# Motion induced Animacy Perception as Optimal Inference

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**Abstract**

We often attribute the state of mind to inanimate things. This type of perception is called animacy perception. animacy perception is thought to be a part of theory of mind module as Fodor's sense and is attracted much attention in function to social perception. Animacy perception was once said to be misleading perception because it was automatically triggered by inanimate thing. The range of parameter's change which was used in previous studies was too small compared with that of actual living things and the interaction of the parameters that effect animacy perception was not considered. We used wide-range parameters and determined animacy perception's psychometric function in this study. Then we got the function of animacy perception that might be appropriate to determine whether the stimulus was a living thing or not. This result suggests that animacy perception is not misleading but optimal when there is little information. Moreover, animacy perception is not response to only one parameter but inference by considered several parameters.

## Introduction

We often find the state of mind in inanimate things: for example, we find it in rolling balls, flyaway twigs or floating clouds; Moreover we sometimes find it even in geometric shapes. Heider & Simmel (1944) showed that, when shown a film of geometric shapes with self-propelled motion, subjects interpreted the shapes as alive. This type of perception is called animacy perception. Animacy perception is said to be a foundation of social perception (Michotte, 1946) and also to be a 'stupid' module to be triggered by a certain cue that results misidentification (Barrett, Dunber & Lycett, 2002). Animacy perception that we will discuss in this is that the motion of simple shapes is spontaneously perceived as being alive, with strong impression.

Since the Heider & Simmel's study, there have been a lot of studies about animacy perception. Some of these studies tried to clarify the motion cue that effected animacy perception (Dittrich and Lea ,1994)

Tremouretto & Feldman (2000) clarified that the motion cue of a single object could effect animacy perception. In their experiments, as they changed the moving speed and direction of a dot only one time, the subjects to rate impression of animacy perception. Their result showed that we perceived animacy perception stronger when both speed and direction changed larger.

If the result of previous studies is taken into account, animacy perception will always increase when the changes increase. In contrast, our hypothesis is that, by broadening the range of change and analyzing with 3 dimensions (speed change, direction change and animacy perception rate), animacy perception will rather decrease if animacy perception is optimal; Even if animacy perception often results misidentification, it could be called optimal perception as long as it gives more important information in our environment and simply triggered by a certain cue.

We made an experiment in which the range of change was enlarged and did a 3 dimensional analysis.

## Method

We used the Tremoulette & Feldman's paradigm to investigate whether animacy perception was stupid or not. We will determine a 3 dimensional function of animacy perception and compare it to the distribution of the probability in our environment. If they were sufficiently similar, we can conclude that animacy perception is optimal.

### Subjects

Twelve graduate and undergraduate students participated in this experiment. All of them were naive as to the purpose of the experiments. All the subjects had normal or corrected-to-normal vision and were tested individually.

### Apparatus and Stimuli

Stimuli were generated by a personal computer (TOSHIBA, Dinabook P4/510PME) and displayed on a CRT monitor (HEI, V770, Refresh rate was 85Hz).

An example of stimuli was shown in Figure1. A black particle went through a white circle (visual angle 7.2°) in black background and, at the center of display, the particle (visual angle 0.4°) changed its speed and direction at once. The initial speed of the particle was 0.7 degree/sec. The particle's starting point and the amount of change in speed and direction were randomized: Here $\Delta v$ means speed change rate and $\Delta d$ means degree of direction change.

There were total 245 trials in one block to ensure that every possible stimulus parameters appeared 5 times; speed change (0.3, 0,5, 0.8, 2, 4, 6, 8) * direction change (0, 30, 60, 90, 120,150,180) * 5 repetitions. All the subjects carried out 3 blocks.

## Procedure

The subjects were seated in front of the display at a distance of 60cm. The subjects pushed the Enter key so that the particle appeared after a 2s-delay. The subjects were asked to rate their animacy impression in seven steps and to push a corresponding ten key. By pushing the enter key, the next trial started.

There was a practice session that consisted of 100 trials prior to an experimental session. The subjects took a rest in the experimental session between blocks and between the practice session and the experimental session.

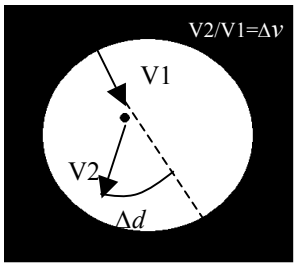


Figure1: The display in this experiment was shown. The parameters were defined by $\Delta v$ and $\Delta d$.

## Result and Discussion

The result was shown in Figure 2. When range of change was extended, it was not shown that the larger the change was, the larger animacy perception was: Animacy perception rate decreased gradually with the increase of the change. This is rational because living things cannot make the sharp change of speed or direction.

In addition, this function was similar to the deference of two Gaussian. If animacy perception is optimal in the sense that perception reflects the probability that the object is alive, the function of animacy perception expresses the distribution of the difference between the motion of actual living things(Figure 3) and that of inanimate things (guessed from Tremoulette et al. 2000). The distributions of living things and inanimate ones come to be approximated by the Gaussian and the deference of the two distributions comes to approximated by the deference of two Gaussian. So it is possible that animacy perception is correspond to the probability of environment.

Figure 4 shows that the difference in two distributions was similar to distribution in animacy perception rating, which was obtained as a result of the experiment. As a result, we might conclude that animacy perception is optimal, from a statistical view.

Our result in this study demonstrates that animacy perception corresponds to the probability in our environment. Animacy perception seemed to be triggered automatically even when it was a misidentification, but our result suggests that animacy perception achieves the maximum of efficiency with the minimum of information. It may mean that to know whether one is alive or not is fatal to survive. So there seems to be an unconscious process to behave optimally.

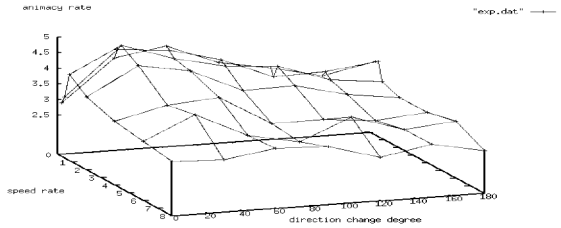


Figure2: X- and Y-axis denote speed change rate and direction change degree. Z-axis denotes animacy perception rate. Animacy perception rate made a sudden upturn at first and had a gradual drop afterward.

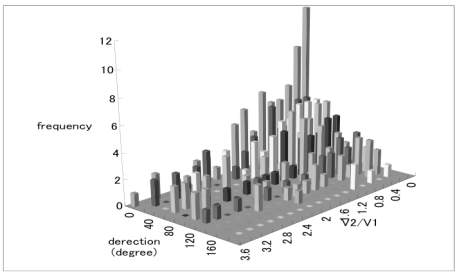


Figure3: The distribution of human's motion in movie recording a ground.( It showed that the average is about (0,0). It were analyzed by the same parameters as the experiment (N = 1180).

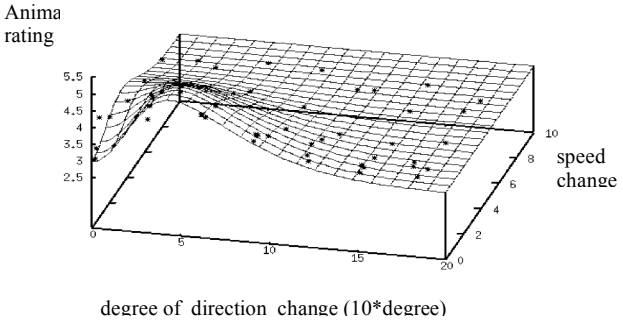


Figure4: the deference of two Gaussian and the experimental data were shown. The experimental data were depicted by "*" and deference of two Gaussian ($3+3*(\exp(-(x/4)^2/2*3^2+ (y/2)^2/2*3^2-\exp(-x^2/2*2^2+ y^2/2*2^2)$ ) was depicted by line.

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