exclusion criteria were met when
  - a)subject spoke another language “moderately” or “very fluently”;
  - b)subject learned a second language in childhood;
  - c)subject stated they lacked fluency in a second language but responded from a nation where that language is used.
- Bilingual exclusion criteria were met when
  - a)subject failed to provide correct, complete English-to-Spanish translations of assigned sentences. Clear, English explicative translations were accepted;
  - b)subject has not been speaking fluently English and Spanish since the age of four;
  - c)subject became fluent in either language outside of upbringing (e.g., classes, YouTube);
  - d. subject has used language other than English or Spanish since childhood.
- General exclusion criteria were only met when
  - a)subject provided blank or incomplete answers;
  - b)subject provided nonsense responses.

After excluding data, there were a total of 59 respondents to the no person monolingual survey, 53 respondents to the person monolingual survey, 17 respondents to the no person bilingual survey, and 17 respondents to

the person bilingual survey.

## Results

Participant responses were scored as either self, other, or neutral depending on whether they gave their answer from their own point of view, the other person's point of view, or did not use left/right terminology. In situations where participants gave two points of view, their answer was scored based on the first point of view with which they responded. Examples of answers scored as self included, "The book is to the right of the bottle" and "about two book lengths to the right of the book." Examples scored as other included, "The book is on the table to the left of the bottle" and "To the person's left." Examples of answers scored as neutral include, "The book is nearby to the water bottle on the desk" and "On the table, about eighteen inches away from the bottle." Five participants were excluded for giving answers that could not be coded into any of the three categories such as, "On the guy's right hand side." This participant seems to be taking the other perspective, but the book would actually be on the left hand side of the man in the photograph.

The responses were then translated into three binary variables. The first variable was coded as a one if the response was the self perspective and a zero if it was not. The second variable was coded as a one if the response took the other perspective and zero if it did not. The third variable was coded as one if it was neutral and zero if it was not. The coding

system used for this study is identical to the one used by Tversky & Hard (2009). However, our study also coded the neutral responses as a binary variable to be analyzed, which the 2009 study did not do.

Three separate two-factor analyses of variance (ANOVAs) were conducted to compare the main effect of the independent variables, language status and condition, and the interaction between them on the dependent variable of perspective taken by the participant. Language status was either bilingual or monolingual and condition was either a survey with a person or a survey with no person. One ANOVA was run for each of the three perspectives: self, other, and neutral. The numbers of each group, means, and standard deviations can be found in Table 1.

For the self perspective, a main effect for language status was found, with monolinguals taking the self perspective significantly more than bilinguals  $F(1, 142) = 5.31, p < 0.05$ . No main effect for condition,  $F(1, 142) = 2.13, p = 0.15$  was found. There was also no significant interaction between the two variables Language Status\*Condition  $F(1, 142) = 2.13, p = 0.15$ . For the other perspective, there were no significant main effects for Language Status,  $F(1, 142) = 0.48, p = 0.49$ , or Condition,  $F(1, 142) = 2.51, p = 0.12$ . Additionally, there was no interaction effect for Language Status\*Condition,  $F(1, 142) = 0.003, p = 0.95$ . For the neutral perspective, there was a main effect of Language status,  $F(1, 142) = 4.00, p < 0.05$ . However, there was no main effect of

**Table 1.** Number of participants in each group, means, and standard deviations.

Language Status	Condition	Sample Size	Self Mean (SD)	Other Mean (SD)	Neutral Mean (SD)
<b>Bilingual</b>	No Person	17	0.41 (0.51)	0.18 (0.39)	0.41 (0.51)
	Person	17	0.41 (0.51)	0.29 (0.47)	0.29 (0.47)
<b>Monolingual</b>	No Person	59	0.76 (0.43)	0.12 (0.33)	0.12 (0.33)
	Person	53	0.49 (0.51)	0.25 (0.43)	0.26 (0.45)

Condition,  $F(1, 142) = 0.03$ ,  $p = 0.86$ , and no an interaction effect for Language Status\*Condition,  $F(1, 142) = 2.66$ ,  $p = 0.11$ . In addition to the three ANOVAs, an analysis that considers only Condition, and not Language Status, was run. These results are trending toward significant,  $F(1, 144) = 3.75$ ,  $p = 0.055$ .

## Discussion

The results of this study indicate that regardless of condition (person or no person), bilinguals are significantly less likely than monolinguals to use the self perspective, and significantly more likely to use the neutral perspective. Interestingly, the same results as Tversky and Hard (2009) were not observed in these ANOVAs. Tversky and Hard (2009) found that when shown a picture with a person, participants were more likely to take the other perspective as compared to when shown the picture without a person. Our results showed no statistical significance for condition in any of the three perspectives. However, by looking only at the effect of condition, a near significant effect was observed, even with a low observed power (0.49).

While this study did produce statistically significant results for Language Status for two perspectives, there are improvements that can be made to increase the statistical power. Due to both the unequal sample sizes between monolinguals and bilinguals and the small sample sizes of the bilingual groups, the observed power for the analyses was very low. For example, in the main effect that was found for language status in the self condition, the observed power was 0.63. For the non-significant effect of language status in the other condition, the observed power was 0.11. Future studies could mitigate this problem by restricting IP addresses to places that do not speak a language other than English or Spanish as their national language. For example, many responses were recorded from individuals in India, who would be expected to speak a language other than English and Spanish,

even if they also spoke both these languages. Restricting participants in the survey may result in more usable answers and therefore a higher number of participants. Additionally, future researchers could include more questions to verify a participant's language status. This could vary from having more translation questions to asking where they were born or what languages their parents speak.

The significant results that were found in this study add to the already robust repertoire of tasks to which bilinguals respond differently than monolinguals. The study was designed to see if the bilingual advantage found in spatial perspective-taking tasks extends to non-communicative tasks. We tested this hypothesis by seeing if bilinguals were more likely than monolinguals to take an observer's perspective, even when not asked or member of a non-collective culture. The original advantage was that bilinguals could more accurately convey an observer's perspective (Greenberg et al., 2013). The results provided evidence that the bilingual advantage in perspective-taking extends to tasks that do not involve direct communication. This is important because it upholds previous research done on bilinguals, thus helping to solidify the idea of the bilingual advantage. None of the previous studies focused on bilinguals' performance in non-communicative spatial tasks; this study opens up the possibility for further research into this area.

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