TIME PERCEPTION IN CHILDREN: EMPIRICAL STUDIES IN A DEVELOPMENTAL APPROACH

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Abstract

Time perception in children has been investigated mostly by an approach that integrates information regarding time, speed and distance in a Piagetian tradition. Piaget claimed that conceptual thinking develops independently of perception. Surprisingly, little subsequent research has been attempted to explore more directly time perception (subjective experience of time) in relation to physical (clock) time in children in a developmental perspective. The purpose of the present experiments was to compare time perception in a prospective paradigm (the experience of time-in-passing) in two groups of children aged 11-13 and 14-16 years with adults aged 19-45 years, using short standard durations and the psychophysical methods of reproduction (Experiment 1) and verbal estimation in subjective seconds (Experiment 2). The results show that reproductions did not differ between the three groups (Experiment 1), while in verbal estimation a developmental trend was found (Experiment 2). The younger group of children estimated the standard durations longer and less veridical than the adults. The estimates of the older group of children lay in between. The ability of children to reproduce standard durations like adults may be due to that the method of reproduction is more based on biological processes and less influenced by cognitive factors, as opposed to verbal estimation, which requires a wide variety of cognitive experiences. The findings also indicate that even the younger children at the age of 11-13 years understand the "logical" concept of time very well, which is clearly evident from the fact that they are able to use conventional time units (seconds) in a consistent way (approximately linearly related to the standard durations), despite their tendency to estimate the standard durations longer than the adults. The reason for this is probably that, besides a certain lack of cognitive experiences, psychological (subjective, perceived) time passes slower for children than for adults, which is in line with Fitzpatrick´s statement (1980). The present findings contradict Fraisse who stated that the abstract quality of the time sense generally does not appear before an age of fifteen years (Fraisse, 1967). The results are discussed in relation to both phylogenetic and ontogenetic approaches, and to a developmental perspective on time perception.

The relation between subjective (psychological, perceived) time and universal objective (physical) time depends not only on the biological time sense ("internal clock"), but also on learning, cognitive ability, age, personality, experience, and the physical and cultural environment. There is some evidence that the experience of time is the result of a long evolution (Guyau, 1902). Edlund (1987) stated that evolutionary advances of other senses of time, particularly objective time, are matters of cultural history.

Subjective time is how time is felt, how much time seems to have gone by. It involves our feelings about past, present, and future, and what they mean.

The process of human development is viewed as consistent with environmental changes. Some empirical evidence relevant to both phylogenetic and ontogenetic evolution exists to support the postulated developmental correlates. For example, the child experiences time as slow and dragging; the adult perceives time as flying or racing (Fitzpatrick, 1980).

That children and old people experience the speed of time flow differently has been known for a long time. Schopenhauer (1851), for instance writes

"The boy´s hours are longer than the old man´s days."

Whitrow (1980) likewise stated that "our sense of temporal duration also depends on our age, for our organic processes tend to slow down as we grow older, so that, compared with them, physical time appears to go faster."

Piaget stated that conceptual thinking develops independently of perception. He suggested that children´s gradual acquisition of temporal concepts is closely correlated with the development of language. According to Piaget´s model, the child constructs the concept of time from information extracted about speed and distance. Piaget also suggested that around the age of seven to eight years, children become capable of correctly conceiving the succession and duration of events (Piaget, 1969).

Fraisse (1967), on the other hand, stated that children of that age do not yet realize that time is a relationship independent of change. This level of abstraction is attained by degrees. Fraisse pointed out that children base their time judgment on the same information as adults, but have not yet learned to relate the various possible estimations of duration. As they grow older they learn to compare these with, and correct them by, indirect evaluations based on methods of measurement: the order of succession, temporal cues, and the inverse relation of time to speed. He also argued that the abstract quality of the time sense generally did not exist in youngsters until they were 15 years or older.

Friedman (1982) stated that there is evidence that children can represent the order of daily activities by about 4 years and certain annual regularities by about 6-7 years.

Many studies in time perception have been published, but only a few of these deal with children, and most are in the Piagetian tradition. One purpose of the two experiments reported here was to compare children aged 11-13 and 14-16 years with adults as to reproduced duration. Another purpose was to study the children´s understanding of objective time, as well as their ability to use conventional time units (seconds) in comparison with adults. More specifically, the following hypotheses were tested: (1) the prediction from a biological clock perspective was that the older group of children reproduce durations about the same as the adults, and (2) from a cognitive perspective that verbal estimation of duration in subjective seconds, which is influenced by cognitive factors, will differ between the three groups.

Most psychological experiments deal with group data. Because of the great inter-individual parameter variations in, at least, time perception, in the present study the raw data are treated individually (see A. D. Eisler, 1992; A. D. Eisler & Eisler, 1994, 2009).

The theoretical starting point for the data treatment is the psychophysical power function (Stevens´ Law):

$$\Psi = \alpha \ (\Phi - \Phi_0)^{\beta},$$

where Ψ denotes subjective and Φ physical duration, and α, β, and Φ_0 parameters to be determined from the data. The exponent β characterizes the continuum under investigation, α is a proportionality constant, usually an arbitrary unit, and Φ_0 the subjective zero (A. D. Eisler & Eisler, 1994, 2009; H. Eisler, 1975, 1976, 1995; H. Eisler, Eisler & Hellström, 2008).

Method

Subjects. Twelve children, aged 11 to 13 years, 20 children, aged 14 to 16 years, and 12 adults, aged 19 to 45 years, participated in the experiments. None of the subjects had previously participated in a time perception experiment and they were naive with regard to the experimental hypothesis.

Stimuli. Ten standard durations, ranging from 1.3 to 20 seconds in logarithmic steps (1.3, 1.8, 2.5, 3.3, 4.5, 6.0, 8.1, 11.0, 14.8, 20.0 s) were used. The durations, both standards and reproductions, were indicated by noise of 50 dB.

Procedure. In the first experiment the subjects were instructed individually to reproduce the standard durations. In the second experiment they were required to verbally estimate in seconds the presented standard durations length (the same standard durations as in the reproduction session). In each experiment, the 10 standard durations were presented four times each for the children and six times each for the adults in individual pseudo-random series. Thus each child made 40 reproductions and 40 estimations altogether, and each adult 60 reproductions and 60 estimations.

Data treatment and results

The arithmetic mean over the 4 reproductions and the 4 estimates (for each child) and the 6 reproductions and the 6 estimates (for each adult) of every standard duration was computed for each subject separately.

An analysis of variance [method(2) x standard duration(10)] showed for the younger group of children significance for method [$F(1,22) = 8.59$, $p = .008$], and a significant interaction method x duration [$F(9,198) = 6.36$, $p = < .0001$]. (See Figure 1). For the older group of children the ANOVA revealed significance for method [$F(1,25) = 25.02$, $p = < .0001$, and a significant interaction method x duration [$F(9,225) = 11.97$, $p = < .0001$. (See Figure 2). In the adult group the analysis of variance shoved only a significant interaction,

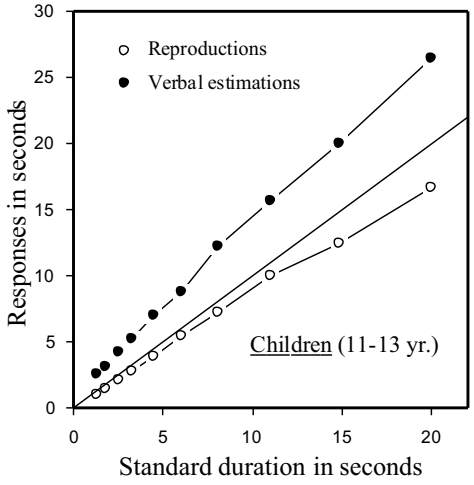

Figure 1

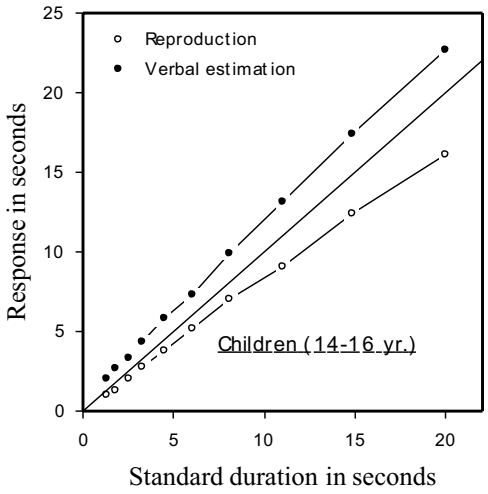

Figure 2

which indicates that duration reproductions and verbal estimates increase unequally with duration length [F(9,198) = 2.30, p = < .02]. (See Figure 3).

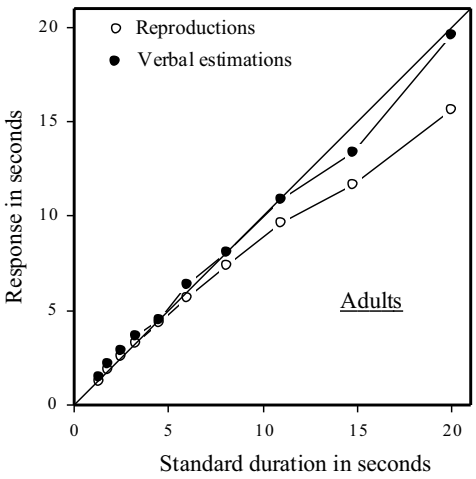

Figure 3

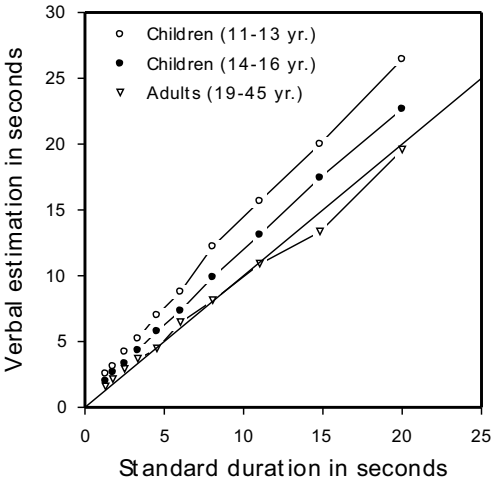

Figure 4

There was also a significant difference in verbal estimation of durations between the younger group of children and the adults [F(1,22) = 4.40, p = .05]; and a significant interaction for duration x group [F(9,198) = 3.24, p < .001]. (See Figure 4). There was no significant difference obtained between the older group of children and the adults.

Finally, the most notable finding is that there was no significant difference in the reproduced durations between the children and the adults.

The value of the exponent β was .83 for the younger, .85 for the older group of children and .86 for adults (see A. D. Eisler & Eisler, 1994; H. Eisler, 1995 and H. Eisler and Eisler, 1992).

Discussion

It seems clear from the results of these experiments that children aged 11-16 years reproduced standard durations like adults. Thus it may be argued that the method of reproduction is more based on biological processes and less influenced by cognitive factors. This result contradicts the prediction that there would be differences between the younger groups of children and the adults. On the other hand did the younger group of children estimate verbally the durations longer than the adults. The reason is probably that, besides a certain lack of cognitive experiences, psychological (subjective) time passes slower for children than for adults, which is in line with Fitzpatrick´s (1980) statement.

There is an additional point of interest from a developmental perspective in the obtained data, namely that children at this age understand the logical concept of time, which is evident from the fact that they are able to use conventional time units (seconds), even if they estimated the standard durations longer than adults. This finding contradicts Fraisse (1967), who stated that the abstract quality of the time sense did not appear before an age of fifteen years. Thus the obtained results could be a useful knowledge, for instance regarding children's traffic behavior, and generally how the children orient themselves in time and space.

References

Edlund, M (1987). *Psychological time and mental illness*. New York: Gardner Press.

Eisler, A.D. (1992). Time perception: Reproduction of duration by two cultural groups. In S. Iwawaki, Y. Kashima, & K. Leung (Eds.), *Innovations in cross-cultural psychology* (pp. 304-310). Amsterdam: Swets & Zeitlinger.

Eisler, A. D. (2010). *Subjective time and personality*. (Manuscript).

Eisler, A. D., & Eisler, H. (1994). Subjective time scaling: Influence of age, gender, and Type A and Type B behavior. *Chronobiologia*, *21*, 185-200.

Eisler, A. D., & Eisler, H. (2009). Experienced speed of time in durations of known and unknown length. *NeuroQuantology, 7*, 66-76.

Eisler, H. (1975). Subjective duration and psychophysics. *Psychological Review, 82*, 429-450.

Eisler, H. (1976). Experiments of subjective duration 1868-1975: A collection of power

function exponents. *Psychological Bulletin, 83*, 1154-1171.

Eisler, H. (1995). The psychophysical functions for time perception: Interpreting their parameters. In R. D. Luce, M. D. Zmura, D. D. Hoffman, G.J. Iverson, & A. K. Romeny (Eds.), *Geometric representations of perceptual phenomena* (pp. 253-265). Mahwah, NJ: Erlbaum.

Eisler, H., & Eisler, A. D. (1992). Time perception: Effects of sex and sound intensity on scales of subjective duration. *Scandinavian Journal of Psychology, 33*, 339-358.

Eisler, H., Eisler, A. D., & Hellström, A. (2008). Psychophysical issues in the study of time perception. In S. Grondin (Ed.), *Psychology of time* (75-109). Bingley, UK: Emerald.

Fitzpatrick, J. J. (1980). Patients´ perception of time: Current research. *International Nursing Review*, *5*, 148-154.

Fraisse, P. (1967). *Psychologie du Temps*. Paris: Presses Universitaires de France.

Friedman, W. J. (1982). Conventional time concepts and children´s structuring of time. In W. J. Friedman (Ed.), *The developmental psychology* (pp. 171-205). London: Academic Press.

Guyau, J. M. (1902). *La genése de l'idée de temps*. Paris: Alcan.

Piaget, J. (1969). *The child´s conception of time*. London: Routledge & Kegan.

Schopenhauer, A, (1851). Vom Unterschiede der Lebensalter [On the difference of periods of life]. In: *Parerga und Paralipomena: Kleine philosophische Schriften* (Aphorismen zur Lebensweishet), *Vol. 1*. Berlin: Hayn.

Whitrow, G. J. (1980). *The natural philosophy of time*. Oxford: Clarendon Press