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Agent preference in chasing interactions in Guinea baboons (*Papio papio*): uncovering the roots of subject-object order in language

Abstract

Languages tend to describe ‘who is doing what to whom’ by placing subjects before objects. This may reflect a bias for agents in event cognition: agents capture more attention than patients in human adults and infants. We investigated whether this agent preference is shared with non-human animals. We presented Guinea baboons (*Papio papio*, N = 13) with a change detection paradigm on chasing animations. The baboons were trained to respond to a color change which was applied to either the chaser/agent or the chasee/patient. They were faster to detect a change to the chaser than to the chasee, which cannot be explained by low-level features in our stimuli like the chaser’s motion pattern or position. An agent preference may be an evolutionarily old mechanism that is shared between humans and other primates, which could have become externalized in language as a tendency to place the subject first.

Keywords: agent-patient, thematic roles, event cognition, language evolution, linguistic universal, syntax

Research Transparency Statement

General Disclosures

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Study One Disclosures

Preregistration: The research aims/hypotheses, methods, and analysis plan were preregistered (https://doi.org/10.17605/OSF.IO/5SZQ4) on 2023-05-09 after data collection had started (which began on 2023-04-24), but prior to data analyses (which began on 2023-06-03). There were minor deviations from the preregistration (for details see Supplementary Table 1). Materials: All study materials are publicly available (https://doi.org/10.17605/OSF.IO/AHFMG). Data: All primary data are publicly available (https://doi.org/10.17605/OSF.IO/H63WS). Data: All analysis scripts are publicly available (https://doi.org/10.17605/OSF.IO/W879A).

Introduction

Human languages vary greatly at all levels of description, yet they also share an important number of commonalities (Greenberg, 1963). For instance, in 97% of languages with a dominant word order, the subject (S) precedes the object (O) (Dryer, 2013), e.g., "the girl (S) pushed the boy (O)" in English or "larki-ne (S) larke-ko (O) dhakka diya" in Hindi. These cross-linguistic statistical regularities have been the topic of many enquiries in the cognitive science of language, but their origin remains a topic of ongoing debates (Chomsky, 1957; Culbertson et al., 2020; Evans & Levinson, 2009; MacWhinney, 1977). Statistical universals may be the product of language contact and history (Dunn et al., 2011) and/or reflect evolutionary processes that are independent of cognition (Bybee, 2006, 2009; Gibson et al., 2019; Kirby et al., 2008). Another possibility is that they are the result of cognitive biases and mental representations that pre-exist language (Culbertson & Kirby, 2016; Martin et al., 2024; Strickland, 2017). For instance, the tendency for word orders to prioritize subjects before objects may originate from the way humans naturally process events around them, with a preference for attending to agents (typically mapped to subject positions) before patients (typically mapped to object positions) (Jackendoff, 1999; Ünal et al., 2021). Such an agent preference, i.e., a prioritized attention towards agents when observing events, has been recently argued to have deep evolutionary roots beyond human language (Wilson et al., 2022; Zuberbühler, 2019, 2020, 2022; Zuberbühler & Bickel, 2022).

The strong link between linguistic event descriptions and event cognition provides support for this theory (Rissman & Majid, 2019; Ünal et al., 2021). While reflected as specific arguments in active transitive sentences, the underlying conceptual structure is thought to be more general: the agent (doer) causes an action that affects the patient (undergoer; Fillmore, 1968; Jackendoff, 2002). Furthermore, the agent and patient are often characterized by features that are associated with their role, such as the agent's volitional behaviour, awareness, motility and independence, while the patient is defined by its reliance on the agent, undergoing change, and being less dynamic (Dowty, 1991). It follows that attributes such as agency (intentionality and goal-directedness) and animacy (being alive) are applicable to both roles, but are more likely to be associated with the agent role. Even though speakers can use linguistic devices to highlight any argument by placing it first, e.g., the patient in passive structures, placing the agent in subject position appears to be the default (Bickel et al., 2015; Gertner & Fisher, 2012).

Evidence that agent and patient may be represented in an abstract sense, comes from experiments demonstrating the saliency of these roles, and in particular the agent, over a wide range of events, such as pictures, drawings and even animations with 2D-shapes. Not only do human adults spontaneously and unconsciously extract event roles from brief visual events (Hafri et al., 2013, 2018), but agents attract their attention more than patients. While watching events, human adults first direct their gaze toward the agent of an action (Webb et al., 2010). Similarly, in cartoons, agents are looked at longer than patients (Cohn & Paczynski, 2013) and from short displays of drawings, agents are systematically better identified compared to patients, instruments and actions (Dobel et al., 2007). Furthermore, adults are faster to orient to agents when asked to detect agents than to orient to patients when asked to detect patients (Wilson et al., 2011).

Developmental studies suggest that this agent preference is not the result of linguistic experience with subject-object ordering. Seven-month-old infants use postural and positional cues to assign agent and patient roles in an abstract way (Papeo et al., 2024). When presented with 2D chasing interactions, five-month-old preverbal infants look more towards the chaser than the chasee (but not towards the leader in a following interaction, Galazka & Nyström, 2016) and thus show an attentional preference for chasers similar to human adults (Meyerhoff et al., 2014). In nine-month-old infants, looking at the chaser evokes neural responses related to social perception, suggesting that the chaser may be perceived as an animate entity (Galazka et al., 2016). This bias towards the agent appears to be reflected in word learning too; 14-month-olds learn more easily a label for a chaser than for a chasee (Yin & Csibra, 2015).

Although an agent preference is thus found under non-linguistic conditions, its evolutionary origins remain a mystery. One possibility is that an agent preference can be found in non-human animals. This would suggest that the structure of event representations has an old evolutionary history and may form the roots of one of the key characteristics of human language, its subject-object word order. Alternatively, an agent preference could be a typically human bias that has evolved concurrently with language (Wilson et al., 2022). The evidence for an agent preference in non-human animals so far is not conclusive. Although non-human animals can detect some cues indicative of animacy (Hauser, 1998; Rosa-Salva et al., 2016), less is known about using the relational aspect of an interaction to identify agents as compared to patients. Great apes (chimpanzees (*Pan troglodytes*), gorillas (*Gorilla gorilla*) and orangutans (*Pongo abelii*)) scan videos of dyadic event scenes similarly to humans with their gaze alternating between the agent and the patient, but in this study an agent preference was not observed in any of the species (including humans) (Wilson et al., 2023). At present, it thus remains unclear whether non-human animals also show an attentional bias for agents as compared to patients.

Here, we investigated the evolutionary origin of the agent preference in Guinea baboons (*Papio papio*). Baboons share a common ancestor with humans that lived 25-30 Mya. They have evolved under similar environmental conditions as humans (Fischer et al., 2019), making them a good model species for language evolution (Fagot et al., 2019), especially with regards to possible roots in social cognition (Seyfarth & Cheney, 2014). To test an agent preference in Guinea baboons, we studied their response to generated animations of chasing interactions in which the agent and the patient were represented by two identical, simple geometrical shapes. Although it is debated whether monkeys attribute mental states to 2D shapes (Schafroth et al., 2021), forms similar to ours have been repeatedly used in previous studies, which revealed that chasing can be discriminated from other motion patterns by human adults (Abdai et al., 2017; Atsumi et al., 2017; Barrett et al., 2005; Hofrichter & Rutherford, 2019; Meyerhoff et al., 2014; Rochat et al., 1997), human infants (Frankenhuis et al., 2013; Rochat et al., 1997) and several non-human species, including dogs (*Canis familiaris*; Abdai et al., 2017; Abdai & Miklósi, 2022), cats (*Felis silvestris catus*; Abdai & Miklósi, 2022), rhesus macaques (*Macaca mulatta*, Atsumi et al., 2017), squirrel monkeys (*Saimiri sciureus*; Atsumi & Nagasaka, 2015) and pigeons (*Columba livia*; Goto et al., 2002).

We presented baboons with a change detection task on a touch screen, in which the participants had to respond to a color change to either the agent or the patient of a chasing interaction, see Fig. 1. The rationale of this procedure is that areas that attract attention are prone to faster change detection than less-attended regions (New et al., 2007); a similar method using dot-probe tasks has been successfully applied to non-human primates (van Rooijen et al., 2017). We pre-registered the prediction that if baboons show an agent preference, such that the chaser captures their attention more than the chasee as in human infants and adults (Galazka et al., 2016; Meyerhoff et al., 2014), they should be faster to detect the color change applied to the chaser than to the chasee. Response time is indeed a widely used measure to test an agent bias (e.g., Hafri et al., 2018; Meyerhoff et al., 2014). We additionally tested accuracy with the same predictions. To control for a preference for the motion pattern regardless of the role, we implemented a random condition where we removed the interaction such that two objects were present that moved chaser-like and chasee-like, but non-contingently to each other. Additionally, to control for a preference for the object's position relative to the other, we implemented a condition where a leader, positioned in front, shows the way to a follower, positioned behind. In this case, the roles were reversed compared to the chasing condition: the agent (the leader) moves in front and the patient (the follower) behind.

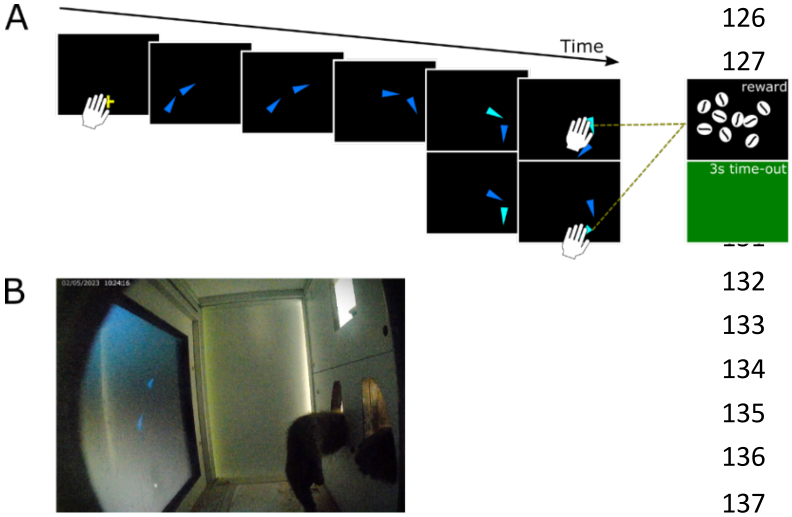

Fig. 1. Experimental set-up. Panel A shows an experimental trial of the chasing change detection task. First, a fixation cross appears that has to be touched by the participant. Next, an animation with moving objects is generated. Depicted here are two objects involved in a chasing interaction. After a certain period, one of the objects will change color. On the top row the agent changed color, on the bottom row the patient changed color. The changed object requires a touch response which subsequently results in a food reward as shown by the dotted line (top). Any other touches result in a three-second time-out screen (bottom). Panel B shows a participant taking part in the experiment.

Method

Ethics statement

The study on baboons was carried out in accordance with French and EU standards and received approval from the French Ministère de l'Education Nationale et de la Recherche (approval #APAFIS-2717-2015111708173794-V3). Procedures used in the present study were also consistent with the guidelines of the Association for the Study of Animal Behavior.

Participants

The study was made available to a group of 23 baboons who are housed at the "Station de Primatologie" in Rousset-sur-Arc (France) in two groups of eighteen and five individuals. 13 individuals (10 females, mean age = 12.1 ± 1.6(SEM) years, age range = 5.5-25.1 years) successfully learnt the task and were included in our analyses. The baboons were tested by using 14 automatic learning devices for monkeys (ALDM; Fagot & Paleressompoulle, 2009), equipped with touch screens and a food dispenser, which were freely accessible from their enclosure. The baboons participated voluntarily in these tasks employing an operant conditioning method.

Data collection started at the end of April 2023 and finished in the beginning of June 2023 for a period of forty days.

General procedure

We designed a change detection task. For humans, change detection paradigms have revealed a substantial role of attention in the detection of changes in scenes (Rensink et al., 1997). Importantly, areas that attract attention are prone to faster change detection than less-attended regions, such that, for example, changes to animate entities are noticed faster than to inanimate entities (Altman et al., 2016; New et al., 2007, 2010). A similar rationale is used for dot-probe tasks which show faster response times for touching the dot behind an attention-attracting picture and this type of paradigm has been successfully applied to non-human primates (van Rooijen et al., 2017).

In our adaptation of the change detection task, we used a color change which required a touch response. The color change was applied to an object in the shown animation, see Fig. 1. A trial consisted of a fixation cross, which had to be touched to start. Next, an animation was generated in which one object (during training) or two objects (during testing) were moving around on the screen. When one of them changed color, the participant had to touch it to earn a food reward. Touching either the background, the object that did not change color or any object before it changed color, resulted in a punishment of a three second green time-out screen, after which the trial ended. Without any touching response, the animation stopped after six seconds, and no reward was distributed. The experiment was created in and presented to the baboons with the Open Monkey Mind plugin of OpenSesame (Mathôt et al., 2012).

Stimuli and conditions

The stimuli were generated using a Pygame script in OpenSesame. For each trial, a new animation was generated such that no trial was ever the same. The animations were shown with a framerate of 60 fps on a black 1024 x 768 screen. The objects were triangles of 70 pixels in size, oriented towards the moving direction. Compared to circular shapes, triangles are known for enhancing the chasing perception (Abdai et al., 2021; Gao et al., 2009). The position of each object on the screen was updated each frame to make it look like it was moving. The stimuli were created with the goal of making the objects in the animation appear animate by mimicking the ability to self-propel and perform speed and directional changes; features to which newborns (Di Giorgio et al., 2017, 2021) and newly-hatched chicks (Rosa-Salva et al., 2016) are sensitive.

The moving behaviors were based on Reynold's descriptions of how to program naturally moving autonomous agents as described by Shiffman (Shiffman, 2012). The moving direction was defined by the current velocity vector and the 'desired' vector. Each frame, the object was updated from the current to the desired vector (the steering behavior), making the object appear to be moving into the direction of the desired vector. The desired vector had a combined direction and length based on a combination of different vectors that are acting on the object. Which forces made up the desired vector depended on the object. Details can be found in our Open Sesame script, which is available on OSF.

Several testing conditions will be presented below. For the chasing condition, we created a chasing interaction with configurations that are required for the impression of chasing to emerge for humans (Gao et al., 2009; Visch & Tan, 2009). During chasing, one object was the chaser that would always move towards a second object, the chasee. The chasee was wandering around and would accelerate and flee away when the chaser came close by (distance smaller than 200 pixels). The chaser is thus positioned behind and the chasee in front. In this interaction, the chaser is the agent and the chasee is the patient. We had two versions of chasing, one where the objects started further away from each other, creating a "heat-seek pursuit" from the chaser, and one where they would start close to one another. A heat-seek pursuit helps human adults and infants detect chasing (Galazka & Nyström, 2016; Gao et al., 2009).

For the following condition, we adjusted the behaviors of chasing such that we removed the fleeing behavior of the object positioned in front, making it seem as if it was leading the way for the object behind.

Note that here the agent-patient roles are reversed compared to chasing and now the object positioned in front is the agent and object behind the patient. Again, we implemented two versions of following, one where the two objects started far away from one another and one where they started close by.

In the random condition, two objects were present that were moving exactly like a chaser and a chasee but not contingently. To achieve this, we generated two sets of chasing interactions of which one showed only the chaser and the other only the chasee. In the first set, we made the object positioned in front black, leaving only the chaser visible, and in the second, we made the object behind black, leaving only the chasee visible.

Additionally, we had a final condition called clone. The clone condition was comparable to the one used by Atsumi & Nagasaka for squirrel monkeys (Atsumi & Nagasaka, 2015). Two objects moved side-by-side, one object moved as a chaser (chasing an invisible chasee) and a second object was placed alongside it. We implemented this condition because we wanted to exclude the possibility that potential differences between the chasing and the random condition could be explained by the fact that in chasing the objects were closer together than in random (regardless of the relation) making it easier to parse these stimuli. Baboons are known to have a local processing bias in visual tasks (Deruelle & Fagot, 1998), which may facilitate the processing of objects closer together compared to objects further apart. In the clone condition, we thus decided to keep the two objects close to each other, but not expressing an agent-patient relation, to test whether this would lead to shorter response times compared to random.

Example videos of our generated animations can be found on OSF (https://doi.org/10.17605/OSF.IO/AHFMG).

Training

We implemented a five-step training phase to familiarize the baboons with our change detection paradigm. During the training phase, only one object moved across the screen. The participant had to touch the object after it changed color. If the participant touched the object that changed color (within a radius of 140 pixels), this counted as a correct response.

We incrementally increased the timing of the color change and we decreased the perceptual saliency of the color change. In step 1, the color change appeared 100ms after the onset of the video, in step 2 it appeared at a randomly chosen time between 500 and 1000ms, in step 3 it was between 1000 and 3000ms and in step 4 and 5 between 3000 and 4000ms. In steps 1-4 we used the color change from blue (RGB(0,0,255)) to cyan (RGB(0,255,255)), in step 5 we used dark blue (RGB(0,55,99)) to another dark blue (RGB(37,43,99)). The two dark blue colors were chosen because they are close, but baboons are still able to perceive them as different (Davidoff & Fagot, 2010). At the same time, this color difference is subtle, which requires the baboons' attention to detect it and respond appropriately.

During training, the generated animations were based on the chasing stimuli from the test phase. Half of the trials, we showed one object moving chaser-like and half of the trials, chasee-like. We presented these trials in randomized order in blocks of 60 trials and when a criterion of 80% correct responses was reached, the participant continued to the next step. We measured which participants reached the criteria and in how many blocks they did so (see SI).

Test phase

During the test phase we showed our participants two-object animations. We implemented different conditions in the test phase: chasing (both with and without heat-seek pursuit), following (with and without heat-seek pursuit), random and clone.

The different conditions were displayed in random order in blocks of 60 trials. We thus had 10 trials per condition per block. The color change was applied at a randomly chosen time between 3000 and 4000ms from dark blue (RGB(0,55,99)) to another dark blue (RGB(37,43,99)). The color change was applied to one object in half of the trials and to the other in the remaining trials. Touching the object that changed color (within a radius of 140 pixels) counted as a correct response. We measured response time. We additionally measured accuracy, see SI for details. We collected 80 blocks of 60 trials, leading to 800 trials per condition per participant.

Analyses

Response time

To measure whether participants would be faster to respond to a color change applied to the agent compared to the patient in a chasing interaction, we tested whether there would be an interaction effect between the response times to the targets' color change in chasing and in the random condition, in which the objects are moving separately and do not display agent and patient roles. We additionally tested whether the direction of effect between the agent and patient would align for chasing and following to rule out an effect of positioning (in front or behind the other object).

We analyzed our data using a Bayesian generalized linear mixed model with ex-gaussian error structure implemented with the brms R package (Bürkner, 2017). Our preregistered model (RT ~ condition * target + (1+block|participant) turned out to be too complex, as it did not converge. To reduce complexity, we decided to 1) focus on the most relevant conditions only: chasing, following and random, excluding the clone condition[1] and 2) merge the chasing with and without heat-seek pursuit, as well as the following with and without heat-seek pursuit (as we detected no differences between them, see SI). Our model thus compares a chasing combined condition, a following combined condition and a random condition.

For all correct trials, we modelled the effect of condition (chasing combined, following combined and random) interacting with target (which of the two objects present changed color) on the response time after the color change, with intercepts varying per participant. We used the following model: RT ~ condition * target + (1+block|participant). We applied 4000 iterations and 4 chains.

For each parameter, we report estimates (B), estimated error (EE), and the 95% credible interval (CI). If zero lies outside the credible interval, we conclude there is sufficient evidence to suggest the estimate is different from zero.

Additionally, since we expected participants to be faster for the agent compared to the patient in chasing, we conducted post-hoc pairwise comparisons between the response times of the two objects within each condition. We used the computed estimated marginal means from the function 'contrast' of the R package 'emmeans' (Lenth, 2022) to determine whether there was an absolute difference between the response times of the two targets per condition.

Accuracy

Even though participants in the test phase were selected for high accuracy during training (participants needed to reach 80% correct responses to proceed through the five steps of training), we also assessed whether participants would identify a color change applied to the agent in a chasing interaction more accurately than a color change applied to the patient. We thus examined whether there would be an interaction between the accuracies of the two targets in chasing (i.e., agent and patient) and in the random condition, where the two targets moved non-contingently. We also tested whether the direction of effect between agent and patient for chasing would align with following, since following was designed to control for the positioning of the two objects. We used a Bayesian generalized linear mixed model with binomial error structure implemented with the brms R package (Bürkner, 2017). We adjusted our preregistered model similarly to the response time model, by 1) excluding the clone condition and 2) merging chasing

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[1] The clone condition was implemented to verify whether it may be easier to parse an animation with two objects that move close together (like chasing and following) compared to far apart (like random), but this was not the case. We observed an average response time of 1024 ± 32(SEM) ms in the clone condition, which appears to be higher than the response times in the random condition: 947 ± 14(SEM)) ms averaged over the two objects, indicating that the clone condition with two objects close together was not easier, but in fact harder, to parse than the other conditions.

and chasing without heat-seek pursuit into chasing combined and merging following and following without heat-seek pursuit into following combined (see below).

We modelled participants' responses (1 for correct, 0 for incorrect) using a mixed logit model specified as: response ~ condition * target + (1+block|participant) with target being one of the two objects present that changed color. We used 4000 iterations and 4 chains.

Like for the response time analyses, we report estimates (B), estimated error (EE), and the 95% credible interval (CI) and conclude there is enough evidence for an estimate different from zero if zero lies outside the credible interval.

We applied again post-hoc pairwise comparisons between the accuracies of the two objects within each condition using the computed estimated marginal means of the function 'contrast' of the package 'emmeans' (Lenth, 2022) to see whether the participants would be more accurate to detect a color change to the agent than to the patient in chasing.

Results

Training phase

The 13 baboons who successfully passed the training phases took on average 2806 ± 301 trials. Of the 13 who succeeded training, 10 completed all 4800 test trials. Three others who completed 2417 test trials, 2763 test trials and 3568 test trials were included in the analyses. See SI Table 2 for individual data.

Test phase

Response time

Our response time analysis revealed an interaction between condition and target when comparing the chasing condition to the random condition (B = -37.01, EE = 5.83, 95% CI = [-48.58, -25.65]), but not when comparing the chasing condition to the following condition (B = -2.66, EE = 4.65, 95% CI = [-11.72, 6.48]), see Fig. 2. These results are in line with our hypothesis for an agent bias that is irrespective of motion pattern (random condition) or positioning (following condition).

In the random condition, the baboons were slower to recognize a color change to the chaser-like object than to the chasee-like object (962 ± 22(SEM) ms vs. 932 ± 16(SEM) ms, B = 25.82, 95% CI = [16.2, 35.06]), suggesting that the motion of the chasee-like object attracts greater attention than the motion of the chaser-like object. This was the case for 9 of 13 baboons. Importantly however, when these same objects moved in concert in the chasing condition, the participants were significantly faster to detect the color change to the agent, the chaser, compared to the patient, the chasee (922 ± 22(SEM) ms vs. 951 ± 18.4(SEM) ms, B = -11.28; 95% CI = [-17.6, -4.75]), in line with the hypothesized agent preference. 11 of 13 baboons detected a color change faster for the agent than the patient during chasing. In the following condition, the color change to the agent, the leader, was detected faster than to the patient, the follower (954 ± 30(SEM) ms vs. 966 ± 35(SEM) ms, B = -8.51; 95% CI = [-15.0, -2.26]), consistent with an agent preference. 9 of 13 baboons had a faster response time for the agent compared to the patient in following. These results suggest that the agent's position behind the patient in chasing cannot account for faster responses when a color change is applied to the agent compared to the patient in a chasing interaction, because in the following condition, the agent was positioned in front and yet captured the fastest responses.

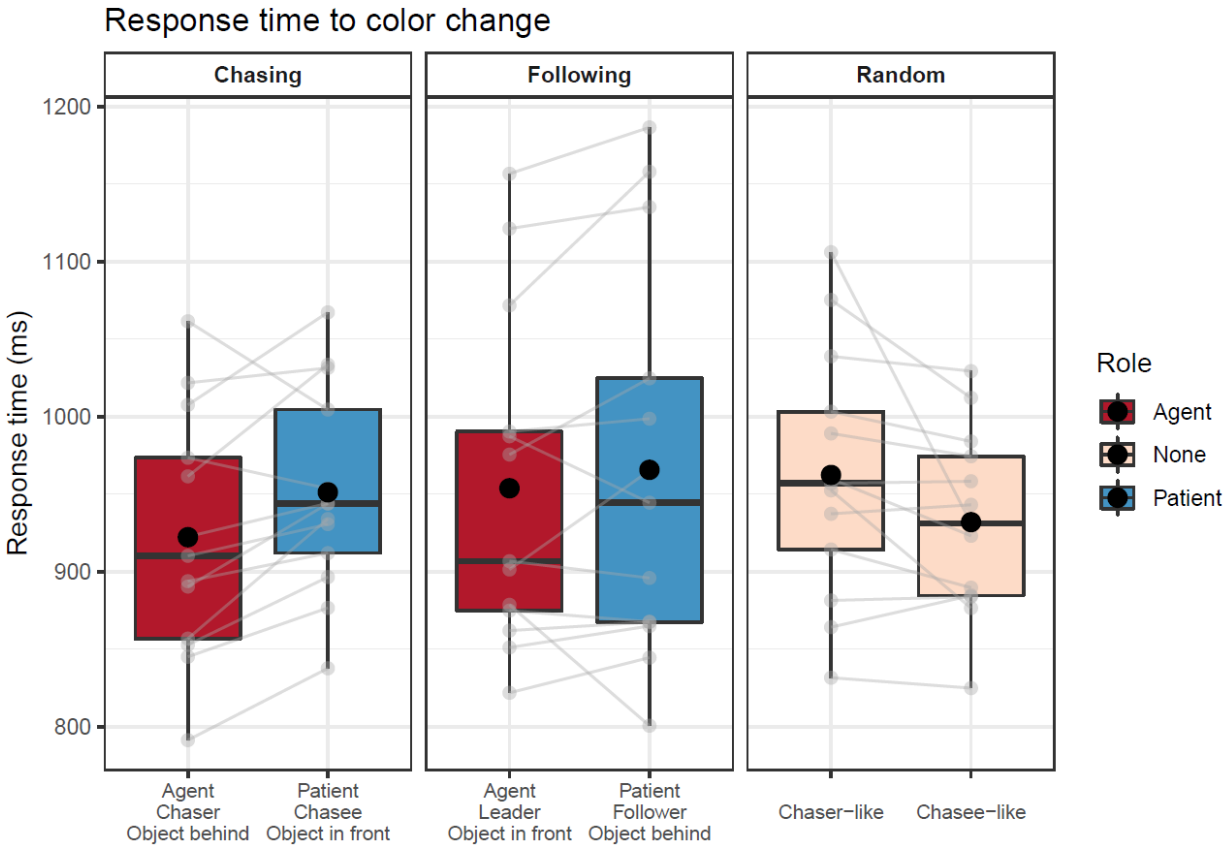

Fig. 2. Response times (in ms) to the color changes applied to the two moving objects in our different conditions. Average response times are displayed with a large black dot and the grey lines indicate individual data.

Accuracy

Accuracy in detecting color changes was consistently high for all conditions and targets because participants were trained to be accurate throughout training and testing by positive reinforcement. As hypothesized, the accuracy analysis showed an interaction between condition and target when comparing the chasing condition and the random condition (B = 0.61, EE = 0.09, 95% CI = [0.43, 0.78]), indicating that motion alone cannot explain the results in chasing, see Fig. 3. Contrary to our expectations, we also found such an interaction when comparing the chasing and the following condition (B = 1.32, EE = 0.08, 95% CI = [1.17, 1.47]), showing that the relative positioning appears to affect accuracy in the following condition.

Post-hoc, we tested for differences in accuracy to detect a color change between the two targets in each condition. In the random condition, the baboons were equally accurate to detect the color change to the chaser-like object as to the chasee-like object (91.1 ± 1.3(SEM) % correct vs. 90.7 ± 1.0(SEM) % correct, B = 0.06, 95% CI = [-0.09, 0.20]). For chasing, the baboons were more accurate for the agent, the chaser, compared to the patient, the chasee (92.1 ± 1.0(SEM) % correct vs. 86.3 ± 1.1(SEM) % correct, B =

0.66, 95% CI = [0.57, 0.77]), which is in line with the hypothesized agent preference. In the following condition, the baboons identified the color change to the patient, the follower, more accurately than to the agent, the leader (94.2 ± 0.8(SEM) % correct vs. 89.6 ± 0.9(SEM) % correct, B = -0.66, 95% CI = [-0.77, -0.55]), which is not in line with an agent preference and shows that the positioning behind the other object (follower behind leader) facilitates responding accurately. We come back to this point in the discussion.

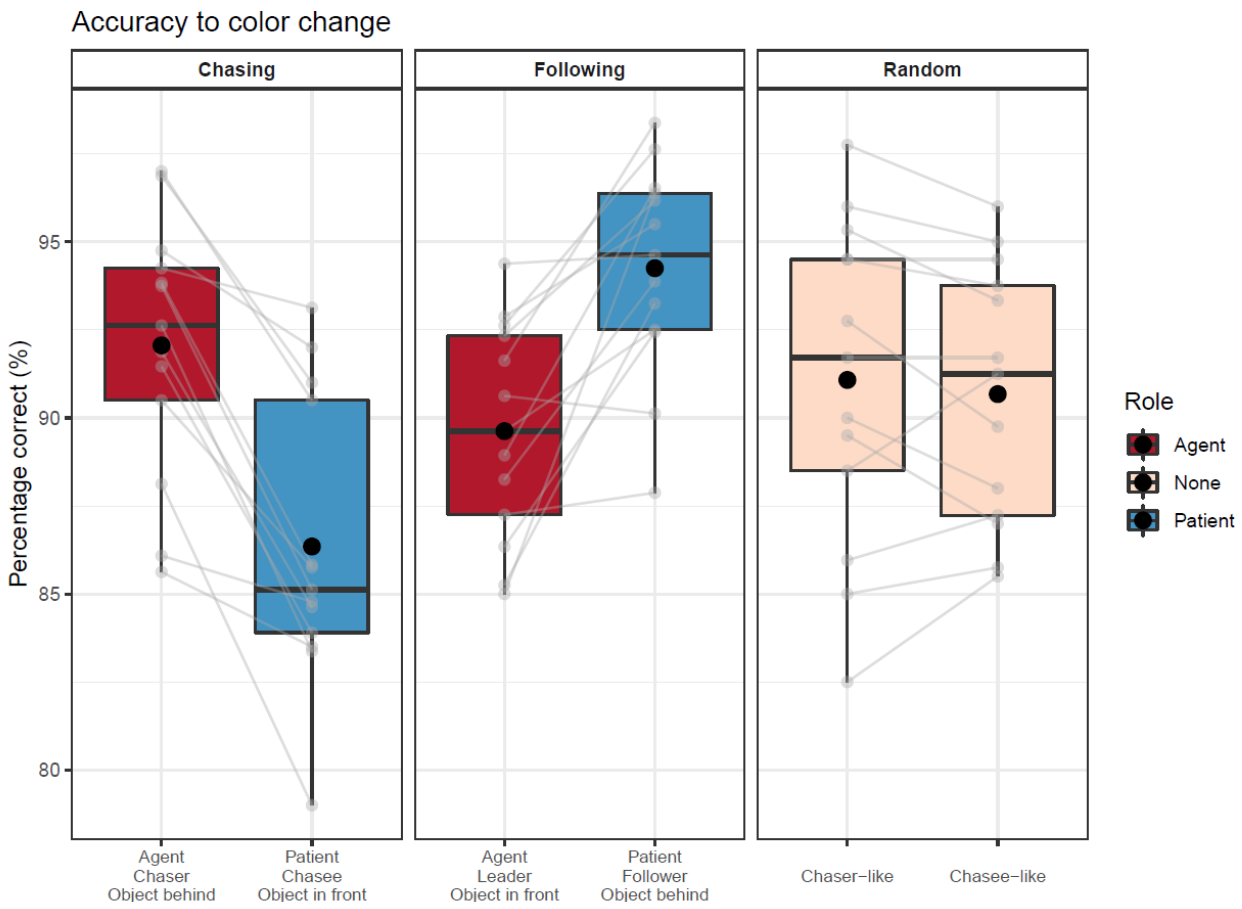

Fig. 3. Accuracy (in % correct) to the color changes applied to the two moving objects in our different conditions. Average accuracy scores are displayed with a large black dot and the grey lines indicate individual data.

Discussion

This study demonstrates that Guinea baboons have an agent preference in chasing interactions: they are faster and more accurate to detect a color change that is applied to the agent compared to the patient of a chasing interaction. This suggests that, consistent with our hypothesis, baboons exhibit an attentional bias towards the chaser similarly to human adults (Meyerhoff et al., 2014) and preverbal infants (Galazka & Nyström, 2016).

Importantly, more accurate and faster responses for the chaser compared to the chasee cannot be attributed to the chaser’s specific motion pattern, because in the random condition, where the objects moved independently, baboons were equally accurate for both objects, and even exhibited a faster response for the chasee-like object instead of the chaser-like object. We speculate that this facilitating effect for faster responses towards the chasee-like object stemmed from the chasee's more erratic movements. Similar preferences for looking at unpredictable movements have been documented in human adults and dogs (Abdai et al., 2017) and newly-hatched chicks (Lemaire et al., 2022). Crucially, when the same two objects move closer together and in contingency in the chasing condition, this preference for a separately moving chasee shifted in favor of the chaser portraying the agent role. We view this as strong evidence for an agent preference, suggesting that the coordinated motion during chasing overcame the preference for the chasee's motion.

Similarly, faster responses for the chaser compared to the chasee cannot be the result of baboons anticipating the chaser's trajectory based on the motion of the object positioned in front. In the following condition, baboons were faster to respond to the object positioned in front, whose trajectory is not predictable (the agent/leader) compared to the object positioned behind, whose trajectory could be predicted from the first one (the patient/follower). This suggests that motion predictability is not what results in faster responses for chasers compared to chasees.

In summary, our findings suggest that baboons possess an agent preference, i.e., a prioritized attention towards agents when observing events. This agent bias was most visible during chasing events, where we observed it in response time and accuracy. In following events, the preference for the agent was smaller in response time and the baboons showed a reversed bias (i.e., greater accuracy for the follower) for accuracy. A possible reason for this discrepancy could be that a following interaction is not the most prototypical agent-patient relation in the sense that the agent is facing *away* from the patient, and that an effect of surprise changed the baboon’s attentional strategy and response biases in the task. Often, having an agent facing towards the patient is considered an important cue for the role attribution (Hafri et al., 2013; Papeo et al., 2024). Consistent with this idea, five-months-old human infants looked longer to a chaser in a chasing interaction but not to a leader in a following interaction (Galazka & Nyström, 2016). Baboons’ agent preference is thus so far restricted to chasing events. Although data on the agent preference in human adults is based on more varied event types, most infant studies used chasing patterns (Galazka et al., 2016, 2016; Yin & Csibra, 2015) making it impossible to judge whether they attend to the chaser because it is the chaser or because it portrays the agent role in an abstract sense (but see: Papeo et al., 2024). Further investigation is thus needed to determine whether the agent preference we uncovered for chasing in baboons, extends to other events.

The discovery that baboons do not process the chasing events holistically, but instead decompose them into agent and patient roles with a specific focus on the agent, alludes to the possibility that baboons cognitively represent events in a similar format to humans, akin a language of thought. The agent preference indeed fulfills a key property of a language of thought: the presence of constituents that are discrete and structured (Quilty-Dunn et al., 2023).

The similarity between baboons' and humans' event processing has important implications. A fundamental cognitive capacity to represent events with a preference for the agent, may form the basis of event syntax in languages, which is proposed by Wilson and colleagues as the agency detection hypothesis (Wilson et al., 2022). This theory accounts for the tight link between event cognition and linguistic structure (Papafragou & Grigoroglou, 2019; Rissman & Majid, 2019; Ünal & Papafragou, 2016) and elaborates that cross-linguistic syntactic regularities in linguistic event descriptions are externalizations of how we mentally represent them (Strickland, 2017; Ünal et al., 2021; Zuberbühler & Bickel, 2022). At minimum, our results suggest that the cognitive mechanisms involved in processing events are evolutionarily old and can possibly be traced back to at least the last common ancestor between baboons and humans who lived approximately 30 Mya.

Considering the relatively recent emergence of language in humans, we propose that it draws upon various cognitive functions that have evolved for diverse purposes. The ability to represent ‘who is doing what to whom’ may be a fundamental cognitive capacity shared across species. An agent preference serves as a possible explanation for why we observe a cross-linguistic tendency to emphasize the subject by placing it first. This word order may stem from an agent preference rooted in cognition, challenging the idea that word order patterns are solely the product of deep linguistic principles.

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