INTUITIVE RELATIVITY: SPONTANEOUS PERCEPTION OF COSMOS-WISE PSYCHOPHYSICAL RELATIONS BETWEEN TIME AND VELOCITY

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Abstract

Most psychological studies of intuitive physics focused on Newtonian functions. The present explorative venture attempts to extend the notion to cosmos-wise intuitive relativity, using psychophysical measurement of spontaneous perception of changes in acceleration/deceleration of time as a functions of accelerated velocity. It was hypothesized that the related function of more knowledgeable (n = 10, nine physics students and one professor) male participants will be more valid than that of laymen (n = 9), an in-between function was expected to typify the estimations of three other participants with amateurish interest in astrophysics. Based on two simple versions of the "Twins paradox", each examinee was exposed to numerical values deliberated to represent the velocity of a spacecraft in terms of kilometer per second (1,000, 50,000, 100,000, 150,000, 200,000, 250,000, 299,990, 299,993, 299,996 and 299,999). He was asked to estimate instantly the time elapsed after one year of space travel from two perspectives – the spacecraft and earth. As hypothesized, the estimations of the more educated participants were much closer to the $\epsilon = \sqrt{1 - v^2/c^2}$ *function (interestingly, there was no difference between the students and the professor), while the function of the naïve participants were nearly linear; as expected, the estimated function of the amateurish participants was in-between (see Figures 1 and 2). While the findings are of a mere exploratory nature they seem to mark a takeoff of a rather novel psychological field of research.*

The human mind captures reality in terrestrial sizes, a reality which described by the Newtonian mechanics. This idea make sense due to the fact that the Newtonian mechanics deals with masses, speeds and forces quite bigger than the size of atoms and slower than the speed of light, big and slow enough for direct measurement and observation. Therefore, most psychological studies of intuitive physics whatsoever have been focused on Newtonian functions (Crowell, 2011). In order to understand spontaneous perception of time and space examined by previous intuitive physics research, one should be familiar with the basic Newtonian laws.

The Newtonian mechanics examines the enhancement of forces influencing masses and causing their movements regarding earth gravitation. For instance, one can calculate vectors related to the movement of an object thrown by a person taking into account forces such as air resistance, direction and earth gravitation (Crowell, 2011).

Early studies revealed a gap between physical reality and related psychophysical functions. For instance, the intuitive theory of motion was found to be inconsistent with the fundamentals of Newtonian mechanics (McClonsky, Washburn and Felch, 1983). Krist, Fieberg & Wilkening (1993) found that trained participants used more valid psychophysical functions than laymen. Laszlo (2009, p. 51), defined spontaneous apprehension as "perception of the world beyond the range of the exteroceptive senses". Spontaneous apprehensions, on the other hand, seems to embrace information originating beyond the sense-perceivable range and transcend the classical limitations of information-transmission in space and time. It appears that knowledge of physics should be associated with more valid intuitive schemata of

Newtonian mechanics. Would this apply to intuitive schemata of astrophysics? This kind of realty can be accounted for by the theory of relativity, not the Newtonian mechanics.

The theory of relativity differs from the Newtonian mechanics by its fundamental principles. While the Newtonian mechanics deals with fixed dimensions of time and space, and considers gravity as a force activates by material bodies on each other, Einstein (1905) relates to gravitation as a sort of geometrical curve in space-time caused by large masses (ben-dov, 1997). The theory of relativity offers new meanings of constructs such as location, velocity and time. For someone which (virtually) moves near the speed of light, the time should be slow its pace dramatically relative to another rather stationary person.

A related imaginary (mind) experiment refers to time dilation effect, known as the "twins paradox" (Debs and redhead, 1995). Two twins in stationary location on earth, synchronize their watches. One of them stays on earth while the other takes of in a spacecraft for a long trip. He accelerates to a velocity the speed of light in unnoticeable time, then he continues flying for some time closnear the speed of light (0.8c). After a while, he turns around and speeds up again close to the speed of light until touch down in earth. Then he finds out that he is younger then his brother. For instance, if the his brother's calendar shows 20 years since the beginning of the space trip, this time for the pilot lasted only 16 years. This function can be calculated via equation 1.

$$\epsilon = \sqrt{1 - v^2/c^2} \qquad \textbf{(1)}$$

According ro Baylis (2004), the theory of relativity, which has been used in the last one hundred years, offers a new physical paradigm comparing to the Galilean and Newtonian mechanics. In his opinion, for beginning students of physics the theory can carry some intuitive elements. Alves (2008) compares the Newtonian notion of space and time and the relativity notion in terms of intuitive grasp. He claims that it is possible to examine intuitive models of time in both contexts – Newtonian and relativity. In terms of the present issue, if there is a valid intuitive model of relative time, it should be close as possible to equation 1.

Fischbeim (1999) assumed that intuition relies on cognitive schemata, which is continuously modified by learning processes. The present explorative venture attempts to identify such schemata regarding the relativity of time and velocity in astrophysics terms among physics students and layman using psychophysical methodology (see Stevens, 1957 and Arieh and Marks, 2008). It was hypothesized that the related function of relatively knowledgeable people will be more valid than that of laymen, an in-between function was expected to typify the estimations of participants with amateurish interest in astrophysics. A more comprehensive assimilation of time and space relativity is assumed to typify the former. Speaking in terms of the twin paradox the time span function illustrated in Addendum A1 should typify the intuitive psychophysical function from the perspective extremely speeding spacecraft, while an inverse function should typify estimations from a stationary perspective, as illustrated in addendum A2.

Method, Results and Discussion

The participants were 22 people who belonged to two groups: Ten physics experts (nine physics students and one professor), and 12 layman (all economics students, 3 of them declared to have amateurish astrophysics background). The age of ll besides the professor is 24-29. The materials were two simple versions of the "Twins paradox", each examinee was exposed with to numerical values deliberated to represent the velocity of a spacecraft in terms of kilometer per second (1,000, 50,000, 100,000, 150,000, 200,000, 250,000, 299,990, 299,993, 299,996 and 299,999). Each participant was asked individually to estimates the time

span for the velocity values, in one condition from the stationary perspective and in the other condition from the astronaut's perspective. These conditions were counter-balanced. Each participant was ask to estimate spontaneously and instantly the time span since taleoff in each of the velocity values included in one of the two conditions. After five minutes he was exposed to the other condition. Grouped results in terms of psychophysical functions of the participants in the different groups are presented in Figures 1 and 2.

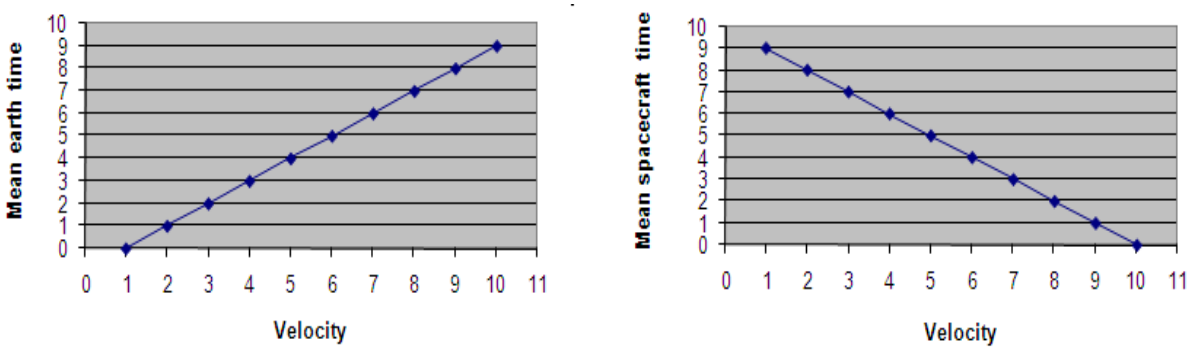

Figure 1. layman's estimated time since takeoff.

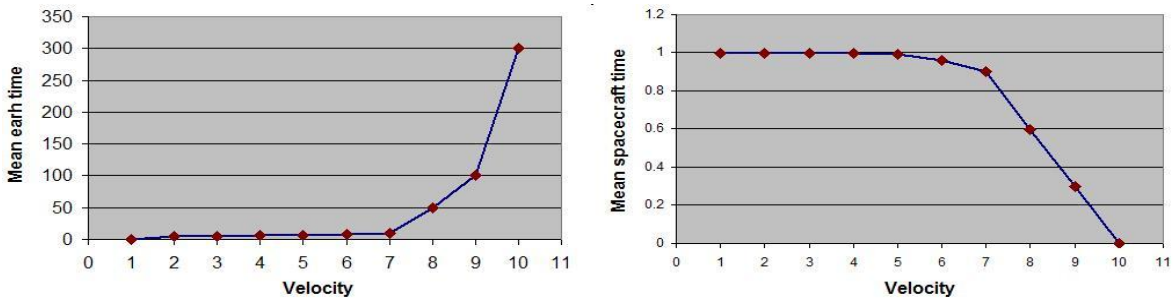

Figure 2. educated participant's estimated time since takeoff.

As hypothesized, the estimations of the knowledgeable participants were much closer to the function formalized in Equation 1 (interestingly, there was no difference between the students and the professor). The results might point of an existence of valid intuitive model of relative time among the physics educated participants regarding relative time and space. The functions of the naïve participants were nearly linear, a finding which points out of non-valid intuitive model among non-educated participants. as expected, the amateurish participants were in-between (see Figures 1 and 2)._This finding can straighten the hypothesis of Fischbeim (1999), which mentions that the cognitive intuitive schema builds and changes relying of continues processes of learning. meaning the relative intuition schema of the amateurish participant, is not yet to become stable, so the values given by them are closer to the valid values given by the physics educated participants but not as accurate.

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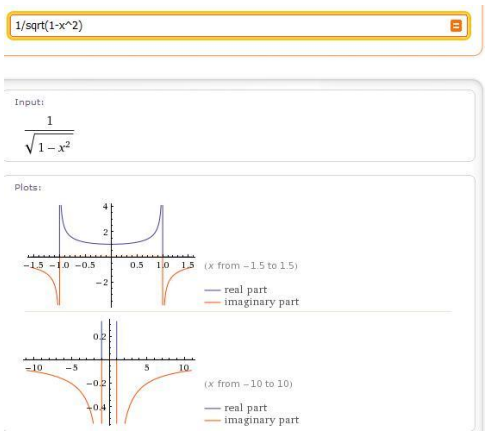
Addendum 1a



Addendum 1b