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Simpson, Austin J
Todd, Andrew R

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Intergroup visual perspective-taking: Shared group membership impairs self-perspective inhibition but may facilitate perspective calculation



Austin J. Simpson*, Andrew R. Todd

Department of Psychological and Brain Sciences, University of Iowa, Iowa City, IA, USA
 Department of Psychology, University of California, Davis, Davis, CA, USA

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ABSTRACT

Reasoning about what other people see, know, and want is essential for navigating social life. Yet, even neurodevelopmentally healthy adults make perspective-taking errors. Here, we examined how the group membership of perspective-taking targets (ingroup vs. outgroup) affects processes underlying visual perspective-taking. In three experiments using two bases of group identity (university affiliation and minimal groups), interference from one's own differing perspective (i.e., egocentric intrusion) was stronger when responding from an ingroup versus an outgroup member's perspective. Spontaneous perspective calculation, as indexed by interference from another's visual perspective when reporting one's own (i.e., altercentric intrusion), did not differ across target group membership in any of our experiments. Process-dissociation analyses, which aim to isolate automatic processes underlying altercentric-intrusion effects, further revealed negligible effects of target group membership on perspective calculation. Meta-analytically, however, there was suggestive evidence that shared group membership facilitates responding from others' perspectives when self and other perspectives are aligned.

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1. Introduction

The demands of social life require that people actively reason about what other agents see, know, and want. Without direct access to other people's minds, however, inferring their contents is challenging: Even neurodevelopmentally healthy adults sometimes stumble in such endeavors (Birch & Bloom, 2004; Nickerson, 1999; Royzman, Cassidy, & Baron, 2003). Recent research has identified various perceiver-based factors, including experiences of high power (Blader, Shirako, & Chen, 2016; Galinsky, Magee, Inesi, & Gruenfeld, 2006), cognitive load (Lin, Keysar, & Epley, 2010; Qureshi, Apperly, & Samson, 2010; Schneider, Lam, Bayliss, & Dux, 2012), and anxious uncertainty (Todd, Forstmann, Burgmer, Brooks, & Galinsky, 2015; Todd & Simpson, 2016), that can magnify these perspective-taking difficulties. Comparatively less is known about how *target-based* factors affect perspective-taking. Contrary to conventional wisdom – and some prior work (e.g., Adams et al., 2010) – suggesting that similarity between oneself and a perspective-taking target should ease mental-state inference, Todd, Hanko, Galinsky, and Mussweiler

(2011) found that adults made more errors on a false-belief task (Birch & Bloom, 2007) when the protagonist was an ethnic ingroup member than when the protagonist was an ethnic outgroup member. Our aim here was to extend this prior work by shedding light on the mechanisms that shape perspective-taking in intergroup contexts.

2. Processes underlying perspective-taking

A major undertaking of much theoretical and empirical work on 'theory of mind' has been to explicate the cognitive processes involved in mental-state reasoning (see Apperly, 2010, for a review). On one noteworthy theoretical account, the ascription of mental states to oneself and others involves several distinct processes: an implicit *calculation* of possible mental contents (e.g., what another agent sees, knows, or wants) and an explicit *selection* of the most plausible among these potential contents while *inhibiting* competitors (Leslie, Friedman, & German, 2004; Leslie, German, & Polizzi, 2005; for related accounts, see Apperly & Butterfill, 2009; Qureshi et al., 2010; Ramsey, Hansen, Apperly, & Samson, 2013). Many of the most widely used mental-state reasoning tasks, including the false-belief task used by Todd et al. (2011), assess the calculation and selection of another person's perspective while inhibiting one's own perspective, thereby conflating these different

* Corresponding author.

E-mail addresses: ajsimpson@ucdavis.edu (A.J. Simpson), artodd21@gmail.com (A.R. Todd).

processes (Ramsey et al., 2013). A major objective of the current investigation was to overcome some of the limitations of tasks used in prior intergroup perspective-taking work by using a task that can tease apart these different processes.

In one such task, a level-1 visual perspective-taking (hereafter, L1-VPT) task,¹ adults view a human avatar standing in the center of a room that has a varying number of dots on the side walls (Samson, Apperly, Braithwaite, Andrews, & Bodley Scott, 2010). On some trials, participants and the avatar can see the same number of dots (i.e., consistent trials); on other trials, the avatar cannot see some of the dots that are visible to participants (i.e., inconsistent trials). Two interference effects commonly emerge in this task: First, on trials in which participants must respond from the avatar's perspective (i.e., other trials), they have more difficulty doing so if their own perspective conflicts with that of the avatar than if self and avatar perspectives are aligned. This *egocentric*-intrusion effect resembles other egocentric biases commonly found on tasks requiring explicit inferences about others' perspectives (e.g., Epley, Keysar, Van Boven, & Gilovich, 2004; Keysar, Lin, & Barr, 2003; Sommerville, Bernstein, & Meltzoff, 2013). Second, on trials in which participants must simply report their own perspective (i.e., self trials), they have more difficulty doing so if the avatar's perspective conflicts with their own than if their perspectives are identical; that is, processing of the avatar's perspective interferes with reporting one's own perspective. This *altercentric*-intrusion effect is commonly interpreted as reflecting a rapid and implicit processing of the avatar's visual perspective and thus is thought to provide an indirect measure of spontaneous perspective calculation² (e.g., Nielsen, Slade, Levy, & Holmes, 2015; Qureshi et al., 2010; Surtees & Apperly, 2012; for alternative, non-mentalistic interpretations of altercentric-intrusion effects, see Cole, Smith, & Atkinson, 2015; Heyes, 2014; Santiesteban, Catmur, Hopkins, Bird, & Heyes, 2014). We used this task in the current research to investigate how target group membership affects these processes during visual perspective-taking.

3. Shared group membership and perspective-taking processes

How might the avatar's group membership affect patterns of egocentric and altercentric intrusion? Prior work suggests that people are more likely to use accessible self-knowledge when making inferences about the beliefs, preferences, and visceral states of similar versus dissimilar others (e.g., Ames, 2004a, 2004b; O'Brien & Ellsworth, 2012; Robbins & Krueger, 2005; Tamir & Mitchell, 2013; Todd, Simpson, & Tamir, 2016). Because reasoning about these and other higher-level mental states has been posited to be grounded in lower-level, visuospatial forms of perspective-taking (e.g., Erle & Topolinski, 2017; Kessler & Thomson, 2010), we anticipated that egocentric intrusion would be stronger with an ingroup avatar than with an outgroup avatar. This prediction aligns with theoretical claims that, when self-other differences are salient, as is typical in intergroup contexts (Turner, Hogg, Oakes, Reicher, & Wetherell, 1987), people rely less heavily on self-knowledge, and more heavily on group knowledge (e.g., stereotypes), to guide their mental-state inferences (Ames, 2004a, 2004b; see also Mussweiler, 2003).

¹ Level-1 visual perspective-taking entails understanding *what* another person can see; this can be contrasted with level-2 visual perspective-taking, which entails understanding *how* something looks from another's perspective (Flavell, Everett, Croft, & Flavell, 1981).

² That visual perspective-taking *can* occur spontaneously does not mean that it occurs *inevitably*. Rather than being reflexively triggered by the mere presence of another agent, altercentric-intrusion effects appear to depend, in part, on whether the agent is physically able to "see" the dots (Baker, Levin, & Saylor, 2016; cf. Conway, Lee, Ojaghi, Catmur, & Bird, 2017; Furlanetto, Becchio, Samson, & Apperly, 2016) and on whether sufficient attention is directed toward the agent (Bukowski, Hietanen, & Samson, 2015; cf. Gardner, Hull, Taylor, & Edmonds, 2017).

It is less clear how avatar group membership might affect altercentric intrusion in L1-VPT. We considered three possibilities, each of which was guided by prior empirical and theoretical work. First, insofar as decrements in explicit perspective-taking (i.e., the deliberate attribution of mental states) based on shared group membership (e.g., Todd et al., 2011) are accompanied by, or even rooted in, implicit cognitive processes (see Lieberman, Gaunt, Gilbert, & Trope, 2002), then similar decrements in spontaneous perspective calculation, as indexed by weaker altercentric intrusion, might also be anticipated. On this *perspective-calculation* account, the pattern of stronger egocentric intrusion with an ingroup avatar versus an outgroup avatar should be accompanied by *weaker* altercentric intrusion with an ingroup avatar versus an outgroup avatar. Prior work suggests that the presence of a non-social (e.g., a dual-colored stick) or a semi-social (e.g., an arrow) entity rather than a social agent (e.g., a human avatar) can bias visual perspective-taking via such a perspective-calculation process (e.g., Nielsen et al., 2015; Samson et al., 2010; Surtees & Apperly, 2012; Todd & Simpson, 2016; but see Gardner et al., 2017; Santiesteban et al., 2014). Although altercentric intrusion is the typical metric used for assessing perspective calculation in L1-VPT (e.g., Qureshi et al., 2010; Todd & Simpson, 2016), impaired perspective calculation could also be revealed by greater difficulty in responding from the avatar's perspective when there is no perspective conflict to resolve (i.e., on consistent trials) and thus little need to recruit effortful processes (Ramsey et al., 2013; Samson et al., 2010).

An alternative account is suggested by the representation and incorporation of close others' responses (RICOR) model of social influence (Smith & Mackie, 2016), which proposes that spontaneous perspective calculation should be especially pronounced for perspective-taking targets to whom one feels socially connected, as is typical in cases of shared group membership (Smith & Henry, 1996). On this view, shared group membership with the avatar would be expected to impair visual perspective-taking not via a process of perspective calculation (i.e., because spontaneous perspective calculation should be *stronger* for ingroup versus outgroup avatars) but rather via a process of viewpoint-independent perspective selection (Ramsey et al., 2013). This *perspective-selection* account predicts that shared group membership should impede the explicit selection of the cued perspective (self or other) whenever self and avatar perspectives are in conflict, resulting in both stronger egocentric intrusion *and* stronger altercentric intrusion with an ingroup versus an outgroup avatar. Prior work has found that cognitive load can bias visual perspective-taking through such a viewpoint-independent perspective-selection process: In one study, for example, both egocentric intrusion and altercentric intrusion were stronger under conditions of divided attention (Qureshi et al., 2010).

Finally, we considered a third possibility: a more specific instantiation of perspective selection in which shared group membership biases visual perspective-taking not by impairing the ability to process an ingroup versus an outgroup avatar's perspective per se but rather by selectively impairing the inhibition of one's own visual perspective when responding from an ingroup versus an outgroup member's perspective (Apperly, Samson, & Humphreys, 2005; Samson, Apperly, Kathirgamanathan, & Humphreys, 2005). On this *self-perspective-inhibition* account, shared group membership with an avatar should strengthen egocentric intrusion but should leave altercentric intrusion relatively unchanged.³ Todd et al. (2011) found that performance on a

³ It is also possible that shared group membership eases responding from the avatar's perspective when the avatar's perspective is aligned with one's own (i.e., on the consistent trials); such a pattern of *enhanced* perspective calculation (Ramsey et al., 2013) with an ingroup versus an outgroup avatar could be accommodated both by this account and by the viewpoint-independent perspective-selection account.

location-change false-belief task (Birch & Bloom, 2007) was worse with an ingroup versus an outgroup protagonist, but only when participants had privileged knowledge about the precise location of the moved object. When the object's new location was ambiguous (i.e., when self-perspective inhibition demands were relatively low), the effects of protagonist ethnicity disappeared. These findings provide suggestive evidence that shared group membership may impair self-perspective inhibition; however, as noted earlier, Birch and Bloom's (2007) false-belief task is ill-equipped to distinguish among processes of perspective calculation, viewpoint-independent perspective selection, and self-perspective inhibition.

4. Overview of experiments

We tested these different accounts (see Table 1) in three experiments in which participants, after having a group identity activated, completed ingroup and outgroup variants of the L1-VPT task. In Experiments 1 and 3, students' university identity was activated, and the avatar was either their own university's mascot or a rival university's mascot. In Experiment 2, participants underwent a minimal-group induction, and the avatar was either a minimal-ingroup member or a minimal-outgroup member. Furthermore, in Experiment 3, we used a variant of the process-dissociation procedure (Jacoby, 1991) to estimate the unique contributions of automatic and controlled processes to altercentric-intrusion effects. For all experiments, we report our a priori sample size rationale, as well as all data exclusions, manipulations, and measures.

5. Experiment 1: University mascots

5.1. Method

5.1.1. Participants and power

We based our sample size in Experiment 1 on prior intergroup perspective-taking research (Todd et al., 2011, Experiments 4 and 5: average $\eta_p^2 = 0.13$), settling on a target sample of 56 participants for 80% a priori power (Faul, Erdfelder, Lang, & Buchner, 2007). Data were collected until this target number was surpassed. University of Iowa undergraduates ($N = 66$) participated for course credit. We excluded data from 2 participants with errors on $\geq 30\%$ of trials (Samson et al., 2010) and 1 participant with RTs < 200 ms on $> 50\%$ of trials, leaving a final sample of 63 participants (45 women, 17 men, 1 unreported).

5.1.2. Procedure and materials

The first two tasks were designed to activate participants' student identity (see Hugenberg & Bodenhausen, 2004, for a similar procedure). Participants first indicated their agreement (1 = *strongly disagree*, 7 = *strongly agree*) with 12 items from the Collective Self-Esteem Scale (Luhtanen & Crocker, 1992) that were tailored for an academic identity (e.g., "I am a worthy member of my academic group [i.e., University of Iowa students]"). They then listed up to three things that they and most other University of Iowa students (a) do relatively often, (b) do relatively rarely, (c) generally do well, and (d) generally do poorly (Haslam, Oakes, Reynolds, & Turner, 1999).

Next, participants completed two variants of the L1-VPT task (Samson et al., 2010). In both, they saw a room with dots on the left and right walls. A cartoon mascot stood in the center of the room facing left or right. In the *ingroup* condition, the mascot (Herky the Hawk) was from participants' own university (University of Iowa). In the *outgroup* condition, the mascot (Cy the Cardinal) was from a rival university (Iowa State University). The mascots appeared in separate, counter-balanced blocks of trials. There were four key types of trials for each mascot condition: On *other* trials,

Table 1

Predicted direction of effects of avatar group membership (ingroup vs. outgroup) on egocentric intrusion and altercentric intrusion, based on the three proposed accounts.

Account	Intrusion type	
	Egocentric	Altercentric
Perspective calculation	Ingroup > Outgroup	Ingroup < Outgroup
Viewpoint-independent perspective selection	Ingroup > Outgroup	Ingroup > Outgroup
Self-perspective inhibition	Ingroup > Outgroup	Ingroup \approx Outgroup

participants responded from the mascot's perspective; on *self* trials, participants reported their own perspective. Additionally, on *consistent* trials, the number of dots visible to the mascot was identical to the number visible to participants; on *inconsistent* trials, the mascot could not see some of the dots that were visible to participants.

Each trial began with a fixation cross (500 ms), followed by a cue (YOU or HERKY/CY) indicating whose perspective to respond from (750 ms), and then another cue (0–3) indicating the number of dots to verify (750 ms). Finally, the room appeared (on screen until participants responded). Participants had to quickly verify if the number of dots on the wall matched or mismatched the given number by pressing one of two response keys. Match and mismatch trials occurred with equal frequency, but only match trials were analyzed (Fig. 1 displays the different types of trials for both mascots). If participants did not respond within a response deadline (2000 ms), a message ("Please try to respond faster!") appeared (1000 ms), after which the next trial began. Incorrect responses triggered a red X (1000 ms), after which the next trial began. Participants completed three equivalent blocks of 52 experimental trials for each mascot; within-block trial order was pseudo-randomized (see Samson et al., 2010, for details). Sixteen practice trials preceded the first block of experimental trials for each mascot.

5.2. Results and discussion

We excluded mismatch trials because specific constraints of the task's design lead to systematic differences across trial types (i.e., consistent-mismatch trials correspond to neither self or other perspective and thus are trivially easy to process; including these trials tends to substantially increase consistency effects; see Samson et al., 2010). We also excluded trials with RTs < 200 ms and RTs > 2000 ms (Todd & Simpson, 2016). Because our hypotheses concerned the processing *difficulty*, rather than speed or accuracy per se, following prior work using this task (e.g., Qureshi et al., 2010; Todd & Simpson, 2016), we integrated speed and accuracy into a single metric of processing cost, or inverse efficiency score, by dividing the mean correct RTs by the proportion of correct responses (Townsend & Ashby, 1983).^{4,5} Table 2 displays processing cost by condition for Experiments 1 and 2.

Preliminary analyses revealed that mascot block order (ingroup mascot first vs. outgroup mascot first) did not qualify the results; thus, we collapsed across this variable in the analyses reported below. A 2 (Mascot) \times 2 (Perspective) \times 2 (Consistency) repeated-measures ANOVA yielded a Consistency main effect (inconsistent $>$ consistent), $F(1,62) = 143.36$, $p < 0.001$, $\eta_p^2 = 0.70$, and a Perspective \times Consistency interaction, $F(1,62) = 52.96$, $p < 0.001$,

⁴ Use of this metric is recommended only when error rates are low and positively correlated with RTs (Bruyer & Brysbaert, 2011); both criteria were met in our data in Experiments 1 and 2.

⁵ Separate analyses on RTs and error rates yielded comparable patterns of results in Experiments 1 and 2 (see the Supplemental Material for full analyses and an internal meta-analysis on both metrics).

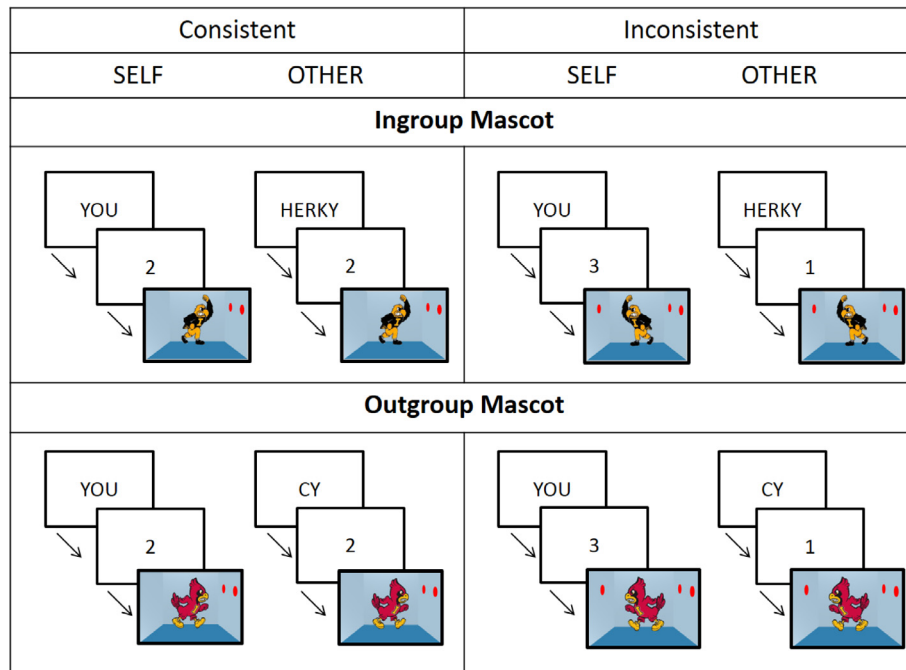


Fig. 1. Trial examples on the L1-VPT task (match trials). Participants verified if a given number (0–3) matched the number of dots visible either from their own perspective (YOU) or from the mascot's perspective (HERKY or CY). The number of dots visible from each perspective was either the same (consistent) or different (inconsistent). (Not pictured are mismatch trials where the number of dots visible did not match the cued perspective.)

Table 2

Processing cost by perspective, consistency, and avatar condition (Experiments 1 and 2).

Avatar condition	Perspective and consistency			
	Other		Self	
	Consistent	Inconsistent	Consistent	Inconsistent
<i>Experiment 1</i>				
Ingroup mascot	602 (179)	860 (297)	654 (175)	744 (233)
Outgroup mascot	623 (144)	815 (191)	662 (150)	763 (205)
<i>Experiment 2</i>				
Minimal ingroup	672 (214)	855 (314)	691 (217)	748 (235)
Minimal outgroup	684 (216)	820 (221)	684 (208)	767 (230)

Note. Values in parentheses are standard deviations. Processing cost = mean RTs/proportion of correct responses.

$\eta_p^2 = 0.46$. Replicating prior work with this task (e.g., Samson et al., 2010; Surtees, Samson, & Apperly, 2016; Todd & Simpson, 2016), the effect of consistency was stronger on other trials than on self trials (egocentric intrusion > altercentric intrusion). More important for the current research was a significant 3-way interaction, $F(1,62) = 8.54$, $p = 0.005$, $\eta_p^2 = 0.12$. There was also a marginal Mascot \times Consistency interaction, $F(1,62) = 3.74$, $p = 0.058$, $\eta_p^2 = 0.06$, that is best understood in the context of the 3-way interaction. Inspection of the Perspective \times Consistency interaction separately in each mascot condition revealed that the underlying pattern of greater egocentric versus altercentric intrusion was more pronounced with the ingroup mascot, $F(1,62) = 53.41$, $p < 0.001$, $\eta_p^2 = 0.46$, than with the outgroup mascot, $F(1,62) = 18.09$, $p < 0.001$, $\eta_p^2 = 0.23$.

To further specify the 3-way interaction, we calculated indices of egocentric intrusion (inconsistent-other trials – consistent-other trials) and altercentric intrusion (inconsistent-self trials – consistent-self trials). As shown in Fig. 2, egocentric intrusion was stronger with the ingroup versus the outgroup mascot, $t(62) = 2.97$, $p = 0.004$, Hedges' $g = 0.38$, whereas altercentric intrusion did not significantly differ across mascots ($|t| < 1$, $p = 0.46$, $g = -0.10$).

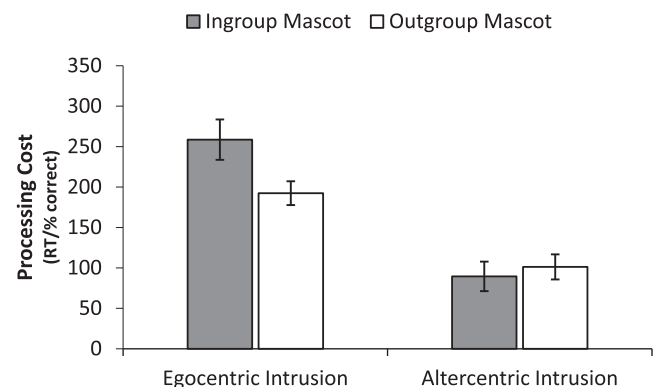


Fig. 2. Egocentric intrusion and altercentric intrusion by mascot condition (ingroup vs. outgroup); error bars depict ± 1 SE (Experiment 1).

Approaching the 3-way interaction differently, we conducted 2 (Mascot) \times 2 (Perspective) repeated-measures ANOVAs separately on the consistent trials and the inconsistent trials. Recall that target-based differences in perspective calculation could also be

revealed by differences in processing cost on trials in which self and other perspectives are aligned. Analyses on the consistent trials revealed a significant Perspective main effect, $F(1,62) = 10.42$, $p = 0.002$, $\eta_p^2 = 0.14$: Replicating prior work (Ramsey et al., 2013; Samson et al., 2010; Todd & Simpson, 2016), processing cost was higher on self trials than on other trials, which may reflect the visual salience of the mascot. Neither the Mascot main effect nor the Mascot \times Perspective interaction was significant ($F_s < 1.32$, $p_s > 0.25$, $\eta_p^2_s < 0.03$), suggesting that avatar group membership effects were negligible when self and other perspectives were in unison. Analyses on trials in which self and other perspectives were in conflict revealed a significant Perspective main effect in the opposite direction (other > self), $F(1,62) = 15.09$, $p < 0.001$, $\eta_p^2 = 0.20$. Although the Mascot main effect was not significant ($F < 1$, $p = 0.52$, $\eta_p^2 < 0.01$), a significant Mascot \times Perspective interaction, $F(1,62) = 4.82$, $p = 0.032$, $\eta_p^2 = 0.07$, indicated that the pattern of higher processing cost on other trials versus self trials when perspectives were in conflict was stronger with the ingroup versus the outgroup mascot.

The results of Experiment 1 indicate that egocentric intrusion was stronger with one's own university's mascot than with a rival university's mascot; however, no significant mascot-based differences emerged in altercentric intrusion, nor in responding from the avatar's perspective when it aligned with one's own. These findings provide initial evidence suggesting that shared group membership may bias visual perspective-taking by impairing the inhibition of one's own perspective (Apperly et al., 2005; Samson et al., 2005).

6. Experiment 2: Minimal groups

In Experiment 1, we examined the effects of target group membership on L1-VPT using mascots from rival universities, which should have effectively communicated group-identity information (Callahan & Ledgerwood, 2016). However, the mascots themselves, despite both being anthropomorphized birds, differed perceptually in several ways (e.g., color, species of bird). With this limitation in mind, we made two modifications in Experiment 2: First, we used human avatars as perspective-taking targets instead of mascots, which allowed us to control for perceptual differences across ingroup and outgroup targets. Second, we used a minimal-group design, in which the basis for group membership was arbitrary and the group itself was unknown to participants prior to the experimental session (Tajfel, Billig, Bundy, & Flament, 1971).

6.1. Method

6.1.1. Participants and power

We based our sample size in Experiment 2 on the 3-way interaction from Experiment 1 ($\eta_p^2 = 0.12$), settling on a target sample of 61 participants for 80% a priori power (Faul et al., 2007). Data were collected until this target number was surpassed. University of Iowa undergraduates ($N = 63$) participated for payment or course credit. We excluded data from 6 participants with errors on $\geq 30\%$ of trials and 1 participant with errors on $> 90\%$ of inconsistent-self trials, leaving a final sample of 56 participants (39 women, 17 men).

6.1.2. Procedure and materials

The first task manipulated participants' minimal-group membership (see Bernstein, Young, & Hugenberg, 2007, for a similar procedure). Participants indicated their agreement (1 = *strongly disagree*, 7 = *strongly agree*) with statements (e.g., "I see myself as extraverted, enthusiastic") from the Ten-Item Personality Inventory (Gosling, Rentfrow, & Swann, 2003), after which the computer

ostensibly calculated their scores. Following a 15-s delay, participants learned that they had either an orange or a green personality type. In actuality, they were randomly assigned to group (see the Supplemental Materials for more details). Participants then received two colored wristbands corresponding to their personality type (e.g., orange for those with an orange personality type), which they wore for the remainder of the experimental session as a reminder of their group membership.

Next, participants completed an L1-VPT task that was identical to that from Experiment 1, with two exceptions: First, gender-matched human avatars replaced the mascots. Second, ORANGE/GREEN replaced HERKY/CY as perspective cues (Fig. 3 displays the different types of trials for a male orange personality avatar and a female green personality avatar). In the *ingroup* condition, the avatar had the same personality type as participants and wore same-color wristbands. In the *outgroup* condition, the avatar had the opposing personality type and wore opposing-color wristbands. The ingroup and outgroup avatars appeared in separate, counter-balanced blocks.

Separately before the ingroup trial block and the outgroup trial block, participants rated their perceived similarity between themselves and the typical person with the respective personality type (1 = *not at all similar*, 7 = *extremely similar*). Using the logic of feature matching (Tversky, 1977; see also Srull & Gaelick, 1983), we aimed to further increase perceived similarity between oneself and the ingroup avatar by making the self the referent (e.g., "In general, how similar do you think the typical person with a GREEN personality type is to you?") before the ingroup trial block. Conversely, to increase perceived dissimilarity between oneself and the outgroup avatar, we made the group the referent (e.g., "In general, how similar do you think you are to the typical person with an ORANGE personality type?") before the outgroup trial block. Not surprisingly, similarity ratings were higher for the ingroup ($M = 5.10$, $SD = 1.05$) than for the outgroup ($M = 3.12$, $SD = 1.13$), $t(51) = 8.36$, $p < 0.001$, $g = 1.78$.⁶

6.2. Results and discussion

Data were prepared as in Experiment 1. Preliminary analyses revealed that avatar block order did not qualify the results; thus, we collapsed across this variable in the analyses reported below. A 2 (Avatar) \times 2 (Perspective) \times 2 (Consistency) repeated-measures ANOVA yielded main effects of Perspective (other > self), $F(1,55) = 7.04$, $p = 0.010$, $\eta_p^2 = 0.11$, and Consistency (inconsistent > consistent), $F(1,55) = 114.55$, $p < 0.001$, $\eta_p^2 = 0.68$, and a Perspective \times Consistency interaction (egocentric intrusion > altercentric intrusion), $F(1,55) = 25.98$, $p < 0.001$, $\eta_p^2 = 0.32$. More important was a significant 3-way interaction, $F(1,55) = 5.98$, $p = 0.018$, $\eta_p^2 = 0.10$. Inspection of the Perspective \times Consistency interaction separately in each avatar condition revealed that the underlying pattern of greater egocentric versus altercentric intrusion was stronger with the ingroup avatar, $F(1,55) = 32.61$, $p < 0.001$, $\eta_p^2 = 0.37$, than with the outgroup avatar, $F(1,55) = 4.93$, $p = 0.031$, $\eta_p^2 = 0.08$.

To further specify the 3-way interaction, as before, we calculated indices of egocentric and altercentric intrusion. As shown in Fig. 4, egocentric intrusion was stronger for the ingroup versus the outgroup avatar, $t(55) = 2.06$, $p = 0.044$, $g = 0.35$, whereas altercentric intrusion did not significantly differ across avatars, $t(55) = 1.42$, $p = 0.160$, $g = -0.20$.

Approaching the 3-way interaction differently, we again conducted separate 2 (Avatar) \times 2 (Perspective) repeated-measures

⁶ Because of a programming error, similarity ratings were not recorded for the first 4 participants.

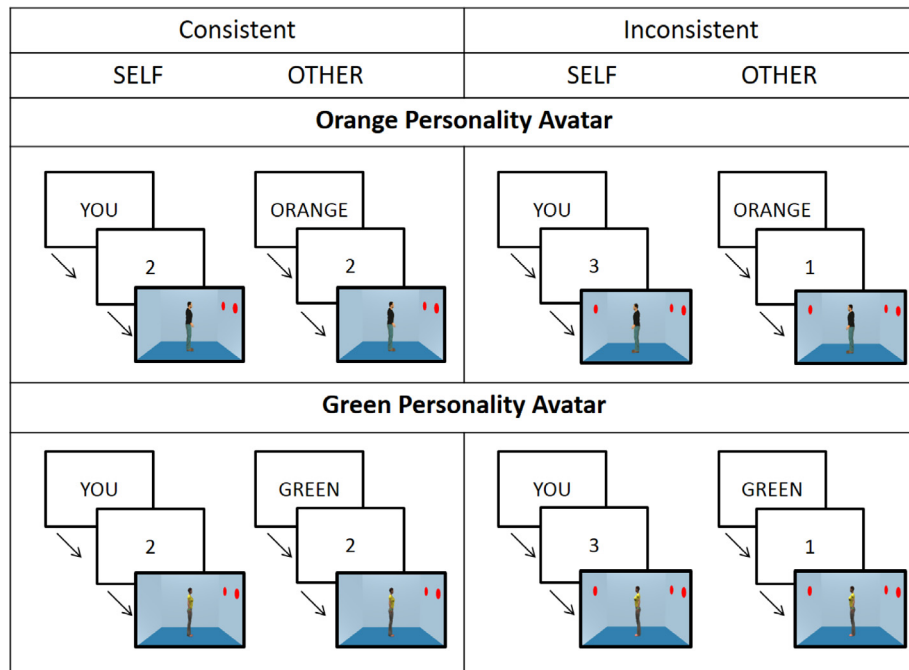


Fig. 3. Trial examples on the L1-VPT task (match trials). Participants verified if a given number (0–3) matched the number of dots visible either from their own perspective (YOU) or from the avatar's perspective (ORANGE or GREEN). The number of dots visible from each perspective was either the same (consistent) or different (inconsistent). (Not pictured are mismatch trials where the number of dots visible did not match the cued perspective.) (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

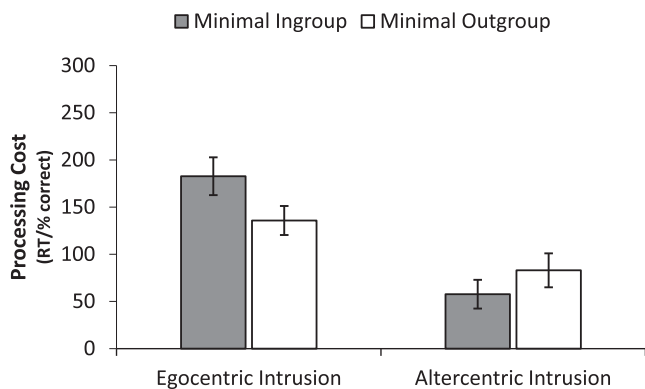


Fig. 4. Egocentric intrusion and altercentric intrusion by avatar condition (minimal ingroup vs. minimal outgroup); error bars depict ± 1 SE (Experiment 2).

ANOVAs on the consistent trials (i.e., perspectives aligned) and the inconsistent trials (i.e., perspectives in conflict). Analyses on the consistent trials revealed no significant effects ($F_s < 1.14$, $p_s > 0.29$, $\eta_p^2_s \leq 0.02$), suggesting again that avatar group membership effects were negligible when self and other perspectives were in unison. Analyses on the inconsistent trials revealed a significant Perspective main effect (other > self), $F(1,55) = 21.05$, $p < 0.001$, $\eta_p^2 = 0.28$. Although the Avatar main effect was not significant ($F < 1$, $p = 0.70$, $\eta_p^2 < 0.01$), a marginal Avatar \times Perspective interaction, $F(1,55) = 3.23$, $p = 0.078$, $\eta_p^2 = 0.06$, indicated that, as in Experiment 1, the pattern of higher processing cost on other trials versus self trials when perspectives conflicted was stronger with the ingroup versus the outgroup avatar.

7. Experiment 3: Process dissociation

Our first two experiments revealed consistent evidence for enhanced egocentric intrusion with ingroup versus outgroup

avatars; however, in neither experiment did we find significant group-based differences in spontaneous tendencies to calculate the avatar's perspective, thus lending additional support to the self-perspective-inhibition account. Granted, this interpretation of our findings assumes that altercentric-intrusion effects are a "pure" measure of automatic processing of the avatar's perspective. One problem with this interpretation is that no single task – nor a set of trials within a task – provides a pure assessment of automatic processing (Jacoby, 1991). If instead we assume that both automatic and controlled processes contribute to the strength of altercentric-intrusion effects in the L1-VPT task, it is possible that there are group-based differences in automatic processing that are masked by differences in controlled processing in the opposite direction.

To examine this possibility, we used a variant of Jacoby's (1991) process-dissociation procedure (PDP). Originally developed to disentangle latent processes that interact to drive performance on memory tasks, the PDP has been used to estimate the unique contributions of automatic and controlled processes to task performance in a wide range of other domains, including racial stereotyping (Payne, 2001; Todd, Thiem, & Neel, 2016), moral judgment (Cameron, Payne, Sinnott-Armstrong, Scheffer, & Inzlicht, 2017; Conway & Gawronski, 2013), empathy for pain (Cameron, Spring, & Todd, 2017), and, of particular interest for the current investigation, visual perspective-taking (Todd, Cameron, & Simpson, 2017). In Experiment 3, we used Todd et al.'s (2017) variant of the PDP to examine the effects of avatar group membership on component processes underlying altercentric-intrusion effects in L1-VPT.

7.1. Method

7.1.1. Participants and power

To increase the interpretability of potential null effects of mascot condition on altercentric intrusion (and PDP estimates of automatic and controlled processing), in Experiment 3, we

collected as much data as our resources would allow in a single semester. University of Iowa undergraduates ($N = 184$) participated for course credit. Following Todd et al. (2017), we excluded data from 21 participants with below-chance task performance, which could indicate confusion about response key mappings or task instructions. Furthermore, the PDP approach assumes that parameter estimates range from 0 to 1 (Jacoby, 1991); thus, we excluded data from 5 participants with negative controlled-processing estimates (Todd et al., 2017). Together, these exclusions left a final sample of 158 participants (92 women, 62 men, 4 unreported), which afforded >85% a priori power to detect a medium-sized effect ($\eta_p^2 = 0.06$).

7.1.2. Procedure and materials

All aspects of the procedure and materials were identical to those from Experiment 1, with one exception: To increase error-rate variability and thus afford more powerful PDP analyses (Payne, 2001), following Todd et al. (2017), we shortened the response deadline from 2000 ms to 750 ms.

7.2. Results and discussion

7.2.1. Error rates

The shortened response deadline restricted the range of RTs and increased error rates, making the processing cost metric unsuitable here (see Footnote 4). Furthermore, because PDP analyses are conducted on error rates, we used error rates as the unit of analysis in Experiment 3. Table 3 displays descriptive statistics by condition.

Unlike Experiments 1 and 2, preliminary analyses revealed that mascot block order moderated the key 3-way interaction; thus, we retained this variable in the analyses reported below. A 2 (Block Order) \times 2 (Mascot) \times 2 (Perspective) \times 2 (Consistency) mixed ANOVA, with repeated measures on the last three factors, yielded main effects of Perspective (other > self), $F(1,156) = 56.14$, $p < 0.001$, $\eta_p^2 = 0.27$, and Consistency (inconsistent > consistent), $F(1,156) = 479.22$, $p < 0.001$, $\eta_p^2 = 0.75$. As before, the Perspective \times Consistency interaction (egocentric intrusion > altercentric intrusion) was significant, $F(1,156) = 125.61$, $p < 0.001$, $\eta_p^2 = 0.45$. Although the Mascot \times Perspective \times Consistency interaction did not reach significance here, $F(1,156) = 2.22$, $p = 0.138$, $\eta_p^2 = 0.01$, a significant 4-way interaction, $F(1,156) = 8.62$, $p = 0.004$, $\eta_p^2 = 0.05$, indicated that the pattern of responding underlying the key 3-way interaction differed by mascot block order. There was also a significant Block Order \times Mascot interaction, $F(1,156) = 18.12$, $p < 0.001$, $\eta_p^2 = 0.10$, a marginal Mascot \times Consistency interaction, $F(1,156) = 3.63$, $p = 0.059$, $\eta_p^2 = 0.02$, and a marginal Block Order \times Mascot \times Consistency interaction, $F(1,156) = 46$, $p = 0.065$, $\eta_p^2 = 0.02$, that are all best understood in the context of the 4-way interaction. To better understand this unexpected 4-way interaction, we conducted separate 2 (Mascot) \times 2

(Perspective) \times 2 (Consistency) repeated-measures ANOVAs for each mascot block order.

7.2.2. Ingroup mascot block first

When participants completed the ingroup mascot block first, the Mascot \times Perspective \times Consistency interaction was significant, $F(1,81) = 8.62$, $p = 0.001$, $\eta_p^2 = 0.13$. Inspection of the Perspective \times Consistency interaction separately in each mascot condition revealed that the underlying pattern of greater egocentric versus altercentric intrusion was considerably stronger with the ingroup mascot, $F(1,81) = 67.10$, $p < 0.001$, $\eta_p^2 = 0.45$, than with the outgroup mascot, $F(1,81) = 13.22$, $p < 0.001$, $\eta_p^2 = 0.14$.

As in Experiments 1 and 2, we calculated indices of egocentric and altercentric intrusion to further specify the Mascot \times Perspective \times Consistency interaction. As shown in Fig. 5 (left side), these analyses revealed that, as before, egocentric intrusion was stronger with the ingroup versus the outgroup mascot, $t(81) = 3.83$, $p < 0.001$, $g = 0.46$, whereas altercentric intrusion did not significantly differ across mascot group membership, $t(81) = 1.33$, $p = 0.186$, $g = -0.18$.

Approaching this 3-way interaction differently, we again conducted separate 2 (Mascot) \times 2 (Perspective) repeated-measures ANOVAs on the consistent and inconsistent trials. Analyses on the consistent trials revealed only a marginal Mascot main effect (ingroup > outgroup), $F(1,81) = 3.83$, $p = 0.054$, $\eta_p^2 = 0.05$. Although neither the Perspective main effect (self > other), $F(1,81) = 2.63$, $p = 0.109$, $\eta_p^2 = 0.03$, nor the Mascot \times Perspective interaction reached significance, $F(1,81) = 2.33$, $p = 0.130$, $\eta_p^2 = 0.03$, the pattern of data indicated that responding from the ingroup mascot's perspective may have been easier than responding from the outgroup mascot's perspective when self and other perspectives were aligned. Analyses on the inconsistent trials revealed significant main effects of Mascot (ingroup > outgroup), $F(1,81) = 117.55$, $p < 0.001$, $\eta_p^2 = 0.14$, and Perspective (other > self), $F(1,81) = 75.66$, $p < 0.001$, $\eta_p^2 = 0.48$. Furthermore, a significant Mascot \times Perspective interaction, $F(1,81) = 10.22$, $p = 0.002$, $\eta_p^2 = 0.11$, indicated that, as in Experiments 1 and 2, the pattern of greater difficulty on other trials versus self trials when perspectives were in conflict was stronger with the ingroup versus the outgroup avatar.

7.2.3. Outgroup mascot block first

When participants completed the outgroup mascot block first, the Mascot \times Perspective \times Consistency interaction was not significant ($F < 1$, $p = 0.34$, $\eta_p^2 < 0.02$). Inspection of the Perspective \times Consistency interaction separately in each mascot condition revealed that the underlying pattern of greater egocentric versus altercentric intrusion was, if anything, directionally weaker with the ingroup mascot, $F(1,75) = 18.77$, $p < 0.001$, $\eta_p^2 = 0.20$, than with the outgroup mascot, $F(1,75) = 26.52$, $p < 0.001$, $\eta_p^2 = 0.26$.

Table 3
Error rates by perspective, consistency, avatar, and block order condition (Experiment 3).

Avatar condition	Perspective and consistency			
	Other		Self	
	Consistent	Inconsistent	Consistent	Inconsistent
<i>Ingroup mascot block first</i>				
Ingroup mascot	10.2 (10.5)	38.3 (18.8)	13.1 (12.4)	23.0 (14.5)
Outgroup mascot	9.6 (10.9)	29.7 (16.9)	9.6 (8.6)	22.0 (13.6)
<i>Outgroup mascot block first</i>				
Ingroup mascot	10.4 (11.2)	32.8 (17.9)	12.2 (10.9)	24.9 (16.0)
Outgroup mascot	13.9 (12.9)	37.4 (17.8)	15.1 (12.8)	25.6 (14.3)

Note. Values in parentheses are standard deviations.

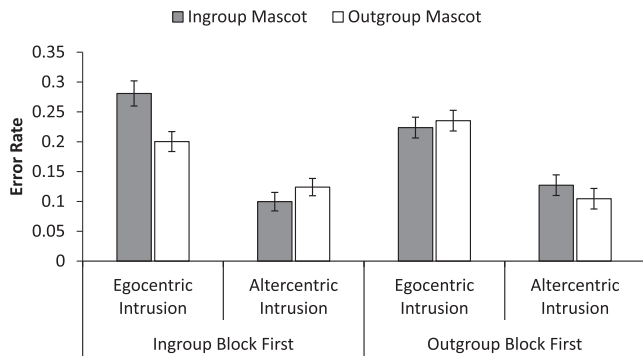


Fig. 5. Egocentric intrusion and altercentric intrusion by mascot condition (ingroup vs. outgroup) when the ingroup mascot block came first (left side) and when the outgroup mascot block came first (right side); error bars depict ± 1 SE (Experiment 3).

For comparison purposes with Experiments 1 and 2 and the preceding analyses (i.e., ingroup mascot block first condition), we again calculated indices of egocentric and altercentric intrusion. As shown in Fig. 5 (right side), these analyses revealed no significant effects of mascot group membership on either index ($|t| < 1$, $ps > 0.36$, $|g|s < 0.15$).

Approaching these data differently, we again conducted separate 2 (Mascot) \times 2 (Perspective) repeated-measures ANOVAs on the consistent and inconsistent trials. Analyses on the consistent trials revealed a significant Mascot main effect (outgroup > ingroup), $F(1, 75) = 7.78$, $p = 0.007$, $\eta_p^2 = 0.09$, and a marginal Perspective main effect (self > other), $F(1, 75) = 3.32$, $p = 0.073$, $\eta_p^2 = 0.04$. The Mascot \times Perspective interaction was not significant ($F < 1$, $p = 0.74$, $\eta_p^2 < 0.01$), which suggests that the pattern of higher error rates on self trials versus other trials when perspectives were aligned was comparable across group membership. Analyses on the inconsistent trials revealed a marginal Mascot main effect (outgroup > ingroup), $F(1, 75) = 3.85$, $p = 0.054$, $\eta_p^2 = 0.05$, and a significant Perspective main effect (other > self), $F(1, 75) = 44.33$, $p < 0.001$, $\eta_p^2 = 0.37$. However, the Mascot \times Perspective interaction was not significant, $F(1, 75) = 1.49$, $p = 0.225$, $\eta_p^2 = 0.02$, suggesting that the pattern of higher error rates on other trials versus self trials when perspectives were in conflict was comparable across group membership.

7.2.4. PDP estimates

We next conducted PDP analyses. The PDP approach assumes that the contributions of automatic and controlled processes can be dissociated by creating conditions that place these processes both in concert and in opposition (Jacoby, 1991). Applying this logic to altercentric-intrusion effects in the L1-VPT task, when one's own perspective aligns with the avatar's (i.e., consistent trials), automatically calculating the avatar's perspective and reporting one's own perspective lead to the same response. When one's own perspective differs from the avatar's (i.e., inconsistent trials), however, automatically calculating the avatar's perspective and reporting one's perspective lead to different responses. The critical equations for calculating estimates of controlled (C) and automatic (A) processing are as follows (for the full set of equations and a detailed description of the process parameters, see Todd et al., 2017):

$$C = P(\text{correct}|\text{consistent trials}) - P(\text{incorrect}|\text{inconsistent trials})$$

$$A = P(\text{incorrect}|\text{inconsistent trials}) / (1 - C)$$

Thus, C reflects accurate reporting of one's own perspective, whereas A reflects calculation of the avatar's perspective despite intending only to report one's own perspective. It is this latter

process that is of focal interest for claims about automatic perspective-taking. In a recent set of experiments, Todd et al. (2017) validated the meaning of these process parameters. Specifically, they found that imposing a fast response deadline reduced controlled processing, but it left automatic processing of the avatar's perspective unchanged. Additionally, automatic processing of the avatar's perspective was stronger for a human avatar than for a non-human entity (i.e., a dual-colored stick), whereas controlled processing was relatively unaffected by the social nature of the target. Importantly, this double-dissociation by theoretically-relevant manipulations (a) validates the assumption that automatic and controlled processes are independent in this task and (b) specifies different conditions under which these distinct processes operate. Following Todd et al. (2017), we computed separate estimates of C and A for each participant. In cases of perfect performance ($C = 1$), A is undefined; thus, we applied an adjustment commonly used in signal detection analyses (see Snodgrass & Corwin, 1988, for details).

A 2 (Block Order) \times 2 (Mascot) mixed ANOVA on the A estimates revealed no significant effects of Block Order ($F < 1$, $p = 0.55$, $\eta_p^2 < 0.01$), Mascot ($F < 1$, $p = 0.85$, $\eta_p^2 < 0.01$), or their interaction, $F(1, 156) = 1.91$, $p = 0.169$, $\eta_p^2 = 0.01$. Estimates of automatic processing were comparable across mascot group membership ($M_{\text{ingroup}} = 0.65$, $SD = 0.19$; $M_{\text{outgroup}} = 0.65$, $SD = 0.18$). An identical ANOVA on the C estimates revealed a marginal Block Order main effect (ingroup block first > outgroup block first), $F(1, 156) = 3.03$, $p = 0.084$, $\eta_p^2 = 0.02$. Furthermore, although the Mascot main effect did not approach significance ($M_{\text{ingroup}} = 0.62$, $SD = 0.22$; $M_{\text{outgroup}} = 0.63$, $SD = 0.20$; $F < 1$, $p = 0.77$, $\eta_p^2 < 0.01$), there was an unexpected Block Order \times Mascot interaction, $F(1, 156) = 4.34$, $p = 0.039$, $\eta_p^2 = 0.03$. When the ingroup mascot block came first, controlled processing was marginally weaker with the ingroup ($M = 0.62$, $SD = 0.22$) versus the outgroup mascot ($M = 0.67$, $SD = 0.17$), $t(81) = 1.69$, $p = 0.095$, $g = -0.21$. When the outgroup mascot block came first, however, controlled processing was non-significantly stronger with the ingroup mascot ($M = 0.61$, $SD = 0.22$) versus the outgroup mascot ($M = 0.58$, $SD = 0.22$), $t(75) = 1.26$, $p = 0.211$, $g = 0.15$.

The results of Experiment 3 partially replicated those obtained in Experiments 1 and 2. Specifically, when participants completed the ingroup mascot block first, egocentric intrusion was stronger with the ingroup versus the outgroup mascot, whereas altercentric intrusion was comparable across mascot group membership. Unexpectedly, however, there were no significant effects of mascot group membership on egocentric or altercentric intrusion when participants completed the outgroup mascot block first, an issue that we revisit below. Importantly, the results of Experiment 3 extend those obtained in our first two experiments: Using a process-dissociation approach designed to isolate the contribution of automatic processes to altercentric-intrusion effects, we found that automatic tendencies to calculate the avatar's perspective were comparable for ingroup and outgroup mascots.

8. General discussion

We used Samson et al.'s (2010) L1-VPT task to investigate the cognitive mechanisms underlying intergroup visual perspective-taking. In three experiments examining two distinct bases for group membership, participants displayed more egocentric intrusion with ingroup avatars than with outgroup avatars. This finding is consistent with prior work suggesting that people typically rely more heavily on accessible self-knowledge when reasoning about the beliefs, preferences, and other higher-level mental states of ingroup versus outgroup members (e.g., Ames, 2004a, 2004b; O'Brien & Ellsworth, 2012; Robbins & Krueger, 2005; Tamir &

Mitchell, 2013; Todd, Simpson et al., 2016; Todd et al., 2011). Across experiments, however, we did not find any significant effects of avatar group membership on altercentric intrusion, and PDP analyses further revealed that automatic processing of the avatar's perspective was comparable for ingroup and outgroup avatars.

8.1. Meta-analytic summary of findings

To estimate more precisely the magnitude of the avatar group membership effects reported across our experiments, we conducted two sets of meta-analytic tests (Borenstein, Hedges, Higgins, & Rothstein, 2009). We used the processing cost metric as the unit of analysis in Experiments 1 and 2 and the error-rate metric (with effect sizes in the two block orders computed separately and then combined⁷) as the unit of analysis in Experiment 3; analogous meta-analytic tests on the RT and error-rate metrics appear in the [Supplemental Material](#). In a first set of analyses, we examined the effect of group membership on the indices of egocentric intrusion and altercentric intrusion. These analyses revealed a small-to-medium-sized effect of avatar group membership (ingroup > outgroup) on egocentric intrusion ($g = 0.27$, 95% CI [0.14, 0.40]; $z = 3.95$, $p < 0.001$) and a non-significant effect in the opposite direction (ingroup < outgroup) on altercentric intrusion ($g = -0.10$, 95% CI [-0.24, 0.04]; $z = 1.41$, $p = 0.158$).

In a second set of analyses, we aimed to tease apart the effect of group membership on responding from the avatar's perspective when self and other perspectives were aligned versus when self and other perspectives were in conflict. We conducted separate analyses on the other-consistent trials and other-inconsistent trials, respectively. These analyses revealed a small effect of group membership (ingroup < outgroup) on the other-consistent trials ($g = -0.10$, 95% CI [-0.20, -0.01]; $z = 2.06$, $p = 0.040$) and a slightly stronger effect in the opposite direction (ingroup > outgroup) on the other-inconsistent trials ($g = 0.14$, 95% CI [0.04, 0.25]; $z = 2.66$, $p = 0.008$).

Together, the results of these analyses paint a more nuanced picture of our collective findings than what was revealed by the individual experiments alone. The analyses on egocentric and altercentric intrusion yielded a significant effect of avatar group membership on the former but not the latter, suggesting that shared group membership may bias visual perspective-taking by selectively impairing the inhibition of one's own perspective. The analyses on the other-consistent and other-inconsistent trials, however, suggest not only that shared group membership interfered with responding from the avatar's perspective when self and other perspectives were in conflict (Apperly et al., 2005; Samson et al., 2005), but also that it *facilitated* responding from the avatar's perspective when self and other perspectives were in unison. This latter finding, which provides suggestive evidence that ingroup members' perspectives may be calculated more readily than outgroup members' perspectives,⁸ comports with shared attention research, which has found that shared group membership with another agent amplifies co-attended aspects of the environment (Shteynberg, 2015; see also Smith & Mackie, 2016).

8.2. Limitations and future research directions

The current work serves as an initial exploration of how features of perspective-taking targets – in this case, their group membership – can shape cognitive processes underlying visual

perspective-taking. We acknowledge several limitations of our experiments, each of which suggests potential directions for future research. First, we did not include a manipulation check in Experiments 1 and 3; thus, we cannot be certain that our academic-identity salience procedure was successful. It is worth noting, however, that all participants in Experiments 1 and 3 were actual members of the group in question (i.e., University of Iowa students). Furthermore, the results observed in Experiment 2, which *did* include a manipulation check, aligned with the results observed in the other two experiments. Nevertheless, future research should aim to ensure that ingroup and outgroup avatars are indeed construed as ingroup and outgroup members.

Second, none of our experiments included a control condition with an avatar that was neither an ingroup member nor an outgroup member for participants. Thus, it is possible that some of the variance in our results might be explained by perceptual differences in the specific agents we used in the L1-VPT task. The results of Experiment 2, which used identical avatars (save for the different-colored shirts and wristbands), are difficult to reconcile with this account. However, including such a control condition in future work would afford a neutral comparison for assessing whether the current findings best reflect ingroup effects, outgroup effects, or both.

Third, all our experiments used designs in which the ingroup and outgroup avatars appeared in different, counter-balanced blocks of trials. One complication that arose from this design choice was the unexpected block order effect in Experiment 3. Specifically, it was only when the ingroup mascot block came first that we replicated the findings from the first two experiments. Importantly, block order did not moderate the effects of interest in Experiments 1 and 2, and accounting for the block order effect in Experiment 3 did not alter the results of our internal meta-analyses. Nevertheless, future research that uses a design in which the different avatars appear in the same block of trials could provide a useful extension of the current work.

The current research sets the stage for several additional directions for future investigations of how target characteristics shape processes involved in mental-state inference. For example, we examined group membership based on university affiliation and minimal groups. We acknowledge that membership in these groups is unlikely to feature importantly in most people's lives, and thus encourage future work to explore other bases of group membership, including identities (e.g., race, political orientation) that are more central to people's lives.

Future work should also investigate whether closeness with the avatar produces results that differ from those reported here—particularly the effects on avatar group membership on altercentric intrusion. The RICOR model (Smith & Mackie, 2016) proposes that people continually consider close others' perspectives and that spontaneous perspective calculation should be especially likely to occur in the presence of close others. Although people typically feel more closely linked to ingroup members than to outgroup members (Smith & Henry, 1996), we found no evidence of significant group differences in altercentric intrusion in any of our experiments, nor in PDP estimates of automatic perspective calculation in Experiment 3. It is possible that participants did not feel close enough to the avatars for detectable effects to manifest on altercentric intrusion. We did, however, find suggestive meta-analytic evidence that participants experienced greater ease in responding from an ingroup versus an outgroup member's perspective when their perspectives were aligned (i.e., on consistent trials), as the RICOR model would predict. By implementing techniques such as “tagging” the avatars as specific people (e.g., one's best friend; Mattan, Quinn, Apperly, Sui, & Rotshtein, 2015), future studies could systematically vary closeness with the avatar to further investigate this hypothesis.

⁷ Simply collapsing the data across block order yielded nearly identical results.

⁸ Because participants *intentionally* respond from the avatar's perspective on 'other' trials, the perspective calculation revealed by this effect cannot be described as *spontaneous*.

Finally, it is important to acknowledge that target *familiarity* and target *valence* both typically covary with target similarity and can have similar effects on perspective-taking. For instance, people tend to rely more heavily on self-referential information when reasoning about the mental states of well-known (Savitsky, Keysar, Epley, Carter, & Swanson, 2011) and well-liked others (Davis, 2017) than when reasoning about the mental states of strangers and disliked others. Although the results of Experiments 1 and 3 could plausibly be driven by target familiarity or target valence (i.e., one's own university's mascot is surely more familiar and arguably more liked than a rival university's mascot), target familiarity cannot explain Experiment 2's results, as participants were unfamiliar with the groups prior to the experiment. Because minimal ingroups are typically liked more than minimal outgroups (Tajfel et al., 1971), it is still possible that target valence can explain the pattern of results in Experiment 2. Challenging this possibility, however, is recent evidence indicating that effects of target valence on the use of self-knowledge during social inference can be entirely accounted for by perceived target similarity (Davis, 2017). Thus, we tentatively suggest that our findings are most parsimoniously explained as target similarity effects, though future research will be needed to disentangle target similarity from both target familiarity and target valence more conclusively.

9. Conclusion

The current research offers novel insights into how target group membership affects visual perspective-taking. Our findings extend those from prior work investigating the effects of group membership on reasoning about higher-level mental states (e.g., Ames, 2004a, 2004b; O'Brien & Ellsworth, 2012; Robbins & Krueger, 2005; Tamir & Mitchell, 2013; Todd, Simpson et al., 2016; Todd et al., 2011) to reasoning about lower-level aspects of what others can see: It is often when attempting to intuit the minds of similar others that our own perspectives most intrusively get in the way.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.cognition.2017.06.003>.

References

- Adams, R. B., Jr., Rule, N., Franklin, R. G., Jr., Wang, E., Stevenson, M. T., Yoshikawa, S., et al. (2010). Cross-cultural reading the mind in the eyes: An fMRI investigation. *Journal of Cognitive Neuroscience*, 22, 97–108.
- Ames, D. R. (2004a). Inside the mind-reader's toolkit: Projection and stereotyping in mental state inference. *Journal of Personality and Social Psychology*, 87, 340–353.
- Ames, D. R. (2004b). Strategies for social inference: A similarity contingency model of projection and stereotyping in attribute prevalence estimates. *Journal of Personality and Social Psychology*, 87, 573–585.
- Apperly, I. A. (2010). *Mindreaders: The cognitive basis of "theory of mind"*. Hove, UK: Psychology Press.
- Apperly, I. A., & Butterfill, S. A. (2009). Do humans have two systems to track beliefs and belief-like states? *Psychological Review*, 116, 953–970.
- Apperly, I. A., Samson, D., & Humphreys, G. W. (2005). Domain-specificity and theory of mind: Evaluating evidence from neuropsychology. *Trends in Cognitive Sciences*, 9, 572–577.
- Baker, L. J., Levin, D. T., & Saylor, M. M. (2016). The extent of default visual perspective taking in complex layouts. *Journal of Experimental Psychology: Human Perception and Performance*, 42, 508–516.
- Bernstein, M. J., Young, S. G., & Hugenberg, K. (2007). The cross-category effect: Mere social categorization is sufficient to elicit an own-group bias in face recognition. *Psychological Science*, 18, 706–712.
- Birch, S. A. J., & Bloom, P. (2004). Understanding children's and adults' limitations in reasoning about the mind. *Trends in Cognitive Sciences*, 8, 255–260.
- Birch, S. A. J., & Bloom, P. (2007). The curse of knowledge in reasoning about false beliefs. *Psychological Science*, 18, 382–386.
- Blader, S. L., Shirako, A., & Chen, Y. (2016). Looking out from the top: Differential effects of status and power on perspective taking. *Personality and Social Psychology Bulletin*, 42, 723–737.
- Borenstein, M., Hedges, L. V., Higgins, J. P., & Rothstein, H. R. (2009). *Introduction to meta-analysis*. Chichester, West Sussex: Wiley.
- Bruyer, R., & Brysbaert, M. (2011). Combining speed and accuracy in cognitive psychology: Is the inverse efficiency score (IES) a better dependent variable than the mean reaction time (RT) and the percentage of errors (PE)? *Psychologica Belgica*, 51, 5–13.
- Bukowski, H., Hietanen, J. K., & Samson, D. (2015). From gaze cueing to perspective taking: Revisiting the claim that we automatically compute where or what other people are looking at. *Visual Cognition*, 23, 1020–1042.
- Callahan, S. P., & Ledgerwood, A. (2016). On the psychological function of flags and logos: Group identity symbols increase perceived entitativity. *Journal of Personality and Social Psychology*, 110, 528–550.
- Cameron, C. D., Payne, B. K., Sinnott-Armstrong, W., Scheffer, J. A., & Inzlicht, M. (2017). Implicit moral evaluations: A multinomial modeling approach. *Cognition*, 158, 224–241.
- Cameron, C. D., Spring, V. L., & Todd, A. R. (2017). The empathy impulse: A multinomial model of intentional and unintentional empathy for pain. *Emotion*, 17, 395–411.
- Cole, G. G., Smith, D. T., & Atkinson, M. A. (2015). Mental state attribution and the gaze cueing effect. *Attention, Perception, & Psychophysics*, 77, 1105–1115.
- Conway, P., & Gawronski, B. (2013). Deontological and utilitarian inclinations in moral decision making: A process dissociation approach. *Journal of Personality and Social Psychology*, 104, 216–235.
- Conway, J. R., Lee, D., Ojaghi, M., Catmur, C., & Bird, G. (2017). Submentalizing or mentalizing in a level 1 perspective-taking task: A cloak and goggles test. *Journal of Experimental Psychology: Human Perception and Performance*, 43, 454–465.
- Davis, M. H. (2017). Social projection to liked and disliked targets: The role of perceived similarity. *Journal of Experimental Social Psychology*, 70, 286–293.
- Epley, N., Keysar, B., Van Boven, L., & Gilovich, T. (2004). Perspective taking as egocentric anchoring and adjustment. *Journal of Personality and Social Psychology*, 87, 327–339.
- Erle, T. M., & Topolinski, S. (2017). The grounded nature of psychological perspective-taking. *Journal of Personality and Social Psychology*, 112, 683–695.
- Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39, 175–191.
- Flavell, J. H., Everett, B. A., Croft, K., & Flavell, E. R. (1981). Young children's knowledge about visual perception: Further evidence for the level 1–level 2 distinction. *Developmental Psychology*, 17, 99–103.
- Furlanetto, T., Becchio, C., Samson, D., & Apperly, I. (2016). Altercentric interference in level 1 visual perspective taking reflects the ascription of mental states, not submentalizing. *Journal of Experimental Psychology: Human Perception and Performance*, 42, 158–163.
- Galinsky, A. D., Magee, J. C., Inesi, M. E., & Gruenfeld, D. H. (2006). Power and perspectives not taken. *Psychological Science*, 17, 1068–1074.
- Gardner, M. R., Hull, Z., Taylor, D., & Edmonds, C. J. (2017). 'Spontaneous' visual perspective-taking mediated by attention orienting that is voluntary and not reflexive. *The Quarterly Journal of Experimental Psychology*.
- Gosling, S. D., Rentfrow, P. J., & Swann, W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality*, 37, 504–528.
- Haslam, S. A., Oakes, P. J., Reynolds, K. J., & Turner, J. C. (1999). Social identity salience and the emergence of stereotype consensus. *Personality and Social Psychology Bulletin*, 25, 809–818.
- Heyes, C. M. (2014). Submentalizing: I'm not really reading your mind. *Perspectives on Psychological Science*, 9, 131–143.
- Hugenberg, K., & Bodenhausen, G. V. (2004). Category membership moderates the inhibition of social identities. *Journal of Experimental Social Psychology*, 40, 233–238.
- Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory. *Journal of Memory and Language*, 30, 513–541.
- Kessler, K., & Thomson, L. A. (2010). The embodied nature of spatial perspective taking: Embodied transformation versus sensorimotor interference. *Cognition*, 114, 72–88.
- Keysar, B., Lin, S., & Barr, D. J. (2003). Limits on theory of mind use in adults. *Cognition*, 89, 25–41.
- Leslie, A. M., Friedman, O., & German, T. P. (2004). Core mechanisms in "theory of mind". *Trends in Cognitive Sciences*, 8, 528–533.
- Leslie, A. M., German, T. P., & Polizzi, P. (2005). Belief-desire reasoning as a process of selection. *Cognitive Psychology*, 50, 45–85.
- Lieberman, M. D., Gaunt, R., Gilbert, D. T., & Trope, Y. (2002). Reflection and reflexion: A social cognitive neuroscience approach to attributional inference. *Advances in Experimental Social Psychology*, 34, 199–249.

- Lin, S., Keysar, B., & Epley, N. (2010). Reflexively mindblind: Using theory of mind to interpret behavior requires effortful attention. *Journal of Experimental Social Psychology*, *46*, 551–556.
- Luhtanen, R., & Crocker, J. (1992). A collective self-esteem scale: Self-evaluation of one's social identity. *Personality and Social Psychology Bulletin*, *18*, 302–318.
- Mattan, B., Quinn, K. A., Apperly, I. A., Sui, J., & Rotshtein, P. (2015). Is it always me first? Effects of self-tagging on third-person perspective-taking. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*, 1100–1117.
- Mussweiler, T. (2003). When egocentrism breeds distinctness: Comparison processes in social prediction. *Psychological Review*, *110*, 581–584.
- Nickerson, R. S. (1999). How we know—and sometimes misjudge—what others know: Imputing one's own knowledge to others. *Psychological Bulletin*, *125*, 737–759.
- Nielsen, M. K., Slade, L., Levy, J. P., & Holmes, A. (2015). Inclined to see it your way: Do altercentric intrusion effects in visual perspective taking reflect an intrinsically social process? *The Quarterly Journal of Experimental Psychology*, *68*, 1931–1951.
- O'Brien, E., & Ellsworth, P. C. (2012). More than skin deep: Visceral states are not projected onto dissimilar others. *Psychological Science*, *23*, 391–396.
- Payne, B. K. (2001). Prejudice and perception: The role of automatic and controlled processes in misperceiving a weapon. *Journal of Personality and Social Psychology*, *81*, 181–192.
- Qureshi, A. W., Apperly, I. A., & Samson, D. (2010). Executive function is necessary for perspective selection, not level-1 visual perspective calculation: Evidence from a dual-task study of adults. *Cognition*, *117*, 230–236.
- Ramsey, R., Hansen, P., Apperly, I., & Samson, D. (2013). Seeing it my way or your way: Frontoparietal brain areas sustain viewpoint-independent perspective selection processes. *Journal of Cognitive Neuroscience*, *25*, 670–684.
- Robbins, J. M., & Krueger, J. I. (2005). Social projection to ingroups and outgroups: A review and meta-analysis. *Personality and Social Psychology Review*, *9*, 32–47.
- Royzman, E. B., Cassidy, K. W., & Baron, J. (2003). "I know, you know": Epistemic egocentrism in children and adults. *Review of General Psychology*, *7*, 38–65.
- Samson, D., Apperly, I. A., Braithwaite, J. J., Andrews, B. J., & Bodley Scott, S. E. (2010). Seeing it their way: Evidence for rapid and involuntary computation of what other people see. *Journal of Experimental Psychology: Human Perception and Performance*, *36*, 1255–1266.
- Samson, D., Apperly, I. A., Kathirgamanathan, U., & Humphreys, G. W. (2005). Seeing it my way: A case of a selective deficit in inhibiting self-perspective. *Brain*, *128*, 1102–1111.
- Santiesteban, I., Catmur, C., Hopkins, S. C., Bird, G., & Heyes, C. (2014). Avatars and arrows: Implicit mentalizing or domain-general processing? *Journal of Experimental Psychology: Human Perception and Performance*, *40*, 929–937.
- Savitsky, K., Keysar, B., Epley, N., Carter, T., & Swanson, A. (2011). The closeness-communication bias: Increased egocentrism among friends versus strangers. *Journal of Experimental Social Psychology*, *47*, 269–273.
- Schneider, D., Lam, R., Bayliss, A. P., & Dux, P. E. (2012). Cognitive load disrupts implicit theory-of-mind processing. *Psychological Science*, *23*, 842–847.
- Shteynberg, G. (2015). Shared attention. *Perspectives on Psychological Science*, *10*, 579–590.
- Smith, E. R., & Henry, S. (1996). An in-group becomes part of the self: Response time evidence. *Personality and Social Psychology Bulletin*, *22*, 635–642.
- Smith, E. R., & Mackie, D. M. (2016). Representation and incorporation of close others' responses: The RICOR model of social influence. *Personality and Social Psychology Review*, *20*, 311–331.
- Snodgrass, J. G., & Corwin, J. (1988). Pragmatics of measuring recognition memory: Applications to dementia and amnesia. *Journal of Experimental Psychology: General*, *117*, 34–50.
- Sommerville, J. A., Bernstein, D. M., & Meltzoff, A. N. (2013). Measuring beliefs in centimeters: Private knowledge biases preschoolers' and adults' representation of others' beliefs. *Child Development*, *84*, 1846–1854.
- Srull, T. K., & Gaelick, L. (1983). General principles and individual differences in the self as a habitual reference point: An examination of self-other judgments of similarity. *Social Cognition*, *2*, 108–121.
- Surtees, A. D. R., & Apperly, I. A. (2012). Egocentrism and automatic perspective taking in children and adults. *Child Development*, *83*, 452–460.
- Surtees, A., Samson, D., & Apperly, I. (2016). Unintentional perspective-taking calculates whether something is seen, but not how it is seen. *Cognition*, *148*, 97–105.
- Tajfel, H., Billig, M. G., Bundy, R. P., & Flament, C. (1971). Social categorization and intergroup behaviour. *European Journal of Social Psychology*, *1*, 149–178.
- Tamir, D. I., & Mitchell, J. P. (2013). Anchoring and adjustment during social inferences. *Journal of Experimental Psychology: General*, *142*, 151–162.
- Todd, A. R., Cameron, C. D., & Simpson, A. J. (2017). Dissociating processes underlying level-1 visual perspective taking in adults. *Cognition*, *159*, 97–101.
- Todd, A. R., Forstmann, M., Burgmer, P., Brooks, A. W., & Galinsky, A. D. (2015). Anxious and egocentric: How specific emotions influence perspective taking. *Journal of Experimental Psychology: General*, *144*, 374–391.
- Todd, A. R., Hanko, K., Galinsky, A. D., & Mussweiler, T. (2011). When focusing on differences leads to similar perspectives. *Psychological Science*, *22*, 134–141.
- Todd, A. R., & Simpson, A. J. (2016). Anxiety impairs spontaneous perspective calculation: Evidence from a level-1 visual perspective-taking task. *Cognition*, *156*, 88–94.
- Todd, A. R., Simpson, A. J., & Tamir, D. I. (2016). Active perspective taking induces flexible use of self-knowledge during social inference. *Journal of Experimental Psychology: General*, *145*, 1583–1588.
- Todd, A. R., Thiem, K. C., & Neel, R. (2016). Does seeing faces of young Black boys facilitate the identification of threatening stimuli? *Psychological Science*, *27*, 384–393.
- Townsend, J. T., & Ashby, F. G. (1983). *Stochastic modeling of elementary psychological processes*. Cambridge, UK: Cambridge University Press.
- Turner, J. C., Hogg, M., Oakes, P., Reicher, S., & Wetherell, M. (1987). *Rediscovering the social group: A self-categorization theory*. Oxford, England: Blackwell.
- Tversky, A. (1977). Features of similarity. *Psychological Review*, *84*, 327–352.