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Social Models Influence Visual Perspective Taking in Memory

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VISUAL PERSPECTIVE TAKING IN MEMORY

Abstract

The ability to take others' perspectives is crucial for social functioning, giving insight into the viewpoints of those around us. Under certain circumstances, we take others' perspectives spontaneously, referring to an event from another's perspective in the absence of explicit prompting. Here, we explored whether this also happens after a delay, with implications for memory. In Experiment 1, we closely replicated a finding that participants are more likely to take an altercentric ("other") perspective with a person present but an egocentric ("self") perspective with no person present. In Experiment 2, we extended these findings to examine what happens with a delay. Here, we provided novel evidence that the mere presence of a person in a still picture can alter memory for the spatial layout of a scene. These results suggest that people spontaneously influence both in-the-moment perceptions and memory for events, with implications for theory and applied settings.

Keywords: perspective taking, social cognition, spatial cognition, memory

VISUAL PERSPECTIVE TAKING IN MEMORY

Social Models Influence Perspective Taking in Memory

1. Introduction

The ability to take the perspective of others is vital for normative human interactions, allowing us to understand the thoughts, desires, and attention of our social partners. In adults, visual perspective taking can at times occur without explicit prompts to take another's perspective. For example, when adults view a person (vs. no person) in a static picture event, they are more likely to describe the event from an altercentric (other-oriented) perspective even when not prompted or told to do so (Furlanetto et al., 2013; Quesque et al., 2018; Tversky & Hard, 2009; see also Tosi et al., 2020). Given the relative ease with which this perspective-taking seems to occur, some have suggested that it is “automatic” or “spontaneous”, often using the words interchangeably (O’Grady et al., 2020). This effect can even be extended to objects if they have a human-like form (Shelton et al., 2012), are presented with agentive cues such as eyes (Clements-Stephen & Shelton, 2013), or display intentional movement (Zwikel, 2009), suggesting that animacy, and not just attentional cueing, is an important factor in spontaneous perspective taking (though see Chen et al, 2011).

The connection between agency and altercentric perspective taking has been underscored by the fact that social abilities appear to underlie the ease with which someone takes the visual perspective of another. For example, individuals who score higher on various social abilities, such as theory of mind, also tend to spontaneously take the perspective of agents with greater accuracy than those with lower social abilities (Clements-Stephens et al., 2013). This link between social skills and spontaneous perspective taking is stronger when taking the perspective of other humans as opposed to inanimate agents (i.e., robots; Xiao et al., 2020). In fact, a lack of spontaneous visual perspective taking has been linked to autism or autistic traits (e.g., Conson et

VISUAL PERSPECTIVE TAKING IN MEMORY

al., 2015; Shelton et al., 2012), suggesting that the fields of spatial cognition and social cognition are actually more related than previously anticipated.

Although research has repeatedly measured the propensity to engage in perspective taking in ongoing social scenarios (i.e., in-the-moment), far less work has explored these propensities in memory. Relatedly, however, some relevant work has shown that memory for events can be altered by working in collaboration with another individual. For example, contexts that facilitate taking into account a collaborator's perspective during joint tasks (whether that be visual perspective or mental representation) lead to better memory for the content of a collaborator's task during recall (Elekes & Sebanz, 2020; Eskenazi et al., 2013; Wagner et al., 2017). Other research has shown that including a set of objects that include faces (e.g., toy animals) can influence how participants remember the layout of objects in a room (Marchette & Shelton, 2010). Both of these bodies of work suggest that, like in-the-moment perspective taking, the social features and social interactions of an agent in a scene can alter memory. However, no work to date has directly explored how the mere presence or absence of a person in an event influences spontaneous visual perspective-taking in memory, and much of the prior work (e.g., Marchette & Shelton, 2010) has asked participants to explicitly encode and remember spatial orientations.

Though there is not much work in adults exploring the connection between social context and memory, there is some evidence in the developmental literature that the presence or absence of agents in events can significantly alter recall of a sequence. For example, children's memory for events that include a person is better than their memory for events that depict the same information without a person present (Howard & Woodward, 2019; Howard et al., 2020). This effect is not dependent on attentional differences during encoding and is seen via spontaneous

VISUAL PERSPECTIVE TAKING IN MEMORY

(predictive looking), effortful (reconstruction) behaviors, and in implicit neural signatures (Howard et al., 2020; Monroy et al., 2017). Similarly, both adults and young children remember a sequence of events more robustly if the protagonist in the sequence is an “animate” (i.e., a common animal or a novel agent with an animate description) as opposed to an inanimate object (i.e., a block or rock; Loucks et al., 2020).

What is the mechanism behind this social memory or animacy bias across the lifespan? One possibility is that the presence of an agent primes individuals to spontaneously take their perspective. This perspective taking might lead to richer, more multi-modal encoding, engaging the sensorimotor system in a unique manner relative to events without agents present (Monroy et al., 2019; Saxe et al., 2006). Since prior work has shown that such “embodied” encoding is likely to lead to better recall (e.g., Steffens et al., 2015), perspective taking could explain improved memory for person-present events.

Prior research on simulated action and memory suggests that an embodied theory may account for both spontaneous perspective taking and differences in event memory across agent (or social) and non-agent (nonsocial) conditions. In adults, simply viewing a static image of an actor beginning an action can result in false memories of having seen the actor complete the action, suggesting a mental simulation of an agentive still picture that unfolds over time (Iani et al., 2018). Viewing another person performing an action can also induce false memories of self-performance after a delay, suggesting an overlap between motor encoding for self and other events (Lindner et al., 2010, 2016). Work in developmental populations suggests similar effects, finding that children often mistakenly misremember having performed actions actually carried out by a social collaborator (Gerson & Meyer, 2020; Sommerville & Hammond, 2007). Importantly, when children make these errors of perspective, they have better memory for how to

VISUAL PERSPECTIVE TAKING IN MEMORY

perform the action that the collaborator completed (Sommerville & Hammond, 2007). This suggests that children may be “putting themselves in the shoes” of the other person and perspective taking in a way that blurs the lines between their own actions and the collaborator’s, resulting in better event memory.

In the current series of experiments, we move beyond asking whether memory is better or worse in a social context, to explore whether the presence or absence of a person in an event alters *how* a scene is remembered. Specifically, we explore whether the presence of a person in a still picture event changes participants’ visual perspective over a short period of time. While it may seem obvious that scene descriptions “in the moment” (e.g., Tversky & Hard, 2009) would also appear in memory, research suggests that is not always the case. Spontaneous perspective-taking during recall might occur similarly to in-the-moment descriptions, become more prevalent over time, or significantly decrease over time, and this effect might be directly influenced by the presence or absence of a person during encoding. For example, work examining episodic memory in virtual environments has found that memory for a scene generally decreases over time, unless there is a virtual avatar (person) in the scene, in which case memory increases after a delay (Bréchet et al., 2019). Thus, the results from the current series of studies could have implications for our understanding of contexts that influence learning and may open doors for future research regarding deficits in both perspective taking and social learning found in certain populations (eg., Shelton et al., 2012).

In Experiment 1, we ran a close replication of a study that had previously found that adults spontaneously take the perspective of an individual in a still photograph (Tversky & Hard, 2009) in order to test modified stimuli and an online format of the task. This study asks whether the presence or absence of a person alters in-the-moment reference frame descriptions

VISUAL PERSPECTIVE TAKING IN MEMORY

(altercentric vs. egocentric). Experiment 2 uses the same picture stimuli to explore whether the presence of a person alters the frame description after a delay. That is, it asks whether visual perspective memory is altered by the mere addition or subtraction of an agent in the scene, with implications for learning and memory in social contexts. All study protocols were approved by Cardiff University's Ethics Committee and were found to follow sound ethical procedures for research involving human subjects (approval number EC.19.09.10.5674G).

2.1. Experiment 1

In an initial experiment, we aimed to carry out a close replication of Tversky & Hard (2009) using new photographs in an online format. In the original study, participants were shown a still photo that included two objects on a table (a water bottle and a book). While looking at the photo, participants were asked "In relation to the bottle, where is the book?" and their verbal responses were coded for orientation. The main contrast of interest across conditions was whether or not a person was present behind the table, and whether or not the person was reaching towards one of the objects. We modelled our stimuli after the original study (i.e., photos that included a water bottle and book on a table, and either included or excluded a person) and participants were asked the same exact question as in Tversky & Hard (2009). Our study involved minor variations from the original Tversky & Hard (2009) paradigm to adapt to an online format: Instead of recording a verbal response, we asked participants to type an open-ended response to the question prompt, and whereas the original paradigm was embedded within a larger set of unrelated questionnaires, our participants only viewed the perspective taking paradigm. All picture stimuli, coding schemes, and de-identified data are openly available at the Open Science Framework and can be found at:

https://osf.io/r3kfa/?view_only=4f22ccd4856a4157ba17e39a954a87ad (Note for reviewers: this

VISUAL PERSPECTIVE TAKING IN MEMORY

is currently a peer-review link. The project will be made fully public and the link updated to that public space upon manuscript acceptance). This first experiment was conducted in order to replicate prior findings and assess feasibility of an online form of this simplified paradigm for a subsequent manipulation to the task in Experiment 2.

2.2. Methods

2.2.2. Participants

Participant sample sizes were determined via a combination of prior literature review (e.g., Tversky & Hard, 2009 reported $N \sim 60$ participants per condition with a medium effect size) and G*Power analysis (one-way ANOVA, three groups, moderate effect size), suggesting a minimum sample size of 215 individuals. The final experimental sample consisted of 235 participants (113 females, 122 males) over 18 years of age who reported English as their primary language. Participants were recruited through Amazon Mechanical Turk (MTurk) with a HIT completion requirement of 97% approval and were compensated \$.10 for their participation. An additional 11 participants were removed from the final data set due to nonsensical typed responses. Participants were randomly assigned to one of three conditions: the No Person condition ($N = 80$, 37 females), the Looking Person condition ($N = 77$, 42 females), or the Reaching Person condition ($N = 78$, 34 females).

2.2.3. Stimuli

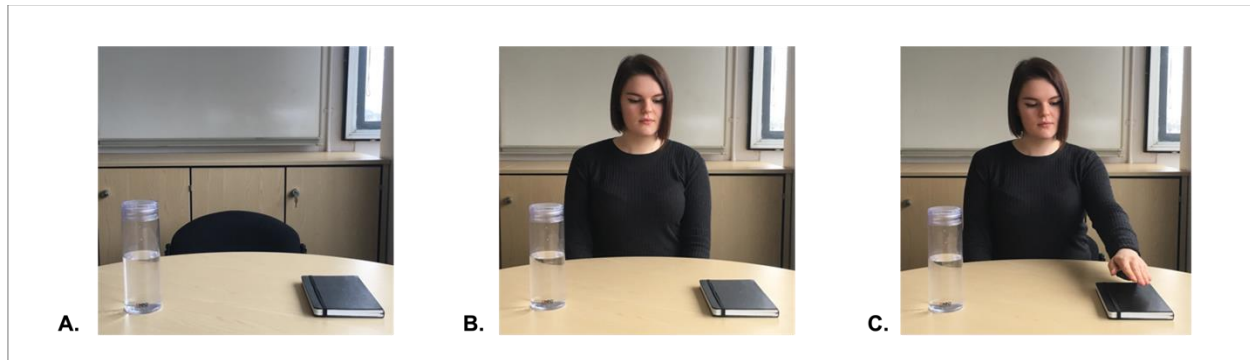
Pictures were adapted from the Tversky and Hard (2009) study exploring spontaneous perspective taking in adults. Each photo depicted a simple scene with two objects on a table (a water bottle and a book). In the No Person condition, an empty chair was positioned on the other side of the table. In the Person Looking condition, a female actor was sat on the opposite side of the table, looking toward the book with a neutral expression. In the Person Reaching condition,

VISUAL PERSPECTIVE TAKING IN MEMORY

the same female actor was sat in the same position and was reaching toward the book with a neutral expression (see Figure 1).

Figure 1

Picture stimuli as shown in the No Person (a) Person Looking (b) and Person Reaching (c) conditions.



2.2.4. Procedure

All stimuli were presented using Qualtrics survey software (Qualtrics, Provo, UT). After providing informed consent, participants were shown one of the stimulus photos (No Person, Person Looking, or Person Reaching) and asked, “In relation to the bottle, where is the book?” (as per Tversky & Hard, 2009). Participants were given a text box in which to type their answer. The stimulus photo remained on the screen during this phase and subjects were allowed as much time as they needed to respond. They then completed a simple attention check (participants were asked to type the word “orange”) and a short demographic questionnaire. On average, the experiment lasted less than 3 minutes.

2.2.5. Coding

Participant responses were coded in accordance with the coding scheme outlined in Tversky and Hard (2009). Each sentence was coded as egocentric (from the participant's own perspective), altercentric (from the perspective of the person at the table), neutral (describing one

VISUAL PERSPECTIVE TAKING IN MEMORY

object in relation to the other item), or both (uses both egocentric and altercentric perspectives).

Egocentric sentences included statements that used the word “right” (e.g., “The book is to the right of the bottle” / “The book is to my right”). Altercentric sentences included statements that used the word “left” (e.g., “The book is to the left of the bottle” / “The book is to her left”).

Neutral statements described one object’s position in regard to the other without mention of the person in the image or to the participant (e.g., “The book is next to the bottle” / “The book is opposite the bottle”). In some cases ($N=9$ across conditions), both egocentric and altercentric wording was used (“The book is to my right, but to her left”). As in Tversky and Hard (2009), for these cases, we noted the first perspective they indicated as their response. In addition, we also noted whether participants explicitly mentioned a perspective in their response, whether that be their own perspective (e.g., “from my view...”), the model’s (“from her view...”), or neither (“if I were sitting in the chair...”). All responses were coded by two raters, blind to condition, who were in agreement on over 98% of trials for all variables (self [99.14%], other [98.72%], and mention of perspective [98.76%]).

2.2.6. Analysis Plan

In order to directly replicate the analyses conducted by Tversky & Hard (2009), we converted scores into two binary variables. The self-perspective variable was coded 1 if the first response was self-perspective and 0 if it was not. The other-perspective variable was coded 1 if the first response was other-perspective and 0 if it was not. Each variable was analyzed using a one-way Analysis of Variance with condition as a between-subjects factor. Two planned contrasts were then conducted to compare (1) the No Person condition to the Person conditions (collapsed across looking and reaching) and (2) the Looking Person versus Reaching Person conditions. In addition to directly replicating prior analyses, we also conducted binary logistic

VISUAL PERSPECTIVE TAKING IN MEMORY

generalized linear models (GLZMs) to follow up results using analyses more suited to the binary nature of the data.

The original research also included descriptive reports of the percentage of participants who explicitly mentioned the perspective within the Person conditions. We report this for both the Person (looking and reaching) conditions and the No Person condition and conduct a chi-square test to investigate whether there was a systematic difference in the propensity to mention perspective in Person versus No Person conditions.

2.3. Results

2.3.1. *Other Perspective*

There was a marginally significant effect of condition for other perspective ($F(2,232) = 2.98, p = .053, \eta_p^2 = .025$). When we look at the planned t-tests and trends, we saw the same effects as those found in Tversky & Hard (2009): Frequency of taking the other perspective for Person ($M = .32, SEM = .038$) was greater than No Person ($M = .18, SEM = .043$), $t(190.42) = -2.59, p = .010$, Cohen's $d = .34$ (equal variances not assumed). As in Tversky & Hard (2009), there was not a significant difference between Looking ($M = .31, SEM = .053$) and Reaching ($M = .33, SEM = .054$) conditions, $t(153) = -.29, p = .78$, Cohen's $d = .046$ (see Figure 2).

Binary logistic generalized GLZMs mirrored the parametric results, with other perspective being significantly higher in the Person conditions than the No Person condition (Wald $\chi^2 = 5.63, p = .018$), with no differences between the Looking and Reaching conditions (Wald $\chi^2 = .083, p = .77$).

2.3.2. *Self Perspective*

Replicating Tversky & Hard (2009), we found a significant effect of condition for self perspective, $F(2,232) = 3.45, p = .033, \eta_p^2 = .029$. Planned t-tests confirmed that self perspective

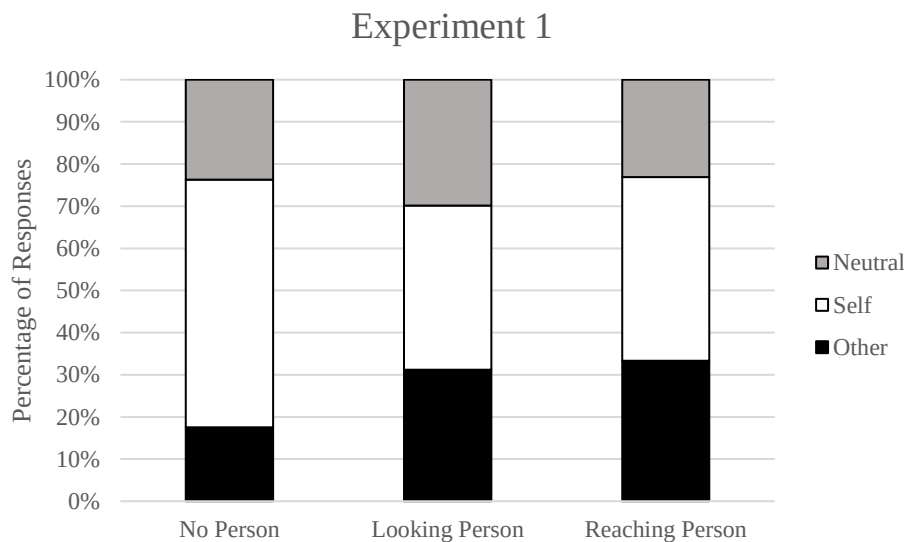
VISUAL PERSPECTIVE TAKING IN MEMORY

was higher in the No Person condition ($M = .59$, $SEM = .055$) than in the Person conditions ($M = .4194$, $SEM = .03976$), $T(233) = 2.56$, $p = .011$, Cohen's $d = .35$. We also found no difference in self perspective between the Looking ($M = .39$, $SEM = .056$) and Reaching ($M = .44$, $SEM = .056$) conditions, $T(153) = -.58$, $p = .56$, Cohen's $d = .094$ (see Figure 2).

Binary logistic generalized GLZMs mirrored the parametric results, with self perspective being significantly higher in the No Person condition than the Person conditions (Wald $\chi^2 = 6.37$, $p = .012$), with no differences between the Looking and Reaching conditions (Wald $\chi^2 = .34$, $p = .56$).

Figure 2

Mean percent of neutral, self, or other perspective descriptions as a function of condition in Experiment 1.



2.3.3. Explicit Mention of Perspective

A large minority of participants in the Person conditions (44/155; 28%) explicitly mentioned perspectives in their answers. This was more than twice as high as the rates seen in

VISUAL PERSPECTIVE TAKING IN MEMORY

Tversky & Hard (2009). Surprisingly, some participants in the No Person condition also mentioned perspectives in their answers (their own, or sometimes the chair's; 13/80; 16%). In order to address whose perspective the participants referred to, we counted the number of participants who explicitly mentioned their own or another's perspective. In this count, unlike the above analyses that only included first responses, participants who mentioned more than one perspective (e.g., "from my perspective...but from her perspective...") were included in counts for both categories. The propensity to explicitly mention a perspective was higher in the Person conditions than the No Person condition ($\chi^2 = 4.23$, $p = .040$). Like Tversky & Hard (2009), within the Person conditions, we found that mentions of perspective were more common when referring to the other's perspective (34 of 58 participants whose responses referred to the others' perspective mentioned the perspective explicitly) than referring to one's own perspective (16 of 65 participants whose responses referred to their own perspective mentioned the perspective explicitly; $\chi^2 = 14.69$, $p < .001$). This pattern did not hold in the No Person condition (8/47 versus 4/14; $\chi^2 = .91$, $p = .34$).

2.4. Interim Discussion

The results of this experiment replicated the original findings by Tversky & Hard (2009) using new stimuli in an online format. That is, we found that participants were more likely to spontaneously describe the scene in an altercentric manner if there was a person present in the scene than if no person was present in the scene. Having established that this effect replicates when adults are presented with new photos, in an online questionnaire, and without the addition of other questions or tasks, we then manipulated the task in a manner that allowed us to address the potential effect of memory.

VISUAL PERSPECTIVE TAKING IN MEMORY

As noted in the introduction, we are interested in whether the presence or absence of a person in the scene alters how individuals recall the scene. Based on the fact that adults describe scenes with and without a person differently in the moment (Tversky & Hard, 2009; Experiment 1) and that memory differs depending on whether a person is present or absent in a scene (Howard et al., 2020; Kamps & Southgate, 2020), we expected there to be differences in memory for the scene dependent on the presence or absence of a person.

3. Experiment 2

3.1. Methods

3.1.2. Participants

The experiment sample consisted of 249 participants (124 females, 122 males, 3 other) over 18 years of age who reported English as their primary language. Participants were recruited through Amazon Mechanical Turk (MTurk) with a HIT completion requirement of 97% approval and were compensated \$0.10 for their participation. Individuals who participated in Experiment 1 were excluded from participation in Experiment 2. An additional 56 participants were removed from the final data set due to nonsensical typed responses or failure to correctly answer the attention check question. Participants were randomly assigned to one of three conditions: the No Person condition ($N = 87$, 37 females, 48 males, 2 other), the Person Looking condition ($N = 77$, 39 females, 37 males, 1 other), or the Person Reaching condition ($N = 85$, 48 females, 37 males).

3.1.3. Procedure

The stimuli, procedure, and coding were identical to Experiment 1 with a few exceptions. First, participants were told that they would be viewing a picture and later would be asked questions about this picture. Next, instead of participants being asked the question “In relation to the bottle, where is the book?” while still viewing the photo, they viewed the photo and then

VISUAL PERSPECTIVE TAKING IN MEMORY

watched a 3 minute 50 second delay phase video that was unrelated to the task (a cartoon with an elephant and a mouse that did not include any language). This length of delay is used in the cognitive literature exploring memory effects and is often the length used for clinical memory assessments (e.g., Pathman et al., 2018; Wall et al., 1994). Delays of this duration have been found to be equivalent to longer delays when testing episodic memory (Xu et al., 2020), and, pairing the delay with an intervening distractor video assured that we were not tapping working memory processes (see Oberauer et al., 2016). Participants then completed a simple attention check before answering the spatial relation question. The attention check required participants to select “origami” as one out of nine possible responses to a question. Those who incorrectly responded to this attention check were removed from the sample (as per Oppenheimer et al., 2009; see Participants section for numbers). Coding was identical to that described in Experiment 1; when participants mentioned both egocentric and altercentric viewpoints ($n = 11$ across conditions), we noted the first perspective they indicated as their response. All responses were coded by two raters, blind to condition, who were in agreement on over 93% of trials for all variables (self [97.59%], other [99.20%], and mention of perspective [93.98%]).

As in Experiment 1, all picture stimuli, coding schemes, and de-identified data are openly available at the Open Science Framework and can be found at:

https://osf.io/r3kfa/?view_only=4f22ccd4856a4157ba17e39a954a87ad (*Note for reviewers: this is currently a peer-review link. The project will be made fully public and the link updated to that public space upon manuscript acceptance*).

3.2. Results

3.2.1. Other Perspective

VISUAL PERSPECTIVE TAKING IN MEMORY

There was no significant main effect of condition for other perspective ($F(2,246) = 1.98$, $p = .14$, $\eta_p^2 = .016$). But when we carried out the planned t-tests, we saw similar effects to Experiment 1: Person ($M = .23$, $SEM = .033$) is marginally greater than No Person ($M = .14$, $SEM = .037$), $t(208.30) = -1.93$, $p = .055$, Cohen's $d = .025$ (equal variances not assumed). As in Tversky & Hard (2009) and Experiment 1, there was not a significant difference between Looking ($M = .21$, $SEM = .046$) and Reaching ($M = .26$, $SEM = .048$) conditions, $t(160) = -.76$, $p = .45$, Cohen's $d = .12$ (see Figure 3).

Binary logistic generalized GLZMs mirrored the parametric results, with other perspective being marginally higher in the Person conditions than the No Person condition (Wald $\chi^2 = 3.22$, $p = .073$), and no difference between the Looking and Reaching conditions (Wald $\chi^2 = .58$, $p = .44$).

3.2.2. Self Perspective

Similar to Tversky & Hard (2009) and Experiment 1, we found a significant effect of condition for self perspective, $F(2,246) = 3.83$, $p = .023$, $\eta_p^2 = .030$. Planned t-tests confirmed that self perspective was higher in the No Person condition ($M = .70$, $SEM = .049$) than in the Person conditions ($M = .52$, $SEM = .039$), $t(189.25) = 2.72$, $p = .007$, Cohen's $d = .37$. We found no difference in self perspective between the Looking ($M = .54$, $SEM = .057$) and Reaching ($M = .51$, $SEM = .054$) conditions, $t(160) = .50$, $p = .62$, Cohen's $d = .079$ (see Figure 3).

Binary logistic generalized GLZMs mirrored the parametric results, with self perspective being significantly higher in the No Person condition than the Person conditions (Wald $\chi^2 = 7.14$, $p = .008$), and no difference between the Looking and Reaching conditions (Wald $\chi^2 = .25$, $p = .62$).

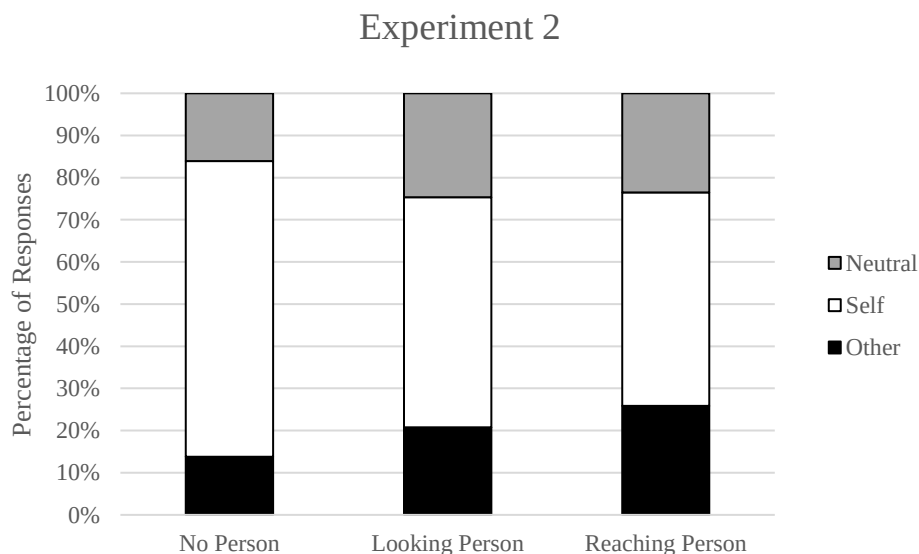
3.2.3. Explicit Mention of Perspective

VISUAL PERSPECTIVE TAKING IN MEMORY

A large minority of participants in the Person conditions (40/162; 25%) explicitly mentioned perspectives in their answers. This was more than twice the rates seen in Tversky & Hard (2009) and similar to the rates in Experiment 1. Some participants in the No Person condition also mentioned perspectives in their answers (their own, or sometimes the chair's; 14/87; 16%). Unlike Experiment 1, the propensity to explicitly mention a perspective was not significantly higher in the Person conditions than the No Person condition ($\chi^2 = 2.46, p = .12$). Like Experiment 1, however, within the Person conditions, we found that mentions of perspective were more common when referring to the other's perspective (21/41) than referring to one's own perspective (22/88; $\chi^2 = 8.65, p = .003$). This pattern did not hold in the No Person condition (5/16 versus 11/61; $\chi^2 = 2.12, p = .14$).

Figure 3

Mean percent of neutral, self, or other perspective descriptions in memory as a function of condition in Experiment 2.



3.3. Interim Discussion

VISUAL PERSPECTIVE TAKING IN MEMORY

Adding a short delay before requesting descriptions of the scenes for pictures with and without a person largely replicated the effects we saw in Experiment 1, when participants were asked to describe the scenes in-the-moment. This supports our hypothesis that the presence of an agent in a scene alters memory for the scene in a systematic way. Below, we discuss the potential implications and future directions of this work.

4. General Discussion

The current experiments sought to explore whether the presence of a person in a still picture “spontaneously” alters participants’ visual perspective in memory. We showed participants a picture that included a person looking at one of two objects (Looking Person), a person reaching to one of two objects (Reaching Person), or did not include a person (No Person) and then either concurrently asked for their spatial description of the picture (Experiment 1) or asked them to describe the picture after a brief delay (Experiment 2). In this way, we were able to replicate prior work showing that participants are more likely to spontaneously take the perspective of a person in a scene (Tversky & Hard, 2009) and we extended this work to look at the phenomenon both in an online format and after a delay.

In Experiment 1, we ran a close replication of Tversky and Hard (2009) to explore visual perspective taking when participants were tested in an online format using new (though similar) stimuli. We found that participants were generally more likely to take the “other” (altercentric) perspective when describing an event if there was a person present, and more likely to take their own (egocentric) perspective if there was a person absent from the scene. Furthermore, as in Tversky and Hard (2009), we found no significant difference in visual perspective descriptions between the Looking Person and Reaching Person conditions. Thus, as in prior work (Furlanetto et al., 2013; Quesque et al., 2018; Tversky & Hard, 2009), the inclusion of a person in a still

VISUAL PERSPECTIVE TAKING IN MEMORY

picture appears to spontaneously cue that agent's perspective for 'in the moment' event descriptions.

Experiment 2 explored whether this “spontaneous perspective taking” is also evident once the picture is removed and participants are asked to recall spatial relations from memory. Here, participants viewed the same pictures as in Experiment 1, but then watched a short film before subsequently describing what they remembered. The effect was slightly weaker than that found in Experiment 1, though the trends were maintained. Participants were marginally more likely to take the “other” (altercentric) perspective when describing an event if a person was present, and they were significantly more likely to take their own (egocentric) perspective if a person was absent from the scene. As in Experiment 1, there were no differences in either other- or self-descriptions across the Person Looking and Person Reaching conditions. These findings suggest that participants' visual perspective is influenced by the presence or absence of a person, not only for concurrent event descriptions, but also when recalling the event after a delay.

Across both studies, a large minority of participants explicitly mentioned either their own or the other perspective in some way or noted that there could be multiple ways of viewing the scene (e.g., “to the left from her perspective, to the right from mine”). Although this was more common in the agent present conditions than the agent absent condition, it is notable that some participants mentioned perspectives even in the agent absent (No Person) condition, as has been found in prior work (Quesque et al., 2018). This highlights the strong propensity to take into account the possibility of multiple perspectives. Still, not all participants in the agent present conditions explicitly mentioned the agent when taking an altercentric perspective, and instead seemed to spontaneously refer to the other's view without the need to mention it. This implies

VISUAL PERSPECTIVE TAKING IN MEMORY

that some participants expected that someone reading their response would share their understanding of the alternative perspective without drawing attention to it themselves.

Of note, it is interesting that participants in Experiment 2 were significantly more likely to describe the event from their own perspective when a person was absent than when a person was present, but the opposite effect (describing the event from the other perspective with a person present relative to a person absent) was only of marginal significance. Relatedly, in Experiment 1, we reported higher rates of “other” perspective in our No Person condition (18%) than Tversky and Hard (2009) did in theirs (3%). Additionally, explicit mentions of perspective were higher in both our Person conditions (28% and 25% in Experiments 1 and 2, respectively) and our No Person Condition (16% and 16%) than found in the Person conditions of some previous research (13%, e.g., Tversky & Hard, 2009). We believe both of these effects may be explained by minor differences between our stimuli and those used in Tversky and Hard (2009). Specifically, we created more streamlined stimuli showing only a person or chair, a table, and the two objects on the table, as opposed to the Tversky and Hard (2009) photographs, which depicted a person sat on a stool at a table within a cluttered room. Though we assumed fewer objects in the picture would allow for less distraction during encoding, our photographs do show the top portion of a chair at the table (which may be more salient with fewer other objects present), whereas the Tversky and Hard (2009) stimuli had the actor sitting on a stool that was not visible when the agent was absent from the scene. Prior work has shown that the inclusion of a chair in a scene can alter participants’ visual perspective for that event (Kessler & Thomson, 2010; Quesque et al., 2018; 2020; Ueda et al., 2021), potentially due to the participant imagining themselves in the position of the chair. Therefore, it is possible that a subset of the participants in our experiments mentally placed themselves within the scene from the “other” perspective in the

VISUAL PERSPECTIVE TAKING IN MEMORY

No Person condition. In fact, a number of participants explicitly described the scene from the chair's perspective (e.g. "The book was to the right of the bottle when looking at the picture. If sitting in chair, it was to the left of the bottle"), something that was not mentioned in the Tversky and Hard (2009) paper. In the future, it may be helpful to fully remove a viewable chair from the scene, or to explore ways in which the affordances of inanimate objects might facilitate or interfere with various perspectives in memory.

In the current studies, we found no difference in spontaneous perspective taking between scenes in which a person was looking at an object versus reaching toward an object. However, some research has shown that variations in the attention and behavior of the agent sometimes alter immediate perspective taking responses. For example, if a person is reaching towards one of two objects and the agent and action are highlighted in the prompt to describe the scene (e.g., 'where does he place the book' versus 'where is the book'), the altercentric effect is amplified (Tversky & Hard, 2009). Similarly, the attentional focus of the person in the scene also seems to play a role in perspective taking in some cases (Böckler et al., 2011; Tosi et al., 2020, though see Mazzarella et al., 2012). It is unknown whether and under what circumstances including additional cues to action or attention (e.g., linguistic framing) would also increase altercentric responses in memory. However, research documenting the joint memory effect in adults suggests that factors that make a shared goal more salient (i.e., create 'common ground') are likely to influence taking another person's perspective during a task and have influences on memories after the fact (Elekes & Sebanz, 2020), making it an intriguing area for future research.

The current series of experiments demonstrates that the presence of a person in a picture can alter visual memory for a scene after a brief delay for adults. Interestingly, a large body of work on both social memory (e.g., Gerson & Meyer, 2020; Howard et al. 2019, 2020) and

VISUAL PERSPECTIVE TAKING IN MEMORY

perspective taking (Kampis & Southgate, 2020; Southgate, 2020, Surtees & Apperly, 2012; Surtees et al., 2013) has been tested in developmental populations. Infants and young children are particularly interesting populations to tap into in further explorations of these questions, as their patterns of perspective taking have been suggested to be due to either egocentric or altercentric biases, depending on the tasks used and the interpretation or theoretical perspective (Epley et al., 2004; Southgate, 2020). The developmental trajectory of spontaneous versus effortful perspective taking also appears to align with the unfolding of other cognitive faculties, such as executive function (Carlson et al., 2004) and mental rotation (Surtees et al., 2013), giving insight into the mechanisms through which adults might take the perspective of others. As such, exploring whether children, like adults, differentially recall the visual perspective of a scene based on its social context could help us better understand the ontogeny of the patterns we see in our current research with adults.

Our findings may also shed light on the mechanisms behind the previously-documented “social memory bias” seen in development, whereby infants and young children remember more sequential information from events that include versus exclude other people (Howard & Woodward, 2019; Howard et al., 2020; Loucks et al., 2020; Monroy et al., 2018). It is possible that children remember more from person-present events because they are “putting themselves in the shoes of” the person they are viewing, embodying both their location in space and their perspective in memory. Work with adults underscores this simulated view of perspective taking, with congruency paradigms demonstrating that embodiment supports perspective taking propensities on visual tasks (Kessler & Rutherford, 2010; Surtees et al., 2013). However, work is needed to fully explore the connection between the perspective taking propensities and event memory in both child and adult populations.

VISUAL PERSPECTIVE TAKING IN MEMORY

Taken together, these findings not only add to the nuanced body of work on adult perspective-taking, they also open doors for a plethora of future research avenues. Furthermore, a better understanding of the effects of perspective-taking on learning and memory has implications for work beyond academic walls. If the presence of a person helps us learn by way of perspective-taking, this could inform future practices in traditional classrooms (e.g., including models in scientific textbooks) or virtual learning environments (e.g., making sure a teacher is visible during online instruction).

VISUAL PERSPECTIVE TAKING IN MEMORY

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