



Published in final edited form as:

Atten Percept Psychophys. 2014 November ; 76(8): 2175–2183. doi:10.3758/s13414-014-0744-x.

Finding Faces Among Faces: Human Faces are Located More Quickly and Accurately than Other Primate and Mammal Faces

Elizabeth A. Simpson

University of Parma, Italy, and *Eunice Kennedy Shriver* National Institute of Child Health and Human Development, National Institutes of Health, USA

Zachary Buchin, Katie Werner, Rey Worrell, and Krisztina V. Jakobsen

James Madison University

Abstract

We tested the specificity of human face search efficiency by examining whether there is a broad window of detection for various face-like stimuli—human and animal faces—or whether own-species faces receive greater attentional allocation. We assessed the strength of the own-species face detection bias by testing whether human faces are located more efficiently than other animal faces, when presented among various other species' faces, in heterogeneous 16-, 36-, and 64-item arrays. Across all array sizes, we found that, controlling for distractor type, human faces were located faster and more accurately than primate and mammal faces, and that, controlling for target type, searches were faster when distractors were human faces compared to animal faces, revealing more efficient processing of human faces regardless of their role as targets or distractors (Experiment 1). Critically, these effects remained when searches were for specific species' faces (human, chimpanzee, otter), ruling out a category-level explanation (Experiment 2). Together, these results suggest that human faces may be processed more efficiently than animal faces, both when task-relevant (targets), and when task-irrelevant (distractors), even when in direct competition with other faces. These results suggest that there is not a broad window of detection for all face-like patterns, but that human adults process own-species' faces more efficiently than other species' faces. Such own-species search efficiencies may arise through experience with own-species faces throughout development, or may be privileged early in development, due to the evolutionary importance of conspecifics' faces.

Keywords

face detection; visual attention; visual search; search efficiency; animal faces

From an evolutionary perspective, conspecifics' faces may be one of the most relevant visual stimuli, given their roles (e.g., identifying, communicating) and the wealth of information they provide (e.g., attention and emotion states). If so, then human faces may be located more efficiently than faces of other species. Previous studies suggest a human face detection advantage (e.g., Hershler, Golan, Bentin, & Hochstein, 2010; Hershler &

Hochstein, 2005, 2006; Rousselet, Macé, & Fabre-Thorpe, 2003; Stein, Sterzer, & Peelen, 2012). Although it may be commonly accepted that human faces should be detected more efficiently than faces of other species, this has not been empirically tested in a context in which faces of different species are competing for attention. The goal of the present study was not to demonstrate that faces are located more efficiently than non-faces, but rather, to test the specificity of human face search efficiency; namely, our goal was to test whether there is a broad window of detection for all face-like patterns or whether own-species faces are processed more efficiently than faces of other species. In natural environments, humans often encounter numerous individuals at once, and therefore, limited attentional resources must be allocated to some faces more than others. We tested attention allocation in this context, specifically, whether human faces, compared to animal faces, are detected more efficiently when surrounded by other species' faces. Searching for a face among faces is more difficult than searching among non-faces, as targets and distractors are more similar (Duncan & Humphreys, 1989).

In addition, if own-species faces are located more efficiently, they may do so even when task-irrelevant. Singleton task-irrelevant human faces slow searches (Devue, Belopolsky, & Theeuwes, 2012; Langton, Law, Burton, & Schweinberger, 2008; Parks, Kim, & Hopfinger, 2014; Ro, Friggel, & Lavie, 2007; Simpson, Mertins, Yee, Fullerton, & Jakobsen, in press); we assessed whether reductions in search efficiency also occur when all distractors are faces, and whether task-irrelevant animal faces influence search efficiency. If human faces automatically attract attention more than animal faces, then searches would be slowed more when task-irrelevant human faces are present, compared to animal faces. Alternatively, human faces may be processed more efficiently than animal faces because they are more familiar (Natu, Raboy, & O'Toole, 2011; Tong & Nakayama, 1999); if this is the case, searches may be faster when distractors are human faces, compared to animal faces.

We tested these hypotheses in two experiments in which human adults were instructed to search for human, nonhuman primate (hereafter primate), and nonprimate mammal (hereafter mammal) faces in 16-, 36-, and 64-item arrays.

Experiment 1

Method

Participants—Thirty-three healthy adults participated for course credit (9 men; age in years: $M = 18.6$, $SD = 0.75$). Twenty-nine participants were Caucasian and four were other ethnicities. This sample excludes two participants who failed to follow instructions and two participants due to technical difficulties. Participants reported normal or corrected-to-normal vision.

Materials—Participants viewed 360 arrays, each containing 16, 36, or 64 colored photographs (Figure 1), using a method employed previously (for stimulus creation details, see Hershler & Hochstein, 2005; Simpson et al., in press). There were 72 arrays for each of four target types (human, primate, mammal, object), and 72 arrays in which there was no target. Within arrays for each target type, there were 24 arrays for each distractor type (i.e., human, primate, mammal, object). Within each of those 24 arrays, there were 8 arrays of

each of the 3 array sizes (16-item, 36-item, and 64-item). Photographs were 2.4–2.9 × 2.6–3 cm (width × height) were collected through internet searches. We used heterogeneous photos (e.g., diverse backgrounds, lighting, angles) to reduce low-level target detection (Herschler & Hochstein, 2005, Simpson et al., in press). Face photos had to contain all inner features (eyes, nose, mouth), did not include excessive costume or makeup, and were confirmed to be neutral in expressions (Simpson et al., in press). Object photos included both natural items (e.g., trees) and man-made items (see Simpson et al., in press). Each target was only used once and each distractor image appeared as a distractor no more than six times. Target locations were semi-random, but appeared within each array quadrant an equal number of times across conditions.

We recorded eye movements via corneal reflection using a Tobii T120XL, with a 43 cm monitor positioned 60 cm from participants, with a sampling rate of 120 Hertz. We used Tobii Studio software (Tobii Technology, Sweden) to collect and summarize data. Participants completed a 5-point eye-gaze calibration before testing. We collected manual responses with a keyboard.

Procedure—Participants searched for targets among distractors. Participants were instructed to “Find the object” or find a particular type of face (i.e., “Find the human/ primate/mammal”) within each block, and to indicate the targets’ locations (left side, right side, or not present). To ensure participants understood the task, they first completed a practice block. Participants completed 360 trials with 45 trials in each of the eight order-randomized blocks. Each block contained only one type of target (objects and faces of humans, primates, and mammals), but each type of distractor (intermixed). Trials with object distractors were analyzed separately (Simpson et al., in press).

Data analysis—We first assessed search efficiency with search slopes, examining gaze reaction time as a function of the number of items in the arrays (i.e., set size; Treisman & Souther, 1985). We next assessed gaze response speed across human, primate, and mammal face distractors, controlling for face target type. Given our primary interests in the effects of target and distractor types, we next report these results pooling across set sizes. Finally, we examined participants’ manual response accuracy across human, primate, and mammal face distractors, controlling for face target type. Our analysis revealed the same effects of target and distractor types across each array size, so we report accuracy results pooling across set sizes.

We extracted gaze data with a clear view filter, and defined fixations as >100 ms in a 50-pixel radius. Within each array, equally sized areas of interest were created around targets (3 × 3 cm). We examined participants’ manual response accuracy (percent correct) and gaze response time (RT). Gaze RT analysis included only correct responses. Homogeneity of variance was verified using Levene’s test. All *t* tests were paired-samples, two-tailed, and included Bonferroni corrections ($p = .05 / 3$ comparisons = .0167).

Results

Face target search efficiency—The average slopes for locating face targets of each species are presented in Figure 2A. Paired samples *t* tests comparing search slopes, revealed

that human face searches were more efficient (slopes were less steep) than primate or mammal face searches, controlling for distractor types, $t(32) = 9.08$, $p < .001$, $d = .97$, and $t(32) = 5.39$, $p < .001$, $d = 1.41$, respectively. There was no difference between the primate and mammal face target search slopes, $t(32) = 1.53$, $p = .0135$. Overall, human face targets had flatter search slopes ($M = 22.98$ ms/item, $SD = 14.01$) compared to nonhuman animal face targets ($M = 56.29$ ms/item, $SD = 19.78$), $t(32) = 10.38$, $p < .001$, $d = 1.81$.

Human faces were located more quickly than primate and mammal faces, $t(32) > 11.56$, $ps < .001$, $ds > 2.01$, and primate and mammal faces were located equally fast, $t(32) = 1.31$, $p = .198$ (Figure 3A). Responses were more accurate when targets were human faces, compared to primate and mammal faces, $t(32) > 8.53$, $ps < .001$, $ds > 1.49$; however, there was no difference in accuracy for primate and mammal face targets, $t(32) = 2.03$, $p = .051$ (Figure 3B).

Human face targets were identified as absent more quickly than primate and mammal face targets, controlling for distractor type, $t(32) > 8.00$, $ps < .001$, $ds > 1.39$; primate and mammal face targets did not differ, $t(32) = .12$, $p = .904$ (Figure 4).

Face distractor rejection efficiency—Gaze RTs to locate target faces were also faster when the distractors were human faces compared to primate and mammal faces, $t(32) > 7.56$, $ps < .001$, $ds > 1.32$ (Figure 4A). When targets were human faces, responses were faster when the distractors were mammal faces compared to primate faces, $t(32) = 2.66$, $p = .012$, $d = .46$ (see Figure 3A). When targets were absent, searches were faster when the distractors were human faces compared to primate and mammal faces, $t(32) > 6.55$, $ps < .001$, $ds > 1.14$, and there were no differences in search speed when distractors were primates or mammals, $ps > .05$ (Figure 4).

Accuracy was higher when distractors were human faces compared to primate and mammal faces, $t(32) > 9.16$, $ps < .001$, $ds > 1.59$; participants were equally accurate when distractors were primate and mammal faces, $t(32) = 1.52$, $p = .139$ (Figure 3B).

Discussion

In support of our predictions, we found that human faces, compared to animal faces, were located faster and more accurately, had less steep search slopes, were rejected as distractors faster and more accurately, and were more quickly identified as absent. Although these results suggest that human faces may be located more efficiently than animal faces, in Experiment 1, the category level of targets and distractors lacked control. That is, humans are a specific species, while primates are an order (broader category), and mammals are a class (even broader category); therefore, the present results may simply reflect differences in category specificity, and not necessarily a human face search advantage. We tested this in Experiment 2, controlling category levels.

Experiment 2

Method

Participants—Thirty-eight healthy adults participated for course credit (9 men; age in years: $M = 18.97$, $SD = 1.05$). Thirty participants were Caucasian and eight were other ethnicities. This sample excluded six participants who failed to follow instructions and six participants who had poor accuracy (<80% correct). None of the participants in Experiment 2 participated in Experiment 1.

Materials—Participants viewed 54 arrays, each containing 16, 36, or 64 colored photographs, with 36 trials each containing one face target, and 18 trials (33%) of trials containing no target (target-absent), as in Experiment 1 (Figure 5). Unlike Experiment 1, the present experiment included specific species categories—human, chimpanzee, and otter faces—both as targets, and as distractors. We selected chimpanzees and otters because they are familiar species. Images were selected and sized as in Experiment 1. Responses were recorded as in Experiment 1.

Procedure—Participants searched for targets among distractors. Participants were instructed to locate specific species faces “Find the human/chimpanzee/otter faces” within each block, and to indicate the targets’ locations (left side, right side, or absent).

Data analysis—Data were extracted and analyzed as in Experiment 1.

Results

Face target search efficiency—Paired samples t tests comparing search slopes, revealed that human face searches were more efficient (slopes were less steep) than chimpanzee face searches, controlling for distractor type, $t(37) = 3.53$, $p = .001$, $d = .57$ (Figure 2B). There were no differences in slopes for locating human and otter face targets, $t(37) = .318$, $p = .75$, or chimpanzee and otter face targets, $t(37) = .898$, $p = .38$. Nonetheless, overall, human face targets had flatter search slopes ($M = 33.27$ ms/item, $SD = 35.82$) compared to nonhuman animal face targets ($M = 47.38$ ms/item, $SD = 20.73$), $t(37) = 2.78$, $p = .008$, $d = .45$.

Gaze RTs to locate faces were faster when targets were human faces compared to chimpanzee and otter faces, $t(37) > 4.12$, $ps < .001$, $ds > .67$ (Figure 3A). Chimpanzee and otter faces, however, were located equally fast, $t(37) = .72$, $p = .476$ (Figure 4A).

Manual response accuracy was greater for human face targets compared to chimpanzee face targets, presented among otter distractors, $t(37) = 3.83$, $p < .001$, $d = .62$ (Figure 3B), and accuracy was greater for chimpanzee face targets compared to otter face targets, presented among human face distractors, $t(37) = 2.49$, $p = .017$, $d = .40$ (Figure 4A), but human and otter face targets did not differ when presented among chimpanzee distractors, $t(37) = 1.61$, $p = .115$.

Human face targets were identified as absent more quickly than chimpanzee and otter face targets, controlling for distractor type, $t(37) > 7.86$, $ps < .001$, $ds > 1.28$ (Figure 4).

Chimpanzee and otter face targets did not differ in the speed with which they were identified as absent, $t(37) = .50, p = .619$. When targets were absent, searches were faster when the distractors were human faces compared to chimpanzee and otter faces, $t(37) > 4.45, ps < .001, ds > .72$. Searches for absent human faces were faster when distractors were otters compared to chimpanzees, $t(37) = 3.67, p = .001, d = .60$.

Face distractor rejection efficiency—Gaze RTs to target faces were faster when distractors were human faces compared to chimpanzee and otter faces, $t(37) > 3.74, ps < .001, ds > .61$ (Figure 4A). When targets were human faces, gaze RTs were faster when distractors were otter faces compared to chimpanzee faces, $t(37) = 2.68, p = .011, d = .45$ (see Figure 3A). When targets were absent, manual RTs were faster when distractors were human faces, compared to otter and chimpanzee faces, $t(37) > 4.45, ps < .001, ds > .72$, and manual RTs were faster when distractors were otters compared to chimpanzees, $t(37) = 3.67, p = .001, d = .60$ (Figure 4).

Accuracy was higher when distractors were human faces, compared to chimpanzee and otter faces, $t(37) > 2.84, ps < .007, ds > .46$ (Figure 4B); and higher when distractors were otter faces compared to chimpanzee faces, $t(37) = 5.98, p < .001, d = .97$ (Figure 3B).

Discussion

As in Experiment 1, we found that human faces, compared to animal faces, were located faster and more accurately, generally had less steep gaze search slopes, were rejected as distractors faster and more accurately, and were more quickly identified as absent. This suggests that, even when controlling for category levels, human faces are located more efficiently than animal faces.

The one exception to this overall finding was when participants searched for a human face target among chimpanzee face distractors in the largest array size; in this case, searches were slowed and were no more efficient than searches for chimpanzee faces (Figure 2B).

However, in all other conditions, human face targets elicited faster responses and less steep search slopes compared to animal face targets, therefore, we speculate that this unexpected finding in this one condition may have something to do with the similarity between targets and distractors (i.e., chimpanzee faces share a number of properties with human faces). Further tests with other face types, including other closely related great ape species (e.g., bonobos, gorillas, orangutans) might reveal whether the human face search advantage is truly species-specific, or whether there is a great-ape face detection advantage, more generally. Nonetheless, overall, the patterns in Experiment 2 were consistent with Experiment 1, suggesting human face search efficiency is evident even when controlling for the category level of the stimulus faces.

General Discussion

While conspecifics' faces are unquestionably one of the single most evolutionarily important visual stimuli for humans, and other vertebrates (Leopold & Rhodes, 2010), relatively little is known about the extent to which humans and other animals are skilled at locating

conspecifics' faces relative to other species' faces. In the present study, we tested whether humans are faster and more accurate at locating human faces, compared to animal faces, in visual arrays in which target faces are surrounded by other species' faces. This method allowed us to examine whether there were species differences in both search efficiency and in efficient rejection of task-irrelevant faces.

Are human faces located more efficiently than animal faces?

First, we examined whether human faces were located more efficiently than animal faces. We found support for our prediction: Human faces elicited more efficient visual searches than primate and mammal faces, both in terms of more accurate manual responses, faster gaze fixations on targets, and faster manual responses to indicate targets are absent.

Critically, this own-species advantage in search speed occurred even when we controlled the category level of the targets and distractors. That is, there were faster searches for own-species' faces, relative to other animals' faces, both when participants searched for human faces among a variety of task-irrelevant primate or mammalian species' faces (Experiment 1), as well as when participants were searching for a single species whose face was presented among a variety of task-irrelevant faces all of a particular species (Experiment 2).

Although the present study does not allow us to test the causes of this differential search sensitivity, we can speculate about the mechanisms that might underlie this effect. One possibility is that more efficient searches for human faces relative to animal faces may be due to the fact that expert objects, compared to non-expert objects, can be located in broader detection windows (i.e., peripheral detection advantage), allowing viewers to scan larger areas of their visual field during each fixation (Hershler & Hochstein, 2009; Hershler et al., 2010). Human faces may be distinct in some preattentive features (Lewis & Ellis, 2003). For example, it appears that human faces' color and shape together may aid face detection (Bindemann & Burton, 2009); however, the extent to which these features are shared with animal faces and likewise contribute to animal face detection remain unexplored. According to one proposal, color vision in primates may be specifically tuned for discriminating conspecifics' face properties, such as the perfusion of the skin by blood (Changizi, Zhang, & Shimojo, 2006). Indeed, searches for certain colors, such as those of human faces (e.g., lips, skin), are faster than searches for other colors (Lindsey et al., 2010). Certainly these are testable questions and future studies with inverted and grayscale stimuli could disentangle the relative importance of color and facial configurations for own-species search efficiency.

Nonetheless, the results of the present study are consistent with studies comparing own-species face processing to processing of other species faces. For example, humans demonstrate an own-species advantage for facial identity discrimination (i.e., superior discrimination of individual faces for one's own species compared to other species; Dufour, Pascalis, & Petit, 2006; Scott & Fava, 2013).

Are human faces rejected as distractors more efficiently than animal faces?

The efficiency with which distractors are identified as such and rejected can also influence search efficiency, as some items are serially checked and rejected more efficiently than others (Treisman & Souther, 1985). If human faces automatically attract attention, then we

would expect task-irrelevant human faces to interfere with searches. Alternatively, if human faces are located and processed more efficiently, then we would expect more efficient distractor rejection and faster searches with human face distractors, compared to animal face distractors. Indeed, we found support for the latter hypothesis: Controlling for target type, searches were faster and more accurate when task-irrelevant faces were humans compared to primates and mammals, perhaps because human faces were more efficiently serially checked compared to animal faces. In other words, participants may have been faster to reject human faces as distractors—perhaps due to their familiarity (Natu et al., 2011; Tong & Nakayama, 1999)—compared to the speed of rejecting nonhuman distractors.

Conclusion and Future Directions

These results suggest that there is not a broad window of detection for all face-like patterns, but that own-species faces are, in some ways, privileged in their processing efficiency relative to other species' faces. The present study contributes two novel findings: first, demonstrating that human faces are privileged in visual searches, even when in direct competition with other animals' faces, and second, revealing that task-irrelevant human face distractors may also be processed more efficiently. We do not know the source of the human face processing advantages, but further tests systematically manipulating faces (e.g., inversion, grayscale, removing features) may uncover the properties driving this search efficiency. In addition, developmental (Jakobsen, Umstead, Eisenmann, Fullerton & Simpson, under review) and comparative (Simpson, Suomi, & Paukner, under review) studies exploring the emergence of search efficiency for conspecifics' faces relative to other animals' faces may reveal the experiential, maturational, and evolutionary factors that drive these apparent own-species face biases.

Acknowledgments

We thank Janet Frick and the research assistants at the University of Georgia for help with stimulus preparation, and the research assistants at James Madison University for testing participants. This research was supported by the National Institutes of Health, NICHD P01HD064653-01 (EAS), and by the Alvin V., Jr. and Nancy C. Baird Professorship (KVJ). Portions of this data were presented at the Association for Psychological Science's 24th Annual Convention.

References

- Bindemann M, Burton AM. The role of color in human face detection. *Cognitive Science*. 2009; 33:1144–1156. doi:111/j.1551-6709.2009.01035.x. [PubMed: 21585498]
- Changizi MA, Zhang Q, Shimojo S. Bare skin, blood and the evolution of primate colour vision. *Biology Letters*. 2006; 2(2):217–221. doi: 10.1098/rsbl.2006.0440. [PubMed: 17148366]
- Devue C, Belopolsky AV, Theeuwes J. Oculomotor guidance and capture by irrelevant faces. *PLoS ONE*. 2012; 7:e34598. doi: 10.1371/journal.pone.0034598. [PubMed: 22506033]
- Dufour V, Pascalis O, Petit O. Face processing limitation to own species in primates: a comparative study in brown capuchins, Tonkean macaques and humans. *Behavioural Processes*. 2006; 73(1): 107–113. doi: 10.1016/j.beproc.2006.04.006. [PubMed: 16690230]
- Duncan J, Humphreys GW. Visual search and stimulus similarity. *Psychological Review*. 1989; 96:433–458. [PubMed: 2756067]
- Hershler O, Golan T, Bentin S, Hochstein S. The wide window of face detection. *Journal of Vision*. 2010; 10:1–14. doi: 10.1167/10.10.21.

- Hershler O, Hochstein S. At first sight: A high-level pop out effect for faces. *Vision Research*. 2005; 45:1707–1724. doi:10.1016/j.visres.2004.12.021. [PubMed: 15792845]
- Hershler O, Hochstein S. With a careful look: Still no low-level confound to face pop out. *Vision Research*. 2006; 46:3028–3035. doi:10.1016/j.visres.2006.03.023. [PubMed: 16698058]
- Hershler O, Hochstein S. The importance of being expert: Top-down attentional control in visual search with photographs. *Attention, Perception, & Psychophysics*. 2009; 71:1478–1486. doi: 10.3758/APP.71.7.1478.
- Jakobsen KV, Umstead L, Eisenmann V, Fullerton A, Simpson EA. For infants, species matters! Infants efficiently detect human faces. (under review).
- Langton SRH, Law AS, Burton M, Schweinberger SR. Attention capture by faces. *Cognition*. 2008; 107:330–342. doi: 10.1016/j.cognition.2007.07.012. [PubMed: 17767926]
- Leopold DA, Rhodes G. A comparative view of face perception. *Journal of Comparative Psychology*. 2010; 124:233. doi: 10.1037/a0019460. [PubMed: 20695655]
- Lewis MB, Ellis HD. How we detect a face: A survey of psychological evidence. *International Journal of Imaging Systems and Technology*. 2003; 13:3–7. doi: 10.1002/ima.10040.
- Lindsey DT, Brown AM, Reijnen E, Rich AN, Kuzmova YI, Wolfe JM. Color channels, not color appearance or color categories, guide visual search for desaturated color targets. *Psychological Science*. 2010; 21(9):1208–1214. doi: 10.1177/0956797610379861. [PubMed: 20713637]
- Natu V, Raboy D, O’Toole AJ. Neural correlates of own-and other-race face perception: Spatial and temporal response differences. *NeuroImage*. 2011; 54:2547–2555. doi: 10.1016/j.neuroimage.2010.10.006. [PubMed: 20937393]
- Parks EL, Kim SY, Hopfinger JB. The persistence of distraction: A study of attentional biases by fear, faces, and context. *Psychonomic Bulletin & Review*. Advance Online Publication. 2014 doi: 10.3758/s13423-014-0615-4.
- Ro T, Friggel A, Lavie N. Attentional biases for faces and body parts. *Visual Cognition*. 2007; 15(3): 322–348. doi: 10.1080/13506280600590434.
- Rousselet GA, Macé MJM, Fabre-Thorpe M. Is it an animal? Is it a human face? Fast processing in upright and inverted natural scenes. *Journal of Vision*. 2003; 3:440–455. doi: 10.1167/3.6.5. [PubMed: 12901715]
- Scott LS, Fava E. The own-species face bias: A review of developmental and comparative data. *Visual Cognition*. 2013; 21:1–28. doi: 10.1080/13506285.2013.821431.
- Simpson EA, Mertins HL, Yee K, Fullerton A, Jakobsen KV. Visual search efficiency is greater for human faces compared to animal faces. *Experimental Psychology*. (in press). doi: 10.1027/1618-3169/a000263.
- Simpson EA, Jakobsen KV, Frick JE, Okada K, Frigaszy DM. The development of facial identity discrimination through learned attention. *Developmental Psychobiology*. (in press). Advance Online Publication. doi: 10.1002/dev.21194.
- Simpson EA, Suomi SJ, Paukner A. Face discrimination in infant rhesus macaques (*Macaca mulatta*): Examination of own-species and own-age face biases. (under review).
- Stein T, Sterzer P, Peelen MV. Privileged detection of conspecifics: evidence from inversion effects during continuous flash suppression. *Cognition*. 2012; 125:64–79. doi: 10.1016/j.cognition.2012.06.005. [PubMed: 22776239]
- Tong F, Nakayama K. Robust representations for faces: evidence from visual search. *Journal of Experimental Psychology: Human Perception and Performance*. 1999; 25:1016–1035. doi: 10.1037/0096-1523.25.4.1016. [PubMed: 10464943]
- Treisman A, Souther J. Search asymmetry: A diagnostic for preattentive processing of separable features. *Journal of Experimental Psychology: General*. 1985; 114:285–310. [PubMed: 3161978]



Figure 1.

Examples of 64-item arrays in Experiment 1. (A) Human face target among primate face distractors (left) and a primate face target among human face distractors (right). (B) Human face target among mammal face distractors (left) and a mammal face target among human face distractors (right). (C) Primate face target among mammal face distractors (left) and a mammal face target among primate face distractors (right).

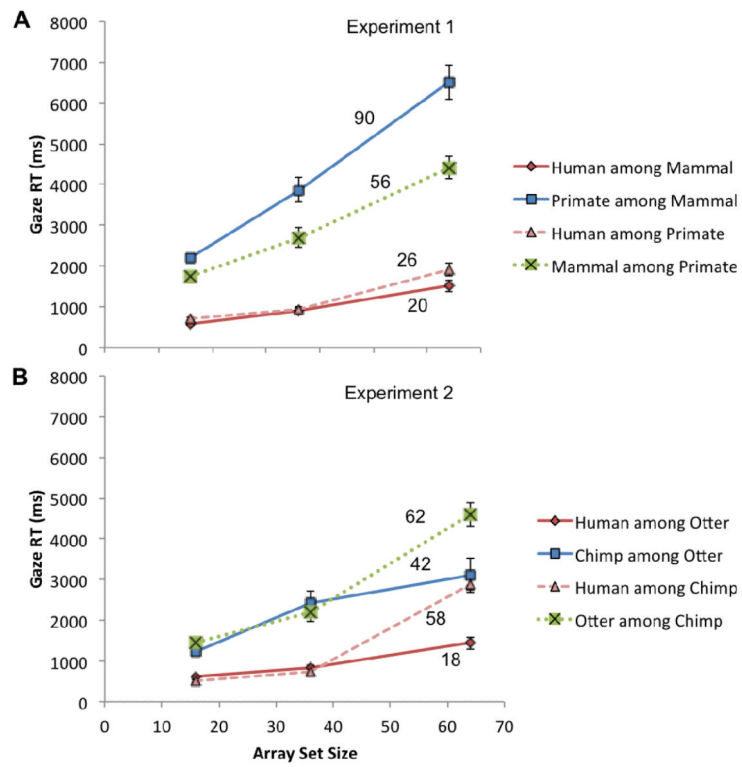


Figure 2. Gaze search slope results for (A) Experiment 1 and (B) Experiment 2. Numbers reflect the search slopes (ms/item). Error bars represent within-subjects standard error of the mean.

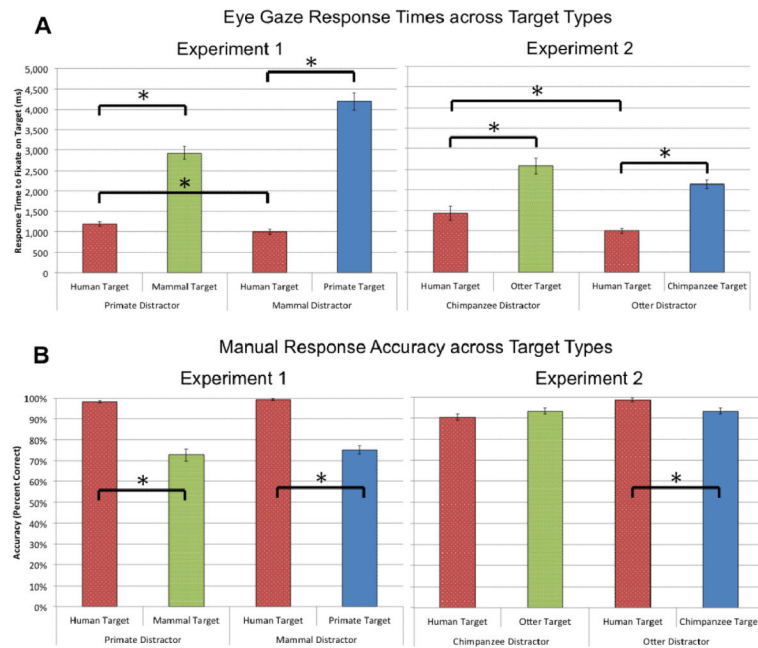


Figure 3. Speed (A) and accuracy (B) with which participants located targets, controlling for distractor type. $*p < .0167$; error bars = standard error of the mean.

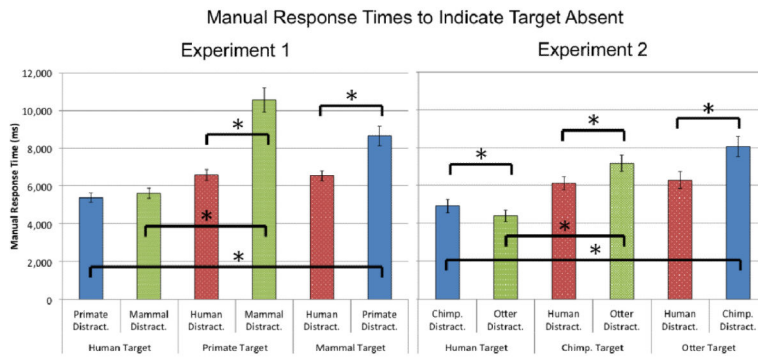


Figure 4. Response speed to accurately report targets absent. * p s < .0167; error bars = standard error of the mean.



Figure 5.

Examples of 64-item arrays in Experiment 2. (A) Human face target among chimpanzee face distractors (left) and a chimpanzee face target among human face distractors (right). (B) Human face target among otter face distractors (left) and an otter face target among human distractors (right). (C) Chimpanzee face target among otter face distractors (left) and an otter face target among chimpanzee face distractors (right).