

A preliminary report:
Do hunter-gatherers have illusions?

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Abstract

This is a preliminary report that studies whether modern hunter-gatherers have illusions, i.e., erroneous perceptions of reality occurring when they watch intentionally designed movies. Experiments were performed in southeast Cameroon and Baka Pygmy hunter-gatherers participated. The result suggests that hunter-gatherers do have illusion.

1. Introduction

Illusions occur when a human sees a 2D image and converts it to a 3D image in brain. Since the conversion from 2D to 3D is mathematically an ambiguous task and since infinite solutions could exist, human brain has to assume some prerequisites in the conversion process. Many examples of illusion exploit human tendency to assume regular patterns such as parallel lines and squares (the angle of 90 degrees). An interesting question is whether this tendency is genetically determined or culturally acquired after birth. If the tendency is culturally acquired, modern human are more likely to see illusion since they grow and live surrounded by modern architectures which are full of geometrically regular patterns such as parallel lines and squares. There is a possibility that individuals living in an environment where few geometrically regular patterns exist have weaker or no tendency to have illusions (i.e., be hallucinated) than individuals living in modern cities. To test this hypothesis, we perform experiments with hunter-gatherers in Cameroon.

2. Method

2.1 Participants

The participants of the present research are hunter-gatherers children and adults in a village Payo near the village center of Lomie, southeast Cameroon. The tribe belongs to Baka Pygmy. The Baka are a group of African Pygmy hunter-gatherers that live in the African rainforest extending over Cameroon, Gabon, the Central African Republic (CAR) and the Republic of Congo. The participants speak the Baka language and some of them speak French. None of them speak English. The experimenter (the first author) knows neither Baka nor French, and thus there was no linguistic communication between the experimenter and participants.

Although many neighboring villages are 'modernized' in a sense that their primary occupation is agriculture (farmers) and they frequently exchange goods in a market, most Baka Pygmy tribes have kept their traditional culture of 'hunting-and-gathering'. For this area, it is said that cultural and genetic hybridization between hunter-gatherers and farmers is far less than the expectation from random communication/mating model (i.e., quite rare).

Following the Cameroon government's policy and the rapid development of rural areas, Baka Pygmy tribes are also being 'modernized', and thus the importance of the present observation (as of 2014) should be noted.

The physical and cultural data of participants (e.g., age, sex, health state, education) were not taken in this preliminary study. They happened to be there on 8th August 2014 at the location ($3^{\circ} 8.734$ N, $13^{\circ} 42.471$ E). The location data was taken by GPS function of a smart-phone (NTT docomo SC-02F).

Children, whose ages are estimated as from 3 to 15 years old, joined the first experiment. All the children looked healthy and this group consists of both boys and girls. Three adult males joined the second experiment. They also looked healthy. They are from families ('Ie' in Baka) of Nboku, Monbito, and Makunbo. Their level of education was not studied, but the environment suggests that they have never seen modern architectures such sky-scrapers.

2.2 Illusion movies

We prepared 3 illusion movies (I1, I2, I3), each of which lasts for 1 minute. For control, we also prepared 3 movies (N1, N2, N3) which look the same in the beginning but no illusion occurs. In total, we prepared 6 movies.

Examples of snapshots of the movies are shown in Figs. M1 and M2. Fig. M1 shows three scenes of the first illusion movie I1. As shown in Fig. M1(a), there is a solid having two windows, and a straight red rod appears. Then, as shown in Fig. M1(b), the red rod is inserted through the two windows simultaneously, which looks impossible. Finally, as shown in Fig. M1(c), the solid together with the rod is rotated so that we can understand the true shape of the solid. In the

corresponding non-illusion movie N1, the initial scene is almost the same as Fig. M1(a), but the rod is inserted through only one window, and the scene is rotated, by which we understand that the shape of the solid is the same as we perceive in the initial scene and hence no surprise.

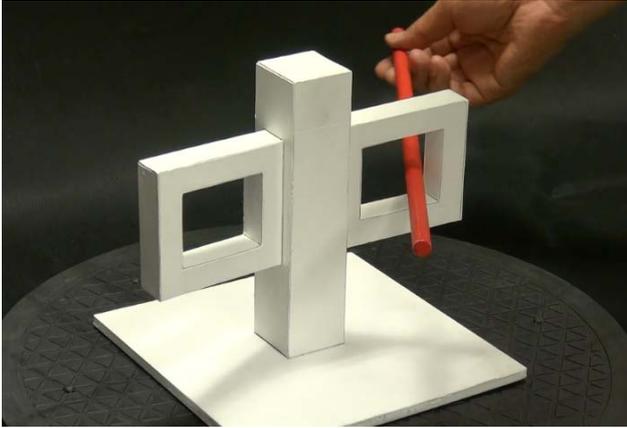


Fig. M1(a)

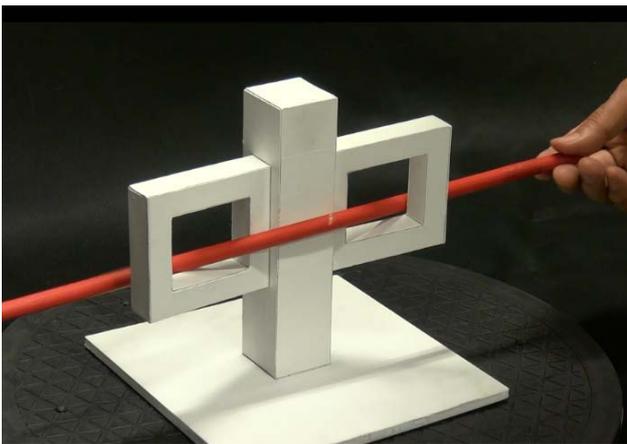


Fig. M1(b)

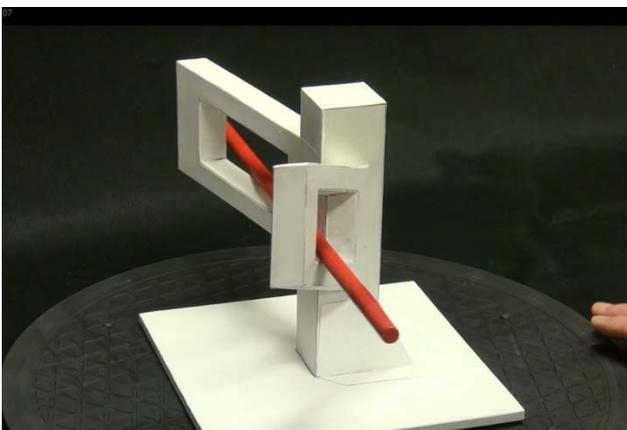


Fig. M1(c)

Snapshots of the third illusion movie I3 is shown in Fig. M2. Initially, as shown in Fig. M2(a), there is a solid having four slopes. Next, as shown in Fig. M2(b), wooden balls put on the slopes look as if they are rolling uphill toward the highest center. Finally, the scene is rotated as shown in Fig. M2(c), by which we understand that the center is the lowest, and hence the motion of the balls is consistent with the gravity. In the corresponding non-illusion movie N3, the initial scene is the same as Fig. M2(a), but when the balls are put on the slopes, they roll downhill, and when the scene is rotated, we understand that the initially perceived shape of the solid is correct.

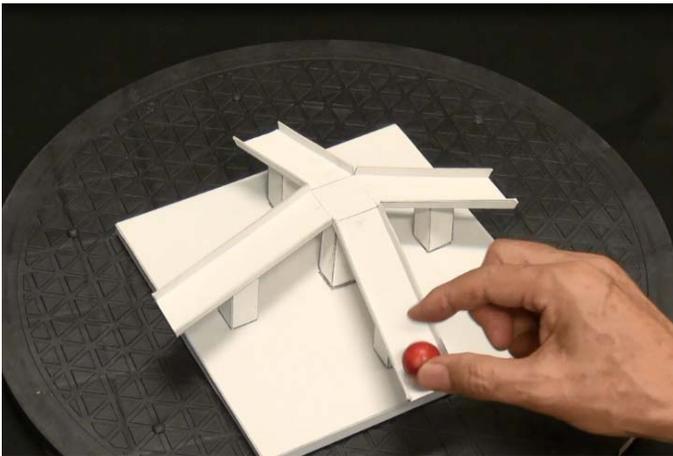


Fig. M2(a)

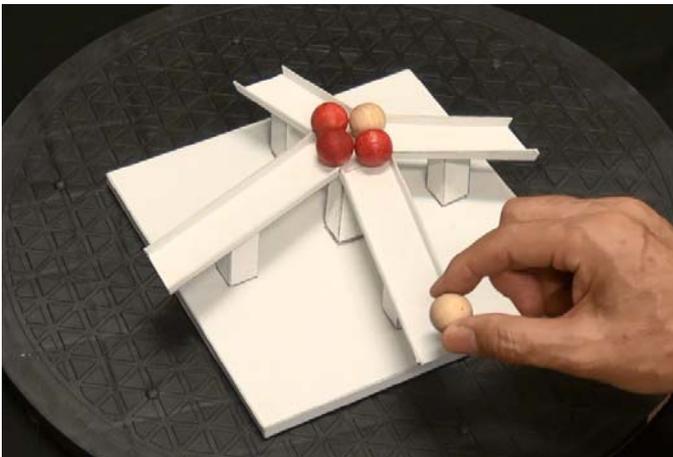


Fig. M2(b)

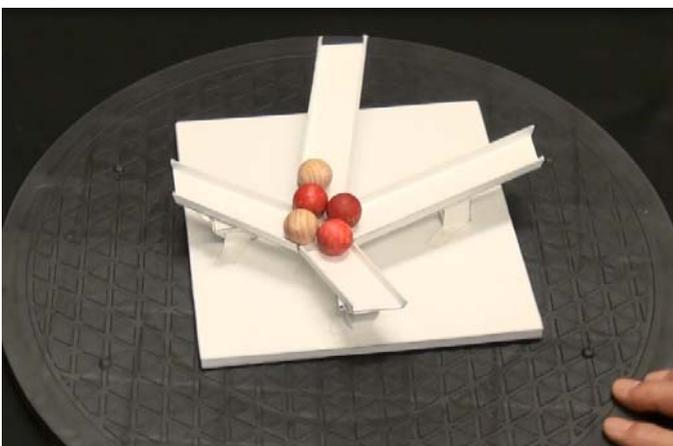


Fig. M2(c)

Movie files were played with a tablet (Google Nexus 7). Files were saved in Japanese file names to prevent a participant to read the content.



2.3 Experiments

Participation to the experiments was completely spontaneous. No instruction was given by experimenters. Upon the arrival to the village (the arrival of the research group had been announced) and after exchanging greetings, we put a tablet on the ground. It seems that the impression "something fun will begin" has attracted most child participants.

Movie files were shown in the following order; N1, I1, N2, I2, N3, I3. No word was spoken by an experimenter.

The experiments were performed twice (child group and adult group in this order in the same day and at the same village).

3. Results

3.1 Child group

Since there is no scientifically-accepted way to detect whether participants have illusions, we took photographs during the experiments. After a sequence (N1 - I3), the same sequence is repeated. After several sequences, participants lost interests in normal movies (N1, N2, N3) while they still showed interests in illusion movies (I1, I2, I3). There was variation in their attitude; some

participants looked concentrating on all the movies, some were interested only in the illusion movies and some lost interests in all the movies after the first sequence. Examples of faces of children looking at an illusion movie are shown below.



3.2 Adult group

The same sequence was displayed. They showed more interests in illusion movies (I1, I2,

I3) than normal movies (N1, N2, N3). After two sequences, they talked with each other. It seemed that they had particular interest in a rotating scene in a movie file I2, which is intended to show that the initially perceived 3D structure is different from the true 3D structure, and hence might tell why illusion occurs. The experimenter repeated this part. Examples of faces looking at an illusion movie are shown below.



4. Discussion

In summary, this preliminary study suggests that hunter-gatherers do have illusions. Thus, by this study, the origin of illusion cannot be attributed to culture or environment.

Several points need to be discussed. Firstly, the occurrence of illusion is judged mainly by the experimenter (the first author). Only photographs describe what actually happened during our experiments.

Secondly, we need to take into consideration that the participants were already in a process of 'modernization'. They lived in farmer's style houses which are square shaped, while their traditional house is round-shaped (shown below). A possible reason for them to have illusion is that parallel lines and squares exist in their life because of recent 'modernization'.



We speculate that the effect of recent 'modernization' had little effect on our result. Already in their traditional house, there is a supporting structure which is perpendicular to the ground (a stick supporting the round roof, see the photograph above). They also make bows and arrows to hunt games. To understand how bows and arrows work, they must have principal ideas in physics and geometry. Thus, even if parallel lines or squares are less seen in hunter-gatherers' life, it is quite natural that they know parallel lines and squares. How brain works to make illusion is another problem, but the followings are not contradicting:

- 1) Hunter-gatherers live in an environment with few geometrically regular structures.
- 2) Hunter-gatherers do have illusion based on such geometrically regular structures.

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