ISSN: 1541-745X www.idrjournal.com

Are Ambiguous Figures Actually Ambivalent?

G. Daniel Lassiter*
Ohio University
Andrew L. Geers
University of Toledo

ABSTRACT - Psychologists have long held that certain stimuli—so-called ambiguous figures—lack intrinsic or objective meaning and therefore give rise to multiple percepts. We argue that such stimuli may actually be better characterized as "ambivalent figures." That is, rather than being devoid of inherent meaningful structure, these stimuli may simultaneously comprise two or more distinct structures, only one of which is detected at a time. Two samples of university students (*N*s = 143 and 157) viewed a stimulus that could be identified as either human or animal following instantiation of a human or animal interpretive set. Independently, location of initial fixation on the stimulus was varied to make a human or animal identification more likely. When the percept suggested by the interpretive set was opposite the percept specified by the initial fixation, the typical effect of interpretive set was actually reversed. These data support the proposed re-conceptualization from ambiguous to ambivalent.

Psychologists have long used so-called ambiguous figures to test a variety of theories and hypotheses about the processes that make the perceptual identification of objects possible. Such figures are described as ambiguous because it is assumed that, unlike relatively unambiguous objects, they are inherently indistinct; that is, not clearly defined by their observable features alone (e.g., Uttal, 1988). Rendering an ambiguous figure like the one depicted in Figure 1 into a meaningful percept (either a man's face or a rat's body), therefore, presumably involves a constructive process whereby the perceiver generates a hypothesis about the identity of the figure (Gregory, 1970; Hochberg, 1968; Rock, 1983).

According to this widely accepted constructivist view, the initial hypothesis entertained by the perceiver can be determined in either a top-down or a bottom-up fashion. A classic demonstration of a top-down influence on the perception of ambiguous figures was provided by Bugelski and Alampay (1961). Participants were presented with a series of drawings depicting either a variety

**G. Daniel Lassiter; Department of Psychology; Ohio University; Athens, OH 45701; lassiter@ohio.edu* (email).

of animals or a variety of human faces and then were asked to identify the rat–man figure noted above. Participants who were previously exposed to the drawings of animals were more likely to perceive the stimulus as a rat, whereas those who were previously exposed to the drawings of human faces were more likely to perceive the same stimulus as a man (see also Binder & Feldman, 1960; Bruner & Minturn, 1955; Goolkasian, 1987, 1991; Leeper, 1935). The constructivist interpretation of this result is that viewing several drawings of animals (or human faces) instantiated the schema for "animal" (or "people"), which in turn led participants to identify the rat–man figure as a rat (or man).

Proponents of the constructivist view have also argued that when perceivers lack any clear expectation of what is to be seen, the part or subregion of an ambiguous figure that is first fixated or glimpsed can "initiate a hypothesis, plan, blueprint, or schema ... to guide subsequent constructive processes" (Chastain & Burnham, 1975, p. 221). Supporting the possibility of such a bottom-up influence, Georgiades and Harris (1997, Study 2) reported that the location of initial fixation on an ambiguous figure significantly influenced perceptual identification of the figure (see also Bernstein & Cooper, 1997; Chastain & Burnham, 1975; Hochberg & Peterson, 1987; Peterson & Hochberg, 1983; Tsal & Kolbert, 1985).

A critical assumption underlying perceptual identification via a bottom-up process is that some parts (features) of an ambiguous figure "must favor one interpretation whereas other parts must favor the alternative interpretation, *although these distinctive parts must be capable of being assimilated into the alternative interpretations* (Peterson & Gibson, 1991, p. 171, emphasis added). This assumption, however, comes very close to implying that some subcomponents of an ambiguous figure are not truly ambiguous. If certain features consistently give rise to one of two possible percepts of an ambiguous figure, then is it appropriate to say such figures are actually ambiguous or indistinct?

Figure 1
The Rat–Man Figure

Nonexistent Structure or Coexisting Structures?

We argue that figures such as the rat–man may not be ambiguous but may instead be ambivalent. Whereas the term ambiguous denotes an object devoid of inherent meaningful structure, the term ambivalent denotes an object that simultaneously comprises two or more distinct structures, only one of which is registered by the perceiver at any given moment. This distinction transcends mere semantics as the notion of ambiguous figures implies a construction (hypothesis-testing) process of the type described above as a necessity for perceptual identification (Uttal, 1988). On the other hand, the notion of "ambivalent figures" implies a detection process as ultimately needed to achieve perceptual identification (Michaels & Carello, 1981; Zebrowitz, 1990).

Before elaborating on the theoretical implications of this re-conceptualization, we present evidence supporting its viability that goes beyond the aforementioned demonstrations that initial glimpse alone can affect perceptual identification. As noted above, constructivists argue that perceptual identification by means of bottom-up processes occurs when perceivers do not have a suitable interpretive set (schema) already activated prior to encountering the figure they are to identify. It follows, therefore, that if a "correct" schema is instantiated just before exposure to a figure such as the rat–man, the schema should serve as the basis for identification (top-down processing) regardless of the subarea or features first attended by the perceiver. That is, as Peterson and Gibson (1991) point out, any particular features of a truly ambiguous figure must be readily assimilable into either of the workable interpretive sets.

A very different pattern of results would support the notion that a figure such as the rat–man is actually ambivalent rather than ambiguous. In instances in which the percept suggested by a prior interpretive set is incongruent with (opposite) the percept specified by the stimulus features that are initially attended, the effect of the interpretive set on perceptual identification of the rat–man figure would be expected to be severely attenuated or, in the most compelling case, to be even reversed from the typical pattern. In instances in which the percept suggested by a prior interpretive set is congruent with (matches) the percept specified by the stimulus features that are initially attended, the effect of interpretive set on perceptual identification of the rat–man figure would be expected to be enhanced relative to that observed in a condition in which first glimpse was not systematically directed to any specific location on the stimulus.

Method

Participants

One hundred forty-three Ohio University undergraduates completed the experiment in return for partial course credit.

Procedure

Participants viewed a series of five, black-ink drawings (the same ones as used by Bugelski & Alampay, 1961) that were displayed one at a time on a classroom projection screen 4.5 m away. Presentation of the drawings was controlled by Superlab software (version 1.68) running on a Macintosh Quadra microcomputer. To maximize stimulus visibility, room lights were dimmed once the experiment began.

Each drawing was displayed for 5 s; the last always being the rat–man figure, which measured 46 cm in height and 56 cm in width. To create two distinct interpretive sets before viewing the rat–man figure, half the participants were first shown four drawings of animals, whereas the other half were first shown four drawings of human faces. The dimensions of these drawings were comparable to those of the rat–man figure.

There was a 3-s interval between the presentation of each drawing. For a third of the participants, the screen was completely blank during this interval (no-fixation condition). For the remaining participants, however, an "x" (height and width = 2 cm) was projected onto the screen and participants were instructed to focus their gaze on the "x" until it disappeared, which occurred when a drawing was displayed. (Participants received no explicit instruction to maintain their gaze once the "x" disappeared. Also, at no point was the actual locus of their gaze measured.)

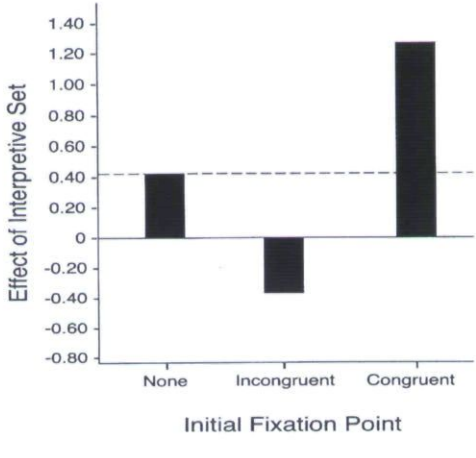
The "x" was always positioned in one of two locations (separated by 41 cm). In one condition the location of the "x" caused participants' first glimpse of the rat–man drawing to be in the area of the rat's "ears." In the other condition the location of the "x" caused participants' first glimpse to be in the area of the man's "chin." These locations were determined by pilot testing, which indicated that when initial fixation was in the area of the rat's "ears," more rat identifications (80%) were made than when initial fixation was in the area of the man's "chin" (47%), χ^2 (1, N = 40) = 4.75, $p < .05$. (Note that the pilot-test results are consistent with previous findings showing that first glimpse influences perceptual identification when no prior expectation or interpretive set is provided to participants.)

After the rat–man drawing disappeared from the screen, participants were instructed to write down what they perceived the figure to be. Next, they were given a response sheet (identical to one used by Chastain & Burnham, 1975) and instructed to indicate which of the following descriptions best matched their perception of the figure: Man, Man with a few ratlike characteristics, Man with many ratlike characteristics, Rat with many manlike characteristics, Rat with a few manlike characteristics, or Rat. Participants' responses to the latter measure were assigned numerical scores from 1 (man) to 6 (rat) for purposes of analysis (cf., Chastain & Burnham, 1975). Both these measures of participants' perceptions yielded the same significant pattern of results; therefore, only the results of one of them—the scalar measure—are presented.

Results and Discussion

Figure 2 graphically depicts the critical pattern of results on the scalar measure. In the figure, the effect of the interpretive-set manipulation was computed by taking the difference between the mean scale rating of participants who were shown drawings of animals and those who were shown drawings of human faces for each of the initial-fixation-point conditions. Resulting values were assigned a positive (negative) sign to indicate that participants' perceptions of the rat–man figure were consistent (inconsistent) with the set of drawings they had previously seen. As reflected in Figure 2, the data support the notion that the rat–man figure is more ambivalent than ambiguous. The effect of the interpretive-set manipulation on perception of the rat–man figure in the no-fixation condition revealed the typical effect: Previous exposure to images of animals produced more rat identifications, whereas previous exposure to images of human faces produced more man identifications. This effect of interpretive set was magnified when participants' first glimpse was on stimulus features that evoked the same percept as that suggested by the interpretive set (congruent-fixation condition). However, quite strikingly, the effect of interpretive set was completely reversed when participants' first glimpse was on a subset of features associated with the opposite percept as that suggested by the interpretive set (incongruent-fixation condition). A planned contrast testing this overall pattern of results was significant, $F(1, 137) = 8.09$, $p < .01$.

Figure 2
Effect of the Interpretive-Set Manipulation on Perception of the Rat–Man Figure



Note: Positive (negative) values indicate that participants' perceptions of the rat–man figure were consistent (inconsistent) with the set of drawings they had previously seen. The dashed line represents the anticipated pattern of results based on a constructivist view; that is, the effect of the interpretive-set manipulation should be constant across all three fixation conditions (cf. Peterson & Gibson, 1991).

It might be argued that the above pattern of data was due in part to a somewhat small effect of the interpretive-set manipulation. That is, if the "people" or "animal" schema was only weakly activated, a critic could claim that perceivers still lacked a clear expectation and thus they would resemble no-expectation perceivers who, as noted previously, are argued to rely heavily on their initial glimpse to generate a more definitive interpretive framework. In an attempt to address this point, we ran the experiment again but this time the experimenter made a point of telling the participants (157 Ohio University undergraduates) that the initial images they would see were very important and that they should pay close attention to them. We believed that the experimenter's added emphasis on the drawings of animals or faces would serve to enhance the effectiveness of the interpretive-set manipulation. A comparison of the effect of the interpretive-set manipulation across the original and follow-up data sets indicated that it was indeed stronger in the latter, $F\,(1, 288) = 4.22$, $p < .05$. Despite this indication that the interpretive-set manipulation was more effective in the follow-up data set, the same overall pattern of results, showing a still potent influence of initial fixation point, was found, $F\,(1, 151) = 6.46$, $p < .02$.

A reader of an earlier version of this article, in an attempt to apply a constructivist interpretation to the findings, argued that the stimulus features of the rat–man figure that were first attended possibly led to a rejection and replacement of the previously activated schema when they appeared discrepant with that schema. The reversal of the typical effect of interpretive set depicted in Figure 2 (incongruent-fixation condition) would thus be accounted for by contending that perceivers activated the alternative schema in their minds rather than detected the alternative structure contained in the stimulus. This argument, however, is antithetical to the constructivist view. That is, it is not possible within the constructivist framework for the stimulus cues in the rat–man figure to be discrepant from either the "animal" or "people" schema. From a constructivist view, the "ears" of the rat can just as readily be interpreted as the "eye glasses" of the man, or the "chin" of the man can just as readily be interpreted as the "tail" of the rat (Peterson & Gibson, 1991). Also contrary to the foregoing argument is empirical evidence indicating that people cling tenaciously to their hypotheses, interpretations, and expectations often even when faced with obviously contradictory information (Bruner & Potter, 1964; Ross, Lepper, & Hubbard, 1975; Wilson, Lisle, Kraft, & Wetzel, 1989).

As summarized by Uttal (1988, p. 98), constructivists have largely considered the fact that the same stimulus can be perceived in two completely different ways as "a compelling argument for the addition of meaning or phenomenological form to the stimulus by the mind in a manner that transcends stimulus determinacy." Our data, however, suggest that the available cues in misnomered "ambiguous" figures are entirely adequate to specify a meaningful percept. In the

case of the rat–man figure, the stimulus contains *both* the structure for a rat and the structure for a man (Michaels & Carello, 1981; Zebrowitz, 1990). Whether this more aptly named ambivalent figure is perceived as a rat or a man appears to be ultimately determined by which of these structures is detected.

If this is indeed the case, how is it that interpretive set affects perceptual identification? Drawing on the ecological view of perception (Gibson, 1966, 1979; Rogers, 2000; Turvey, Shaw, Reed, & Mace, 1981), we suggest that recent exposure to images of animals (or human faces) attunes people's attention to the rat (or man) structure within the figure. This "education of attention" occurs because prior exposure to the drawings of animals, for example, gives perceivers experience with detecting the critical structures that specify various animals. Each particular animal's structure would differ somewhat, but there would also be aspects that were common to, or invariant across, all the animals seen. Having repeated opportunities to detect such "animal-defining" invariances sensitizes perceivers to the presence of those same invariances in subsequent encounters (McArthur & Baron, 1983; Michaels & Carello, 1981; Tanaka & Curran, 2001). Consistent with such a possibility, results of a recent study that measured brain activity (using functional magnetic resonance imaging) while participants viewed "ambiguous" figures indeed indicated that spontaneous reversals between the rival percepts were strongly associated with shifts of spatial attention (Kleinschmidt, Büchel, Zeki, & Frackowiak, 1998).

Obviously, the foregoing explication requires further testing before its merits can be fully determined. It is interesting to note, however, that this line of reasoning may help explain an apparent anomalous finding reported by Leeper (1935) nearly 70 years ago that the orthodox constructivist view cannot easily accommodate. As in the present no-fixation condition, Leeper found that priming information (designed to induce a workable hypothesis) influenced the perceptual identification of an "ambiguous" figure when it was presented visually. On the other hand, when comparable priming information was presented verbally, it was ineffective in biasing perceptual identification (cf. Weldon & Roediger, 1987, Study 4). Both the visual and verbal methods of presentation should have been adequate to trigger a schema capable of influencing perceptual identification. However, only the visual method of presentation would have provided individuals with an opportunity to attune their perceptual apparatus to one or the other meaningful structures that the present research suggests reside in stimuli that can more befittingly be described as ambivalent.

Author Note

This research was facilitated by grants from the Ohio Board of Regents and the National Science Foundation (SBR-9514966). We thank Matt Hiatt for his assistance with data collection, and Mark Alicke, Hal Arkes, Frank Bellezza, Bill Dember, Kim Dudley, Chris France, Claudia Gonzalez-Vallejo, Ian Handley, Keith Markman, Andrea Patalano, Jennifer Ratcliff, Robert Roe, and Julie Suhr for their comments on earlier drafts of the manuscript.

References

Binder, A., & Feldman, S. E. (1960). The effect of experimentally controlled experience upon recognition responses, *Psychology Monographs*, *No. 496*.

Bernstein, L. J., & Cooper, L. A. (1997). Direction of motion influences perceptual identification of ambiguous figures. *Journal of Experimental Psychology: Human Perception and Performance*, *23*, 721-737.

Bruner, J. S., & Minturn, A. L. (1955). Perceptual identification and perceptual organization. *Journal of General Psychology*, *53*, 21-28.

Bruner, J. S., & Potter, M. C. (1964). Interference in visual recognition. *Science*, *144*, 424-425.

Bugelski, B. R., & Alampay, D. A. (1961). The role of frequency in developing perceptual sets. *Canadian Journal of Psychology*, *15*, 205-211.

Chastain, G., Burnham, C. A. (1975). The first glimpse determines the perception of an ambiguous figure. *Perception and Psychophysics*, *17*, 221-224.

Georgiades, M. S., & Harris, J. P. (1997). Biasing effects in ambiguous figures: Removal or fixation of critical features can affect perception. *Visual Cognition*, *4*, 383-408.

Gibson, J. J. (1966). *The senses considered as perceptual systems*. Boston: Houghton Mifflin.

Gibson, J. J. (1979). *The ecological approach to visual perception*. Boston: Houghton Mifflin.

Goolkasian, P. (1987). Ambiguous figures: Role of context and critical features. *Journal of General Psychology*, *114*, 217-228.

Goolkasian, P. (1991). The effect of size on the perception of ambiguous figures. *Bulletin of the Psychonomic Society*, *29*, 161-164.

Gregory, R. L. (1970). *The intelligent eye*. New York: McGraw-Hill.

Hochberg, J. (1968). In the mind's eye. In R. N. Haber (Ed.), *Contemporary theory and research in visual perception* (pp. 309-331). New York: Holt, Rinehart and Winston.

Hochberg, J.. & Peterson, M. A. (1987). Piecemeal perception and cognitive components in object perception: Perceptually coupled responses to moving objects. *Journal of Experimental Psychology: General*, *116*, 370-380.

Kleinschmidt, A., Büchel, C., Zeki, S., & Frackowiak, R. S. J. (1998). Human brain activity during spontaneously reversing perception of ambiguous figures. *Proceedings of the Royal Society of London*, *265*, 2427-2433.

Leeper, R. W. (1935). A study of a neglected portion of the field of learning—The development of sensory organization. *Journal of Genetic Psychology*, *46*, 41-75.

McArthur, L. A., & Baron, R. M. (1983). Towards an ecological theory of social perception. *Psychological Review*, *90*, 215-238.

Michaels, C. F., & Carello, C. (1981). *Direct perception*. Englewood Cliffs, NJ: Prentice-Hall.

Peterson M. A., & Gibson, B. S. (1991). Directing spatial attention within an object: Altering the functional equivalence of shape descriptions. *Journal of Experimental Psychology: Human Perception and Performance*, *17*, 170-182.

Peterson M. A., & Hochberg, J. (1983). Opposed-set measurement procedure: A quantitative analysis of the role of local cues and intention in form perception. *Journal of Experimental Psychology: Human Perception and Performance*, *9*, 183-193.

Rock, I. (1983). *The logic of perception*. Cambridge MA: MIT Press.

Rogers, S. (2000). The emerging concept of information. *Ecological Psychology*, *12*, 335-343.

Ross, L., Lepper, M. R., & Hubbard, M. (1975). Perseverance in self-perception and social perception: Biased attributional processes in the debriefing paradigm. *Journal of Personality and Social Psychology*, *32*, 880-892.

Tanaka, J. W., & Curran, T. (2001). A neural basis for expert object recognition. *Psychological Science*, *12*, 43-47.

Tsal, Y., & Kolbert, L. (1985). Disambiguating ambiguous figures by selective attention. *Quarterly Journal of Experimental Psychology*, *37A*, 25-37.

Turvey, M. T., Shaw, R. E., Reed, E. S., & Mace, W. M. (1981). Ecological laws of perceiving and acting: In reply to Fodor and Pylyshyn. *Cognition*, *9*, 237-304.

Uttal, W. R. (1988). *On seeing forms*. Hillsdale, NJ: Erlbaum.

Weldon, M. S., & Roediger, H. L., III. (1987). Altering retrieval demands reverses the picture superiority effect. *Memory and Cognition*, *15*, 269-280.

Wilson, T. D., Lisle, D. J., Kraft, D., & Wetzel, C. G. (1989). Preferences as expectation-driven inferences: Effects of affective expectations on affective experience. *Journal of Personality and Social Psychology*, *56*, 519-530.

Zebrowitz, L. A. (1990). *Social perception*. Pacific Grove, CA: Brooks/Cole.

Publisher's Note: This article previously published in Psychology Research Journal.