Research Report

Humans Prefer Curved Visual Objects

Moshe Bar and Maital Neta

Martinos Center at Massachusetts General Hospital, Harvard Medical School

ABSTRACT—***People constantly make snap judgments about objects encountered in the environment. Such rapid judgments must be based on the physical properties of the targets, but the nature of these properties is yet unknown. We hypothesized that sharp transitions in contour might convey a sense of threat, and therefore trigger a negative bias. Our results were consistent with this hypothesis. The type of contour a visual object possesses—whether the contour is sharp angled or curved—has a critical influence on people's attitude toward that object.***

What are the physical elements in a visual stimulus that make one like it, dislike it, or respond fearfully to it? Liking of visual objects has been shown to be affected by factors such as symmetry, prototypicality, contrast, complexity, and perceptual fluency (Reber, Schwarz, & Winkielman, 2004). However, given how quickly such impressions can be formed (Ambady, Bernieri, & Richeson, 2000; Bar, Neta, & Linz, in press), they must rely on visual primitives that can be extracted from the image extremely quickly. We hypothesized that one key visual primitive that mediates the formation of such rapid impressions is the extent to which the contour of an object and its features is curved. Specifically, we predicted that emotionally neutral objects with primarily pointed features and sharp angles would be liked significantly less than corresponding objects with curved features (e.g., a guitar with a sharp-angled contour compared with a guitar with a curved contour). The rationale for this prediction was that sharp transitions in a contour might convey a sense of threat, on either a conscious or a nonconscious level, and thus trigger a negative bias. Indeed, old reports on person perception suggest that jagged human figures, in which the shoulders, elbows, and knees are made sharp angled, are perceived as being associated with aggressive traits (Guthrie & Wiener, 1966). We tested our prediction by comparing subjective preference for objects with a sharp-angled contour with subjective preference for the same objects when their contour was instead curved.

Address correspondence to Moshe Bar, Martinos Center at MGH, Harvard Medical School, 149 Thirteenth St., Charlestown, MA 02129, e-mail: bar@nmr.mgh.harvard.edu.

EXPERIMENT

Method

Stimuli

The stimuli included 140 pairs of real objects. The items in each pair had the same semantic meaning and general appearance, and the major difference between them was the curvature of their contour (Fig. 1a). These were everyday objects with no inherent positive or negative valence (e.g., a watch or a sofa). Twenty-three of the pairs were English characters (Arial font for the sharp letters and Arial rounded MT for the smooth letters). In addition, we created 140 pairs of meaningless patterns that were likewise matched across all visual features except for contour (Fig. 1b). We included these patterns to control further for the possible role of semantic meaning, familiarity, and associations in preference formation. To investigate whether any observed difference in preference stemmed from increased liking of the objects in one condition, reduced liking of the objects in the other condition, or both, we included a control condition of 80 real objects with a roughly equal mixture of curved and sharp-angled features (Fig. 1c). Like the other real objects, the objects in the control condition were not associated with an inherent valence. All pictures were presented in gray scale on a gray background (the complete set of stimuli can be viewed on the Web at http://barlab.mgh.harvard.edu/BarNetaPsychSci2006.htm).

Participants

Fourteen subjects (18–40 years old) participated for monetary compensation. All had normal or corrected-to-normal vision, and none were aware of the purpose of the experiment. Informed written consent was obtained from each participant prior to the experiment. All procedures were approved by Massachusetts General Hospital Human Studies Protocol Number 2001P-001754.

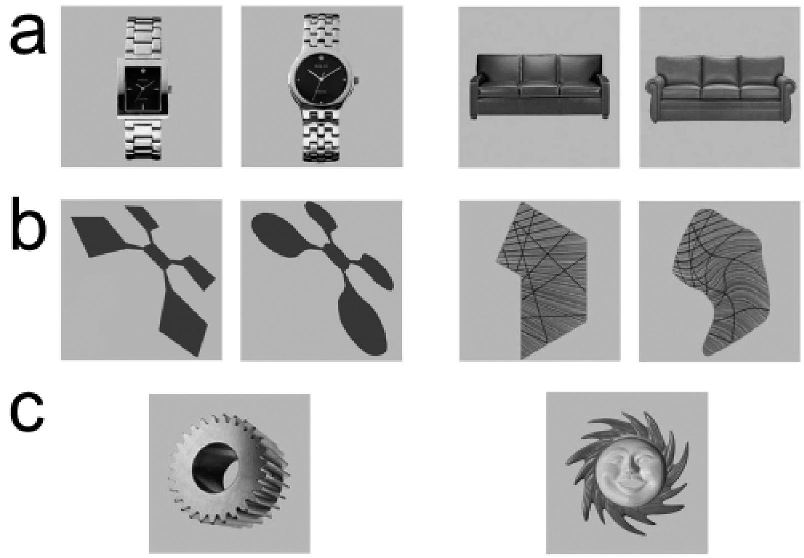

Fig. 1. Examples of the stimuli used in the experiment: (a) pairs of real objects, (b) pairs of meaningless patterns, and (c) control objects. Paired real objects were matched in appearance and semantic meaning so that the contour was the critical difference between them. The control objects, which had a mixture of curves and sharp angles, were used to provide baseline data.

Procedure

Each subject viewed one member of each pair (either the sharp-angled or the curved item, counterbalanced across subjects) and all the control objects. Each picture was presented for 84 ms, and subjects were required to make a like/dislike forced-choice decision about each picture based on their immediate, "gut" reaction. For each condition, percentage liking was calculated as the proportion of "like" responses out of the total number of responses.

Results

Participants liked the curved objects significantly more than the control objects, $t(13) = 2.43$, $p_{rep} = .94$, $d = 0.62$, and liked the sharp-angled objects significantly less than the control objects, $t(13) = -2.34$, $p_{rep} = .93$, $d = 0.65$ (mean liking was 50.6% for sharp-angled objects and 67.2% for curved objects; Fig. 2). Thus, the curved objects were liked significantly more than the sharp-angled objects, $t(13) = 3.53$, $p_{rep} = .98$, $d = 0.94$. A similar outcome was obtained with preference for the meaningless patterns. Participants liked the curved patterns (37.9%) significantly more than the sharp-angled patterns (24.8%), $t(13) = 2.56$, $p_{rep} = .95$, $d = 0.67$. An item analysis indicated a significant difference between the curved and sharp counterparts of each real-object pair, $t(139) = 4.47$, $p_{rep} > .99$, $d = 0.38$, and of each meaningless-pattern pair, $t(139) = 6.41$, $p_{rep} > .99$, $d = 0.54$; the curved items were liked more than the sharp-angled items. The same effect was present for the 23 letter pairs; that is, single characters with curved contours were liked significantly more than their sharp-angled counterparts, $t(22) = 3.00$, $p_{rep} = .97$, $d = 0.62$. The smooth letters we used were somewhat thicker than their sharp counterparts, but the general liking effect was significant also in an analysis of real objects that excluded the letters, $t(116) = 3.65$, $p_{rep} = .99$, $d = 0.34$. Thus, the pattern of preference judgments was consistent across subjects and across items.

Finally, there was no significant difference in average reaction time between the curved (595 ms) and sharp (600 ms) real objects, $t < 1$, or between the curved (571 ms) and sharp (572 ms) meaningless patterns, $t < 1$. This specific result demonstrates that the bias in favor of the curved objects cannot be explained by perceptual fluency; it is not the case that the preferred items were those that could be processed more readily. This result also suggests that there was no consistent difference in a gestalt-like good continuation between the objects in the curved and the sharp-angled conditions, because one would predict better performance with objects that rank higher on good continuity. Taken together, the results indicate that fine details of contour provided the critical influence on liking preferences.

In addition to supporting our main hypothesis, these data show that overall preference was significantly higher for real objects than for meaningless patterns, regardless of contour type. A Contour (curved, sharp) × Stimulus Type (real objects, patterns) analysis of variance revealed a significant main effect of both contour, $F(1, 13) = 10.8$, $p_{rep} = .96$, $\eta^2 = .45$, and stimulus type, $F(1, 13) = 23.5$, $p_{rep} > .99$, $\eta^2 = .64$.

DISCUSSION

Naturally, a dangerous object (e.g., a knife) can impose a negative sense of threat. However, our results show that a negative

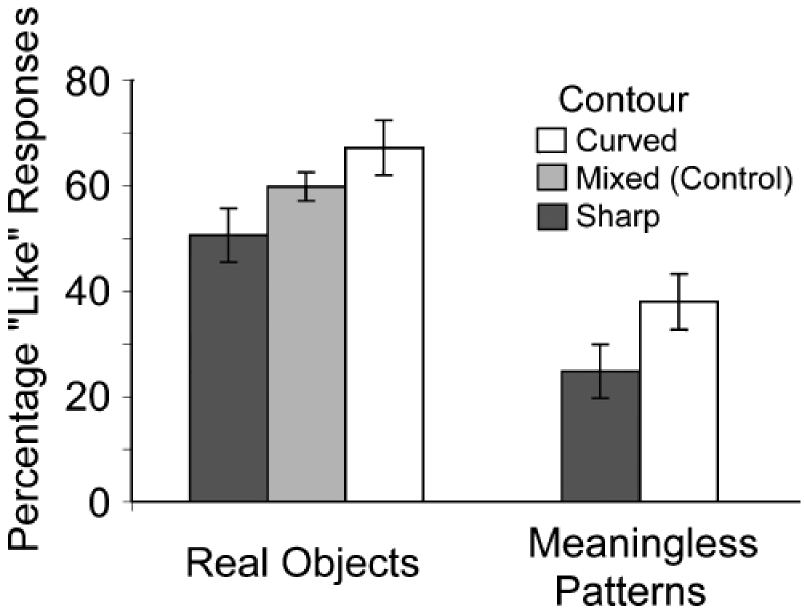

Fig. 2. Percentage of ''like'' responses for sharp-angled real objects and patterns, curved real objects and patterns, and control objects with a mixture of curved and sharp angles (baseline).

bias toward a visual object can be induced not only by the semantic meaning of that object (e.g., "used for cutting"), but also by low-level perceptual properties; even a picture of something as harmless as a watch will be liked less if it has sharp-angled features than if it has curved features. We propose that disliking of the sharp-angled neutral objects in our experiment stemmed from a similar feeling of threat, and that this feeling was triggered by the sharpness of the angles per se. Indeed, previous studies of human facial expression and interpretation of movement suggest that sharp primitive elements (e.g., a V-shaped corner) convey threat, whereas round primitives convey "warmth" (Aronoff, Woike, & Hyman, 1992). This result supports our hypothesis that preferences can be driven by a threatening impression conveyed by contour, and furthermore that such preferences are influenced by the sharp angles themselves, rather than by the mere straightness of the contour. Therefore, simple physical elements in a stimulus can directly mediate relatively high-level judgments of preference.

There are other types of basic physical features that can influence high-level judgments. For example, people wearing black-colored sports uniforms were shown to perceive themselves, and to be perceived by observers, as being more aggressive than those wearing uniforms of another color (Frank & Gilovich, 1988). This idea has been utilized in the world of product design; manufactured products often make a statement through visual features such as texture, shape, and color, using these basic features to appeal to human emotions (Demirbilek & Sener, 2003). For example, research on car interior design suggests that curved designs are preferred to straight designs, and that curvature elicits increased positive emotions (Leder & Carbon, 2005).

It is important to emphasize that there are exceptions in which preference and attitude might bypass the characteristics conveyed by the type of contour. For example, there are curved objects that people dislike (e.g., snakes) and objects with sharp corners that people like (e.g., chocolate bars), but these objects tend to have a strong affective valence (or strong associations with other types of information), which can override the effects of contour and dominate preference. The stimuli in our study had a neutral valence, allowing the effects of contour to be studied in better isolation. Period trends, fashion, and aesthetic values are also certain to play a role in forming preferences, but by pairing objects, and furthermore by using meaningless patterns, we minimized the effects of these variables in this experiment so we could focus on the contribution of contour.

In addition to finding that sharp-angled contours induced lower preference, we found that real objects were preferred over meaningless, novel patterns. This specific result might indicate that familiarity with a stimulus is another source of influence on liking preferences and may be related to the mere-exposure effect (Zajonc, 2001), in which subjects show an increased preference for stimuli they have seen before, compared with novel stimuli of similar nature. It is possible that subjects preferred the real objects over the novel patterns in our experiment because the uncertainty that novelty holds elevated an implicit sense of potential threat, in accordance with previous reports (Blascovich, Mendes, Hunter, & Salomon, 1999). Alternatively, the meaningful objects could have been liked more than the patterns simply because people tend to feel more comfortable with familiar objects and the associations they may elicit. An evolutionary standpoint suggests that people might learn to prefer objects that promote safety, and to fear objects that impede it (Feist & Brady, 2004).

In conclusion, the results we report here may have broad ramifications for most aspects of preference and impression formation. Beyond its implications for consumer behavior, the present study reveals a basic feature that affects attitudes toward the environment. For example, even when people judge faces of other people, rounder faces (i.e., "baby faces") are more liked and generally perceived as more attractive than more angular faces (Zebrowitz, 1997). Another interesting aspect of our results is that although people are aware of the perceptual features of a stimulus, they are not necessarily aware of how those features influence their impressions. Indeed, many types of first impressions are determined nonconsciously (Banaji & Greenwald, 1995; Bargh & Pietromonaco, 1982; Fazio, Sanbonmatsu, Powell, & Kardes, 1986). By giving a high priority to the processing of threat-specific physical primitives, possibly using rapidly available low-level sensory information (Bar, 2003), the human cortex might be designed for detecting such features quickly. Future studies will help to characterize the cortical pathways and dynamics mediating this swift extraction of basic visual primitives and their possible use for rapid assessment of fight-or-flight responses.

Acknowledgments—We thank D. Carney, M. Fenske, N. Gronau, K. Kveraga, M. Mason, and D. Proffitt for helpful comments on the manuscript and I. Ostrovskaya for help with the stimuli. This work was supported by McDonnell Foundation Grant No. 21002039, National Institute of Neurological Disorders and Stroke Grant NS44319-01, and the MIND Institute.

REFERENCES

Ambady, N., Bernieri, F.J., & Richeson, J.A. (2000). Toward a histology of social behavior: Judgmental accuracy from thin slices of the behavioral stream. In M.P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 32, pp. 201–271). New York: Academic Press.

Aronoff, J., Woike, B.A., & Hyman, L.M. (1992). Which are the stimuli in facial displays of anger and happiness? Configurational bases of emotion recognition. *Journal of Personality and Social Psychology*, *62*, 1050–1066.

Banaji, M.R., & Greenwald, A.G. (1995). Implicit gender stereotyping in judgments of fame. *Journal of Personality and Social Psychology*, *68*, 181–198.

Bar, M. (2003). A cortical mechanism for triggering top-down facilitation in visual object recognition. *Journal of Cognitive Neuroscience*, *15*, 600–609.

Bar, M., Neta, M., & Linz, H. (in press). Very first impressions. *Emotion*.

Bargh, J.A., & Pietromonaco, P. (1982). Automatic information processing and social perception: The influence of trait information presented outside of conscious awareness on impression formation. *Journal of Personality and Social Psychology*, *43*, 437–449.

Blascovich, J., Mendes, W.B., Hunter, S.B., & Salomon, K. (1999). Social "facilitation" as challenge and threat. *Journal of Personality and Social Psychology*, *77*, 68–77.

Demirbilek, O., & Sener, B. (2003). Product design, semantics and emotional response. *Ergonomics*, *46*, 1346–1360.

Fazio, R.H., Sanbonmatsu, D.M., Powell, M.C., & Kardes, F.R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology*, *50*, 229–238.

Feist, G.J., & Brady, T.R. (2004). Openness to experience, non-conformity, and the preference for abstract art. *Empirical Studies of the Arts*, *22*, 77–89.

Frank, M.G., & Gilovich, T. (1988). The dark side of self- and social perception: Black uniforms and aggression in professional sports. *Journal of Personality and Social Psychology*, *54*, 74–85.

Guthrie, G., & Wiener, M. (1966). Subliminal perception or perception of partial cue with pictorial stimuli. *Journal of Personality and Social Psychology*, *3*, 619–628.

Leder, H., & Carbon, C. (2005). Dimensions in appreciation of car interior design. *Applied Cognitive Psychology*, *19*, 603–618.

Reber, R., Schwarz, N., & Winkielman, P. (2004). Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Personality and Social Psychology Review*, *8*, 364–382.

Zajonc, R.B. (2001). Mere exposure: A gateway to the subliminal. *Current Directions in Psychological Science*, *10*, 224–228.

Zebrowitz, L.A. (1997). *Reading faces: Window to the soul?* Boulder, CO: Westview Press.

(Received 10/6/05; Revision accepted 12/1/05; Final materials received 12/5/05)