Title
Real-time Perspective Taking: When Your Decision is Influenced Through Visual Competition

Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 36(36)

ISSN
1069-7977

Authors
Greenwood, Michelle
Spivey, Michael

Publication Date
2014

Peer reviewed

Real-time Perspective Taking: When Your Decision is Influenced Through Visual Competition

Michelle D. Greenwood (mgreenwood@ucmerced.edu)
Cognitive and Information Sciences, 5200 North Lake Road
Merced, CA 95348 USA

Michael J. Spivey (spivey@ucmerced.edu)
Cognitive and Information Sciences, 5200 North Lake Road
Merced, CA 95348 USA

Abstract

People often tacitly assume an egocentric perspective when describing spatial scenes, and then use ambiguous descriptions (e.g., "The bottle is on the left."). However, they can also take an alternative perspective, for instance referencing an agent that is present in the scene to reduce ambiguity (e.g., "The bottle is on your right."). In this experiment, participants viewed a computer screen that contained a photograph of a basket on a table. Participants were given ambiguous spatial relationship directions for placing the objects (trials) in the scene (e.g., "Place the X to the right of the basket."). The goal was to determine, through mousetracking, how often people choose an other-centric perspective, and if they chose an egocentric perspective did they consider other viewpoints. Results showed that the visual input (conditions) influenced the initiation times and maximum deviation of an egocentric response when a person was present in the scene compared to when a person was absent.

Keywords: perspective taking; viewpoint; affordances; other-centric

Introduction

In everyday conversation, spatial descriptions are ubiquitous. People often have to explain where they are in physical space, including their position relative to other people or objects. Sometimes these descriptions are ambiguous. For example, imagine that Bob and Julie are sitting on opposite ends of a table, and two coffee cups are placed on the table. Bob says to Julie, "The cup on the right is mine." Which cup is Bob referring to? The cup on Bob's right, or the cup on Julie's right? The answer depends on perspective.

People often take an egocentric perspective when describing a spatial scene (Piaget & Inhelder, 1956; Pick & Lockman, 1981; Shelton & McNamara, 1997). However, they can also choose another perspective by adopting the viewpoint of another person or object (e.g., "The dent is on the car's front left fender", "A mosquito is on your right shoulder"). Object anchoring is one way people take an other-centric perspective. They use a particular object or person to describe the location of another object or person (e.g., "Mary is on John's right") (Schober, 1993; see also Borghi, Glenberg, & Kaschak, 2004). They can also vary intonation patterns or use gesture (Clark, 1996). In recent years, many researchers have argued that the egocentric perspective is the default mechanism in conversation (Hanna, & Tanenhaus 2004; Horton & Keysar, 1996; Keysar, Barr, Balin & Brauner, 2000; Tversky, Lee & Mainwaring, 1999; Nadig & Sedivy, 2002). Critically, however, there are circumstances that give rise to an other-centric perspective (Tversky & Hard, 2009).

A considerable amount of psycholinguistic literature has treated the egocentric perspective in language processing as a default mode that is enforced by the cognitive architecture of the language processing system (Epley, Keysar, Van Boven, & Gilovich, 2004; Horton & Keysar, 1996; Keysar et al., 2000). In that account, factors that might encourage an accommodation of another's perspective come into play during a second stage of processing after an initial egocentric anchoring point has been assumed. An alternative approach has been to treat egocentric biases and "other" centric biases as competing against one another simultaneously and on equal footing (Hanna & Tanenhaus, 2004; Hanna, Tanenhaus, & Trueswell, 2003; Nadig & Sedivy, 2002).

Much research shows a preference for egocentric perspective in viewing scenes, but little is known about how or why this occurs. Tversky and Hard (2009) began to explore these questions in a novel study using photographs. Participants viewed pictures of objects (water bottle or book) and explained where the objects were in relation to one another. If a person also appeared in the picture (facing the participant), participants occasionally accommodated that person's perspective and chose it over their own. Tversky and Hard also manipulated the question to highlight action in the scene, which yielded interesting differences, such as increased other-centric perspective taking. Their findings provide an excellent foundation for exploring the role of viewpoint in spatial descriptions.

Choosing another's perspective when describing a spatial scene seems like a natural way to help achieve mutual understanding when another person is present. But to what extent does this generalize? Previous work (Greenwood, Matlock, Matthews, & Spivey, 2010, 2011, & 2013) suggests participants sometimes take a perspective other than their own when there are affordances present in the visual scene that allow them to take advantage of the affordances to produce that other centric response. This arises from nothing more than a *hint* of volitional agency. In one study, participants take the other perspective of a toy robot that does not actually afford the task but participants still assume the perspective of the toy robot because the language and visual input still hint at the toy robot being the volitional agent (Greenwood, Matlock, Matthews, & Spivey, 2011). Another experiment using the same paradigm showed participants taking the other perspective more often when the visual scene included an empty chair across the table from the participant. Once again, participants produce other centric responses because of a hint of volitional agency when no agent exists (Greenwood, Matlock, Matthews, & Spivey, 2011). They also showed that in social settings, such as committee participation, individuals took the perspective of a stranger in the scene more often than they do their friends'. They suggest that participants take the stranger's perspective in an effort to find common ground amongst the committee members. They also manipulated verb agency and found that a greater number of other centric responses are elicited when action in the scene is highlighted (Greenwood, Matlock, Matthews, & Spivey, 2010, 2011, & 2013).

The other studies participants were given a free response task and used off line measures where participants typically chose one perspective as their response. The following experiment used online measures and allowed participants to decide between one of two possible perspectives. In this experiment we used MouseTracker (Freeman & Ambady, 2010; Freeman, Dale, & Farmer, 2011) in an effort to determine the spatial attraction in real-time of the possible choices. Using the mouse-tracking method, constraining the possible perspectives available in the spatial scene to two, and by varying the visual input participants would see we devised the following experiment. From previous work (Tversky & Hard, 2009) we knew that when a person was present individuals are more likely to take the perspective of that person. In this online version we wanted to determine through the trajectories of their responses, the differences in reaction times and maximum deviation if we could replicate that finding but also find pointers to attraction toward the other response even if they ultimately choose the egocentric response. We predicted that when there was a person present in the scene, people would more often take the perspective of that person. In addition, we predicted that when participants were in the "person present" condition their maximum deviation would be greater for those taking their own perspective due to the visual competition of the person in the scene there would be attraction toward the "other" perspective. In terms of initiation latency we hypothesized that participants would be slower to initiate their reaction time if they were in the "person absent" condition and choosing their own perspective because of the ambiguous nature of the instructions and the competition of another perspective would inhibit their decision-making process. We also predicted that their overall reaction time would be slower in the "person absent" condition and choosing the other perspective. We predicted this because when an individual chooses the other perspective and there is no person that they are placing the object in front of (but beside the basket) it might take longer to decide where placement of the object should be located. Although this was not something that could be measured in the offline versions this was something we considered when designing this online version.

Experiment

Using MouseTracker (Freeman & Ambady, 2009), we examined how participants would respond to an online task of moving objects on a screen when directions were spatially ambiguous. We tracked participants' computer mouse movements while making decisions to get a graded measure of thought output over time. We were interested in both participants' final responses, but also attraction toward alternative responses as well.

Method

Participants were given instructions to place objects, using a computer mouse, on either the right or the left side of a basket displayed on a computer screen (we also used inside the basket as filler trials). Participants were never told which side should be right or left. Although the task never changed during the experiment and neither did the condition participants could assume an egocentric perspective on trial one and assume an "other" centric perspective on trial two. The potential to switch perspectives from trial to trial existed. Assuming participants took an egocentric perspective, when asked to place objects to the right of the basket, right would be located on the right side of the computer screen. If participants took an "other" perspective, placing an object to the right of the basket would mean that the object was placed on the left side of the computer screen. Trials always began with the mouse curser in the same location at the bottom of the screen in a small box that was labeled "start." When the individual would left click on the start location the trial began and the mouse pointer would turn into the object they were being instructed to place in or by the basket on the screen. The trial would end once they released the left mouse button and dropped the object to their desired location. Then, the next trial would begin and they would repeat this sequence until they placed all the trial objects on the right, left or inside the basket.

Participants

Fifty-seven individuals (37 females, 1 declined to answer) between the ages of 18-32 from the University of California, Merced participated in this experiment. They were given course credit for their participation.

Materials

An Apple iMac (Apple, Inc., 1997-2014) running Microsoft Windows 7 (Microsoft Corporation, 2001-2014) and MouseTracker (Freeman & Ambady, 2010) software was used in this experiment. Photographs of the objects and the backgrounds used for the experiment were taken with a Sony (Sony Corporation, 1946-2014) digital camera. The female voice used for each of the trials was recorded using Praat (Boersma & Weenink, 2014).

Procedure

Participants were brought into the lab to perform the task individually. After consenting to participate research assistants explained the task and sat them at the computer station. Instructions on how to proceed were displayed on the computer. Participants were given several practice trials and then continued on to experimental trials. The first screen was written directions for the participant explaining how to partake in the trial but as they proceeded to the trials the instructions were given verbally through a female-recorded voice. The female voice was in an effort to counterbalance the male photo that participants would view in Condition 2 as shown in Figure 2. Critically, we did not want participants to believe the instructions were coming from the person in the photo. Participants were instructed to "place the object [listed in Table 1] to [the right], [the left] or [inside] the basket." There were twenty different objects (see Table 1) and each object was presented three different times, once for right, once for left and once for inside. Each object, and the direction that the object was to be placed, were randomized for each participant. Each participant was also randomly placed in one of two conditions: Condition 1 contained a table, on which a basket was placed; Condition 2 was similar to condition 1 except it included a person sitting behind the table facing the participant.

Figure 1: Condition 1 background.

Figure 2: Condition 2 background.

Table 1: Each object is an individual trial, repeated for "left," "right," and "inside," and randomized for each participant.

Objects (alphabetically)	Objects (continued)
Apple	Matches
Berries	Mug
Bowl	Nuts
Candle	Orange
Candy	Pizza
Chips	Pliers
Clip	Roll
Cup	Salt
Gum	Scissors
Keys	Tape

Results

The data were coded using MouseTracker Analyzer (Freeman & Ambady, 2009). Technically, there were no right or wrong answers in this task, due to the ambiguous nature of the questions. However, we coded the responses such that individuals would take an egocentric perspective. From the 57 participants we collected 2280 critical trials (right or left) and discarded 63 total trials due to the incompletion of the trial. We hypothesized that those individuals in Condition 2 would be more likely to take an "other" perspective more often than those in Condition 1. We hypothesized that initiation latency would be slower for egocentric perspectives in the "person absent" condition. We also hypothesized that reaction times would be faster for egocentric perspectives in the "person absent" condition. Our last prediction was that maximum deviation would also show a pattern of attraction toward the other perspective when another person was present even when they chose the egocentric perspective. We ran an item analysis to rule out the possibility that a particular object could potentially drive a specific perspective. This was not the case; all items were used in both perspectives and were used on average about 14% of the time. This result is consistent with the overall finding that individuals chose the other perspective about 10% of the time when there was a person in the scene compared to 2% when there was no person in the scene, Welch's *t*-test, $t(395.22) = 14.9$, $p < .001$. The 95% confidence interval for the effect of perspective on condition is between 1.5 and 1.2 percent. We also analyzed initiation latency, reaction times and maximum deviation to examine our hypotheses. However, we began with replicating former findings, when individuals saw Condition 2, as shown in Figure 2, participants took the other perspective more often than they did in Condition 1, as reported in this regression, $b = 1.53$, $t(2215) = 139.93$, $p < .001$. Perspective also explained a significant proportion of variance in the condition the participant was randomly assigned, $R^2 = .49$, $F = (1, 2215) = 137.9$, $p = .001$. When individuals saw another person facing them in the scene, as shown in Figure 2, regardless of which perspective they chose, initiation times were about the same, (egocentric: $M = 1470.30$, $SD = 1273.72$; other centric: $M = 1527.30$, $SD = 1205.65$). However, when there was no person facing them as shown in Figure 1, people were much slower to initiate an egocentric response but much faster to initiate an other person response ($M = 2018.16$, $SD = 1184.28$; $M = 1255.43$, $SD = 1348.32$). This was confirmed significant by Welch's *t*-test, $t(41.33) = 3.3$, $p < .001$, as shown in Figure 3.

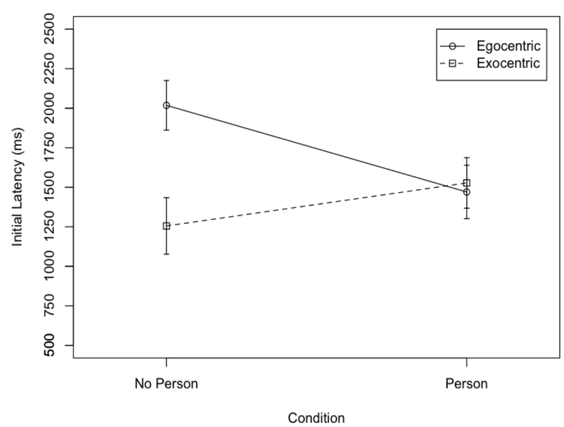

Figure 3: Initial Latency by Condition for Egocentric vs. Exocentric responses.

For overall reaction time, in the Condition 1 as shown in Figure 1, participants were slower when choosing the other perspective compared to when they chose their own perspective ($M = 4165.18$, $SD = 685.93$; $M = 3775.36$, $SD = 812.23$). Again, this was confirmed significant by Welch's *t*-test, $t(43.29) = -3.5$, $p < .001$. The 95% confidence interval for the effect of perspective on reaction time is between -614.3 and -165.3 percent.

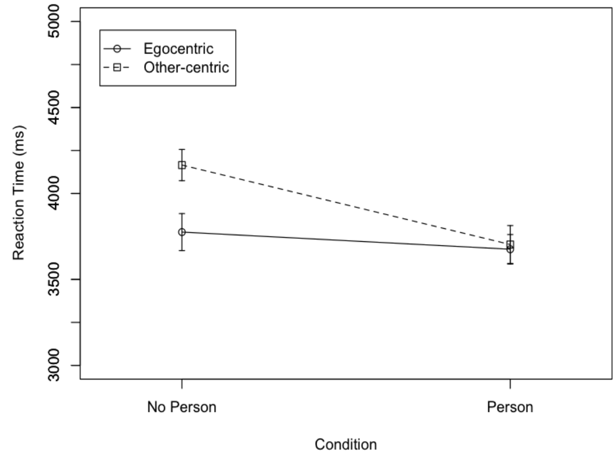

Figure 4: Reaction time by Condition for Egocentric vs. Exocentric responses.

The maximum deviation had an interesting pattern; there is more curvature toward the egocentric response in Condition 2 ("person present") than there is for the "other" perspective even though as reported earlier more people are taking that perspective than in the "person absent" condition. However, that pattern is reversed in Condition 1 as reported in this regression, $b = .085$, $t(2214) = 8.86$, $p < .001$. Maximum deviation also explained a significant proportion of variance in the perspective the participant chose, $R^2 = .14$, $F = (2, 2214) = 9.4$, $p = .001$.

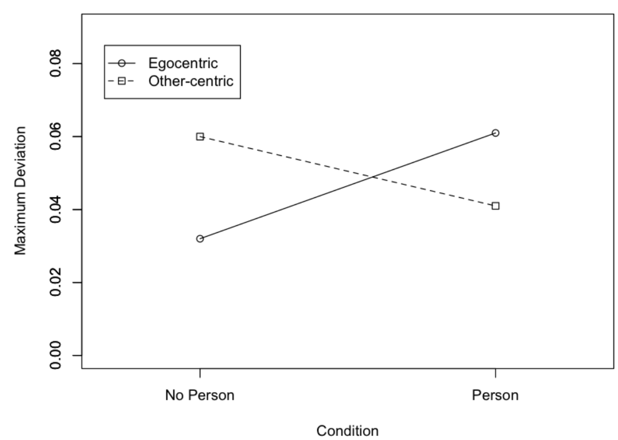

Figure 5: Maximum Deviation by Condition for Egocentric vs. Exocentric responses.

Discussion

Using computer mouse trajectories we compared initiation latency, reaction times, and maximum deviation trajectories of the competing biases in two unique conditions (other person present/other person absent). In this experiment the language processing necessary to complete the task is exactly the same but we find that with a slightly different visual input we get a significantly different result. The findings showed the distinctly different initiation latency, overall reaction time, and maximum deviation patterns that emerged. The initiation latency pattern for individuals in the condition where the visual scene contained a person was about the same regardless of the perspective participant's took and in this condition we see an increase in participants taking the "other" perspective. Yet in the "person absent" condition we see less people taking the other perspective; individuals are much slower to initiate the egocentric response and much faster to initiate the other perspective. Overall reaction times are also faster for the other centric response in Condition 2 when a person is facing them. For maximum deviation we also see an interesting pattern for egocentric and other centric responses. In Condition 1 the maximum deviation is less for the other perspective than it is for the egocentric response. However, in the Condition 2 we see that pattern reversed and participants' maximum deviation for the egocentric response is greater than the other centric response. These results seem to suggest that even when participants are taking the egocentric perspective they are also considering taking the other perspective. This finding also seems to dispute the default account of processing that involves a second stage of accommodation. It seems to support the competing biases account where two perspectives are on equal footing. This experiment gives us a glimpse into the time course of perspective competition as it unfolds over time.

Acknowledgments

Thanks to all the research assistants that helped with taking photographs, MouseTracker experiment coding, and interacting with participants: Norma Cardona, Cynthia Carlson, James Greenwood, Caleb Henke, Vandana Koppula, Courtney Griffin-Oliver, Elaine Lai, David Sparks, and Monica Yanez. There was an extra amount of work done by the following research assistants: Yaasha Ephraim, Jesse Falke, Morgan Fleming, Fatima Panes, and Zachary Tosi. Special thanks to Dr. Eric Chiu for his tireless help with statistical analysis. Also special thanks to Janelle Szary for all her beautiful work of voice recordings on over sixty object references.

References

Apple Incorporated. (1997-2014). iMac (21.5 inch) [Computer hardware]. Cupertino, CA: Apple, Inc.

Apple Incorporated. (2006-2014). Boot Camp (4.0) Boot Camp is a multi boot utility included with Apple Inc.'s OS X that assists users in installing Microsoft Windows operating systems on Intel-based Macintosh computers. [Computer utility] Cupertino, CA: Apple, Inc.

Boersma, P. & Weenink, D. (2014) Praat: doing phonetics by computer [Computer program]. Version 5.3.51, retrieved 2 June 2014 from http://www.praat.org/.

Borghi, A. M., Glenberg, A. M., & Kaschak, M. P. (2004). Putting words in perspective. *Memory & Cognition, 32(6),* 863-873.

Clark, H. H. (1996). Using language. Cambridge; UK: Cambridge University Press.

Epley, N., Keysar, B., Van Boven, L., & Gilovich, T. (2004). Perspective taking as egocentric anchoring and adjustment. *Journal of Personality and Social Psychology, 87(3),* 327.

Freeman, J. B., Dale, R., & Farmer, T.A. (2011). Hand in motion reveals mind in motion. *Frontiers in Psychology*, 2, 59.

Freeman, J. B., Ambady, N. (2010). MouseTracker: Software for studying real-time mental processing using a computer mouse-tracking method. *Behavior Research Methods*, 42, 226-241.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Greenwood, M. G., Matthews, J. L., Spivey, M. J., Matlock, T. (2013). Taking someone else's perspective: When body "position" is more important than body "presence". *The 35th Annual Meeting of the Cognitive Science Society*. Berlin, Germany.

Greenwood, M. D., Matlock, T., Spivey, M. J., & Matthews, J. L. (2011). Looking at the social dynamics of viewpoint. *The 33rd Annual Conference of Cognitive Science Society*. Boston, MA.

Greenwood, M. D., Matlock, T., Spivey, M. J., & Matthews, J. L. (2010). Am I a robot? How verb agency and agent depiction influence perspective in visual scenes. *The 32nd Annual Conference of Cognitive Science Society*. Portland, OR.

Hanna, J. E., & Tanenhaus, M. K. (2004). Pragmatic effects on reference resolution in a collaborative task: evidence from eye movements. *Cognitive Science, 28(1),* 105-115.

Hanna, J. E., Tanenhaus, M. K., & Trueswell, J. C. (2003). The effects of common ground and perspective on domains of referential interpretation. *Journal of Memory and Language, 49(1),* 43-61.

Horton, W. S., & Keysar, B. (1996). When do speakers take into account common ground? *Cognition, 59(1),* 91-117.

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(1),* 32 -38.

Microsoft Corporation. (2001-2014). Microsoft Windows 7 (7.0) Windows 7 is an operating system produced by Microsoft for use on personal computers, including home and business desktops, laptops, netbooks, tablet PCs, and media center PCs. Redmond, WA: Microsoft.

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

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

Pick, H. L. J., & Lockman, J. J. (1981). From frames of reference to spatial representations. In L. S. Liben, A. H. Patterson, & N. Newcombe (Eds.), *Spatial representation and behavior across the life span : theory and application*, Developmental psychology series. New York: Academic Press.

Schober, M.F. (1993). Spatial perspective-taking in conversation. *Cognition, 47*, 1-24.

Shelton, A.L., & McNamara, T.P. (1997). Multiple views of spatial memory, *Psychonomic Bulletin & Review, 4*, 102-106.

Sony Corporation. (1946-2014). Sony Electronics [digital camera]. San Diego, CA: Sony Electronics.

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

Tversky, B., Lee, P., & Mainwaring, S. (1999). Why do speakers mix perspectives? *Spatial Cognition and Computation, 1*, 399-412.