Brief article

The perceived intentionality of groups

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Abstract

Heider and Simmel [Heider, F., Simmel, M., 1944. An experimental study of apparent behavior. American Journal of Psychology 57, 243–259] found that people spontaneously describe depictions of simple moving objects in terms of purposeful and intentional action. Not all intentional beings are objects, however, and people often attribute purposeful activity to non-object individuals such as countries, basketball teams, and families. This raises the question of whether the same effect found by Heider and Simmel would hold for non-object individuals such as groups. We replicate and extend the original study, using both objects and groups as stimuli, and introducing two control conditions with groups that are not engaged in structured movement. We found that under the condition that best promoted the attribution of intentionality, moving groups are viewed as purposeful and goal-directed entities to the same extent that moving objects are. These results suggest that the psychological distinction between the notion of 'intentional entity' and the notion of 'object' can be found even in the perception of moving geometrical figures. © 1999 Elsevier Science B.V. All rights reserved.

1. Introduction

What kinds of entities do we think about? Many psychological theories focus exclusively on material objects, and there are numerous proposals concerning the cognitive mechanisms that categorize objects, learn object names, count objects, track them through time and space, perform inductive reasoning about their properties, and so on. The fundamental role of the notion 'object' in human psychology is

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not in doubt. Nevertheless, our abilities in the domains of categorization, word learning, enumeration, tracking, and induction extend to other domains as well. For instance, we are capable of similar computations with sounds (e.g. beeps), actions (e.g. kicks), events (e.g. parties), groups of objects (e.g. families), and more abstract individuals (e.g. prime numbers). Such abilities emerge early in development. For instance, 1- and 2-year-olds are capable of learning names for some kinds of non-object individuals (Bloom, 1996, in press), and 6-month-olds can individuate and enumerate such individuals (Wynn, 1995).

   This paper concerns the perception of intentional action. In a classic study, Heider and Simmel (1944) showed subjects a film in which simple geometric figures (a large triangle, a small triangle, and a circle) moved relative to a stationary three-sided figure in a manner consistent with acting out a story. When told 'write down what happened in the picture', almost all the subjects interpreted the movement of the figures as the purposeful actions of animate beings. This was also the case when the film was shown in reverse, though here the subjects' interpretations showed more variation, presumably because there was no coherent 'story' that emerged from this reversed version. Similar findings were obtained in a more controlled set of experiments by Bassili (1976), who found that the temporal contingency between the figures was relevant for whether or not they were perceived as interacting, while the type of spatial contingencies determined the precise nature of the interactions (see also Dittrich and Lea, 1994). Studies using a habituation methodology have found that even infants treat simple moving figures as goal-directed beings (Dasser et al., 1989; Gergely et al., 1995).

   On some accounts, the mental mechanism giving rise to such intentional interpretations is a specialized innate 'theory of mind' module evolved for reasoning about the activities of animate beings (e.g. Leslie, 1994; Baron-Cohen, 1995). Alternatively, such interpretations might arise from other processes, perhaps those which yield causal attributions more generally (Michotte, 1963). A related proposal, which is consistent with the finding of cross-cultural differences in the interpretation of moving figures (Morris and Peng, 1994), is that these attributions are the result of naive theories acquired over the course of development (Morris et al., 1995).

   What types of stimuli elicit this intentional attribution? Previous experiments have focused exclusively on depictions of objects, where 'object' is defined as a bounded solid that obeys spatio-temporal continuity (see Spelke, 1994). This is sensible, as most of the entities we view as having purposes and goals, humans and other animals, are themselves perceived as bounded objects.

   We attribute intentional states and actions to other entities as well, however. We make claims such as 'The IRS took much of my income, but they didn't appear to be bothered by my home office deduction', 'Despite a hard fight, the NY Knicks lost a close battle with the Chicago Bulls', and 'The United States has concluded that Serbia is routinely violating the United Nations ban on flight over Bosnia' (from The New York Times, Dec. 4, 1992, cited by Clark, 1994). Such attributions are commonplace (Clark, 1994), even though entities such as the IRS, the Knicks, and the United States are in no interesting sense objects.

   The relationship between this type of attribution and the attribution by subjects in

the Heider and Simmel task is unclear. They might have nothing to do with each another. Perhaps the attribution of intentional properties to non-object entities is based exclusively on a more abstract aspect of social cognition (such as the capacity for the metaphorical extension of notions that we more naturally apply to people), and cannot be induced directly from perceptual input. Alternatively, it might be that the mechanism underlying the Heider and Simmel findings is sufficiently abstract that it can apply to perceptual individuals other than objects, such as distinct groups. Although there is considerable research within social psychology as to how people form impressions or stereotypes of social groups (see Hamilton and Sherman, 1996 for review), the question of when we will think of groups as single intentional entities has not been previously addressed. This motivated the following experiment.

2. Method

Ninety-six University of Arizona undergraduates participated for class credit. Subjects were tested either alone or in pairs. They were seated approximately 90 cm away from an Apple Color High Resolution RGB Monitor that was 33 cm in diameter. They were told that they were going to see a brief movie, that it would be repeated, and that when it was over, they should 'write down what happened, as best as you can remember'. They were shown a movie, which lasted 67 s, and then, after a brief pause, were shown the same movie again. Subjects were then asked to write down what they had seen. After they had finished this, they were asked to write down 'how many different characters you saw', and, after they had done so, were asked to write a brief description of each of the characters.

There were six movies; each was shown to 16 subjects. The object forward and object reverse movies were modifications of the films used in the Heider and Simmel (1944) study. In the object forward movie, three geometrical objects of different colors (blue, red, and green) moved in systematic patterns that were intended to reflect intentional action. The movie also included a three-sided black figure (the 'box') on the lower left of the screen. Described with an intentional gloss, the movie went as follows:

1. The green object is trying to escape from the box, but the blue object is repeatedly moving in front of it and pushing it back.
2. The red object emerges from the top of the screen and pushes the blue object out of the way.
3. The green object escapes and moves to the top of the screen. The red object joins it.
4. The blue object repeatedly darts towards the green object, but the red object intercepts it, keeping them apart.
5. The red object and the green object briefly dance around together and retreat off the screen
6. The blue object pounds against the box. The box falls on the blue object, trapping it.

The object reverse movie was this film played backwards. The group forward and group reverse movies were the same as the two object movies, except that instead of three objects, there were three groups of objects that moved together: a blue group, a red group, and a green group. A stationary frame from each movie is shown in Fig. 1.

The two other movies served as control conditions. In the group still control, the groups stood stationary to the right of the box for the duration of the movie. In the group repeated control, the three groups of objects appeared side-by-side to the right of the box, and moved repeatedly up and down the screen at a constant rate for the duration of the movie. Through most of the movement, the groups were in synchrony, but they moved asynchronously when they reached the top and bottom of the screen.

The subjects' responses were independently coded by two students who were blind to the hypothesis tested. The coders were asked to rate the stories as to 'the extent that the actions of the participants are described in terms of the intentional actions of animate beings' and they were given a scale that went from 1 'not at all intentional' to 5 'highly intentional', with 3 marked as 'intermediate'. They were told to ignore the precise descriptions of the participants (e.g. 'a red square' versus 'a group of red squares'), and to 'just focus only on the descriptions of the activities, what the participants are doing.'

3. Results and discussion

Coder's scores were averaged together to generate a score for each subject. (The correlation between the coder's scores was 0.90 for all of the stories and 0.79 for the four experimental stories, excluding the control stories.) The degree of perceived intentionality for each group is shown in the second column of Table 1. The main analysis excluded the control conditions. A two-way ANOVA on entity-type (object vs. group) and direction (forward vs. reverse) revealed a main effect of direction; subjects' interpretations of the forward movies were significantly more intentional than those of the reverse movies (3.9 vs. 3.3; $F(1,60) = 5.8$, $P = 0.02$). This is likely to be because the forward movies were purposefully constructed so as to make a coherent story, while the reverse movies did not have a 'plot', and were thus harder to describe in a consistent manner through reference to intentional states such as desires and goals.

There was no main effect of entity-type, and no interaction between entity-type and direction. However, it should nevertheless be noted that the group reverse condition received lower ratings than any of the other conditions, though the difference between it and the object reverse condition was only marginally significant ($t = 1.9$, $P = 0.07$, two-tailed). Sample descriptions that subjects from each group provided are shown in Appendix A.

The main finding of interest is that there was no significant difference between the object stories and the group stories in the overall intentionality ratings, and when the movies were played in the forward direction, the degree of intentional attribution was virtually identical for the objects and for the groups.
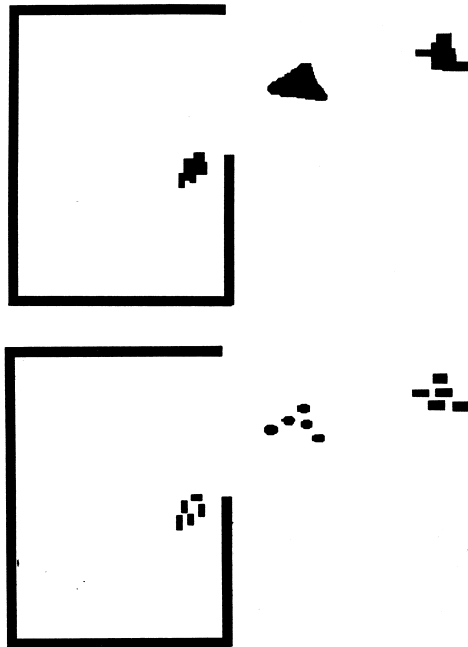
Fig. 1. Top: depiction of a segment from the object forward and object reverse movies; bottom: depiction of the same segment from the group forward and group reverse movies.

The group still movie was never given an intentional interpretation; all of the descriptions generated by subjects in this condition were coded as '1' (the lowest score possible) by both of the coders. The group repeated movie was also rarely given an intentional interpretation. The intentionality ranking for the group repeated movie was significantly lower than for the object forward, object reverse, group forward, and group reverse movies, as found by t-tests (all t's > 5.8; all P's < 0.001). The low intentionality ratings for the control conditions show that the mere presence of three groups, or even three moving groups, is not sufficient to generate intentional attribution. Some movement of sufficient complexity and structure is required.

Table 1
Subjects' responses to the stories: mean intentionality scores and number of subjects who viewed the groups as characters

Condition		Intentionality ranking (1 = not at all intentional; 5 = highly intentional)	Number of subjects (out of 16) who judged that there were three or four characters
Objects	Forward	3.91	16
	Reverse	3.66	16
Groups	Forward	3.94	15
	Reverse	2.97	15
Group still		1.00	7
Group repeated		1.25	6

A second set of analyses was based on subjects' responses to the question 'How many different characters were there?' If the subjects who were shown groups answer 15 (or 16, including the box), it would suggest that they are construing the objects, not the groups, as the intentional participants. In contrast, if they answer 3 or 4, it would suggest that they are construing the groups as intentional entities. The number of 3 or 4 responses from the subjects in each group is shown in the third column of Table 1.

Not surprisingly, the object forward and object reverse movies were always described as having either three or four characters, since this was how many objects were depicted: three moving objects, and a stationary box. More interestingly, the group forward and group reverse movies were also almost always described as having either three or four characters, which is consistent with the conclusion from the analysis of the subjects' descriptions that they were treating the groups as intentional agents. The proportion of three or four responses in each of the above conditions was significantly greater than the proportion of three or four responses in each of the group still and group repeated conditions (both under 50%) (all χ^2's > 9.3; all P's < 0.01).

The subjects' responses when asked to describe the characters in the group movies allow us to explore an alternative explanation for our findings, which is that they viewed the groups as intentional entities because they were actually seeing them as spatially continuous objects, in this sense that one might see a figure such as '– – – –' as four segments of a single line. This cannot be the case, however. Almost all of the subjects described the characters either as groups (e.g. 'a group of/made of blue things'), or with a plural count noun (e.g. 'blue circles'). This was consistent with their descriptions of the events, which almost always contained at least some instances of plural reference. Only four subjects never gave group or plural references, all of these were in the group reverse condition. One used highly anthropomorphic descriptions (e.g. 'a blue child'); the other three described each of the groups as an 'object' or 'shape'.

These results suggest that the effect discovered by Heider and Simmel is not limited to objects; it extends to other perceived individuals as well. Nevertheless, it is worth noting that the groups we used were quite object-like. They were bounded (through the Gestalt principles of proximity and common fate) and, although they were not spatially continuous, their component parts were in a static spatial relationship with respect to one another. It is an open question whether the same results would emerge if each group was a swarm of distinct objects moving relative to one another. Alternatively, what if the 15 objects started off scattered across the screen, coalesced into three groups for the purpose of acting out the events in the movie, and then broke up again into 15 separate entities? Or if the entities within the groups were constantly being replaced, with one darting off the screen in the middle of an activity, and another taking its place, like players on a hockey team? Answers to these questions might give us insight as to the nature of the entities we can perceive as intentional individuals.[1]

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[1] We thank Elizabeth Spelke for discussion of the examples raised in this paragraph.

A final issue concerns the responses in the group reverse condition. Although the extent of intentional attributions for this condition was much higher than for the group still and group repeated conditions, it was lower than for any of the other variants of the Heider and Simmel film. This was also the only condition in which subjects did not always describe the groups using plural reference, but sometimes described each group as an object or shape.

One possibility is that, in general, groups of objects are less viable candidates than single objects for intentional interpretation (see also Bloom and Kelemen, 1995; Bloom, 1996, in press). So while objects are readily viewed as intentional individuals, even under very minimal conditions, people might be less prone to think of a group as engaging in purposeful action in cases where the motivation for this interpretation is not very strong, as in the less structured group reverse movie. This does not explain, however, why four of the subjects in the group reverse movie, and none in the group forward movie, described the groups with singular reference. Another possibility, not inconsistent with the first, is that the processing and memory demands involved in tracking three groups of five objects apiece are high, and get worse when there is no coherent plot line. This might cause some of the subjects in the group reverse condition to adopt the strategy of 'chunking', encoding the entities as objects or shapes instead of actual groups. The processing load might additionally lead to more confusion and failure to recall the scene, which would further diminish the extent of subsequent intentional attribution.

The motivation for this experiment was the observation that we can attribute intentional states and actions to entities that are not objects, such as teams and countries. But note that even the ordinary act of attributing intentionality to a person makes reference to an entity that is not entirely co-extensive with our notion of 'object'. If the reader of this paper was to keel over with a fatal heart attack, he or she would cease to exist, but the object, the body, would remain. Under many belief systems, the converse is true; the reader will survive the complete destruction of his or her body, as an immortal soul, a ghost or spirit, or as the inhabitant of another, different, body. Intentional entities are identified, counted, and tracked differently from material objects (for discussion, see Descartes, 1637; Parfit, 1984). The results discussed above suggest that one can observe the dissociation between the notions of 'intentional entity' and 'object' even in the simple context of the perception of moving geometrical figures.

Appendix A. Sample stories from each condition

Group stationary (rating: 1)
'There was a black outlined box not completely finished on the left hand side of the screen. Then there was a bunch of blue circles bunched together, behind that a bunched together group of red boxes; and behind that was a group of green boxes outlined in black. Everything stayed motionless.'

Group repeated (rating: 1)
'We watched a brief movie that consisted of three sets of items: five red brick

shapes, five green smaller brick shapes, and five blue dots. There were moving vertically in front of what looked to be an unfinished rectangle.'

Object forward (rating: 4.5)

'The green object was inside a box and the blue object would not let him get out. It kept making sure the green object stayed inside. Then a red object came and pushed the blue object out of the way and helped the green object out of the box. Then the red object kept the blue object away from the green one. The blue object ended up being trapped in the box and the red and green objects went off together.'

Object reverse (rating: 4.5)

'In the beginning, there is a triangular, blue object that seems to be stuck in a box with a missing edge. After the blue object tries finding a way out for a while, two other objects come onto the screen. They were green and orange. The box then moves and allows the blue object out. The blue object goes over and examines the other two objects. He tries to get them into the same box that it came out of. It successfully gets the green one in but the orange one escapes. The blue one then holds the green one in the box by guarding the opening and every once in a while it traps the green one by going into the box with it and then returning to the guard position.'

Group forward (rating: 4.5)

'The blue dots would not let the green rectangles pass. However the green rectangles did not seem to mind and didn't try that hard. All of a sudden, red rectangles came flying in to the scene, and carried away the green rectangles. The blue dots seemed frustrated by this and still tried to get to the green rectangles. The red rectangles were very fast-moving and did not let the dots touch the green rectangles. All of a sudden the box closed upon the blue dots.'

Group Reverse (rating: 2.5)

'On the screen we saw six blue dots inside of a rectangular box with an opening. The six blue dots began to move around- bouncing off corners and sides of the box. Then a group of five 'red bricks' and a group of five green dots come onto the screen. The rectangular box turned sideways (short side on bottom) and the six blue dots left the box to the open area. The five green dots did not come in contact with the blue dots at this time. However the red and blue groups made contact. The red group left the screen. Then the green dots entered the rectangular box with an opening. The blue dots kept trying to get in but were pushed away by the green dots. In the end, the green dots were in the rectangular box and the blue dots were in the screen.'

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