

Use of heuristics and hand gestures in time conceptualization among different age groups



Sandra Stojić^{1,2,3} & Zoltan Nadasdy^{2,4,5}

¹Doctoral School of Psychology, Eötvös Loránd University, Budapest, Hungary, ²Institute of Psychology, Eötvös Loránd University, Budapest, Hungary, ³Faculty of Humanities and Social Science, University of Mostar, Mostar, BiH, ⁴Department of Psychology, University of Texas at Austin, Austin, TX, USA, ⁵NeuroTexas Institute, St. David's Healthcare, Austin, TX, USA



INTRODUCTION: Conceptualization of time is hard to grasp without a spatial context, regardless of whether the causes are linguistic structures or a concrete domain's easiness over an abstract. There are a substantial philosophical debate and experimental work on how time and space are represented in the human mind. Accordingly, even more challenging is to reason how time and space are being represented in the child's mind. Whether it is about a single metric that becomes gradually differentiated as proposed by Piaget (1927/1969), what would be congruent with contemporary Walsh's "A Theory of Magnitude" (2003), or whether the children adopt the time-space relation during the pre-linguistic developmental period as a consequence of tracking useful cross-dimensional correlation (according to Casasanto, Fotakopoulou & Boroditsky, 2010), it is yet to be investigated.

METHODS: The study included 138 female and male participants, organized into three age groups. The participants from the youngest group ($N=46$; mean age=4.70; $SD=.59$) were collected at the state kindergarten; school-age children ($N=48$; mean age=9.61; $SD=.49$) at the State Primary School, while the student sample ($N=48$; mean age=22.22; $SD=5.2$) was gathered at the University. Participants displaying any signs of learning impairments, developmental or neurological difficulties were excluded.

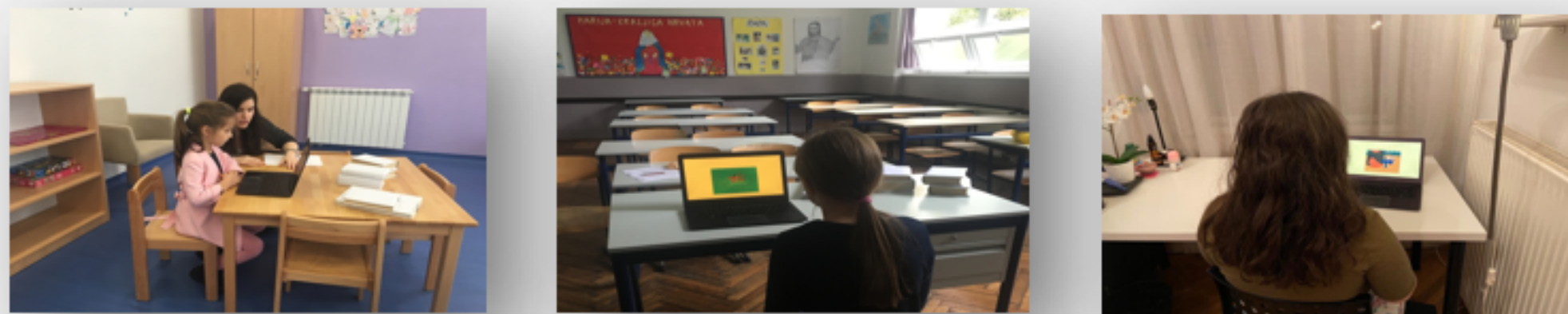


Fig. 1. Participants of each age-group during the experiment: (a) kindergartener; (b) schooler; (c) student

The experiment consisted of two parts; when the videos were presented and the estimation part, when the participants verbally expressed the perceived durations and cartoon's features by simple hand gestures. Each of the participants had to make a comparison by identifying which of the two presented animated videos, A or B, subjectively appeared to be longer in duration. The retrospective method was the method of estimation, and each participant complied with only one estimation. Regarding the hand-gestures, the direction of the orientation was noted, whether horizontal or vertical, and the arm-spread was measured.



Fig. 2. Although both of the cartoons were set to last for 60 seconds each, they varied greatly in their content; "A" set was an exciting, action-packed composition, accompanied with a melodically-rich tune, while "B" set was monotonous and slow, with repetitive actions and flat background music



RESULTS: Two chi-square tests of independence were conducted; the first chi-square test served to examine the binary duration estimate across the three age-groups (Fig. 3). The second chi-square test examined the direction of hand-gestures across the different age-groups (Fig. 4).

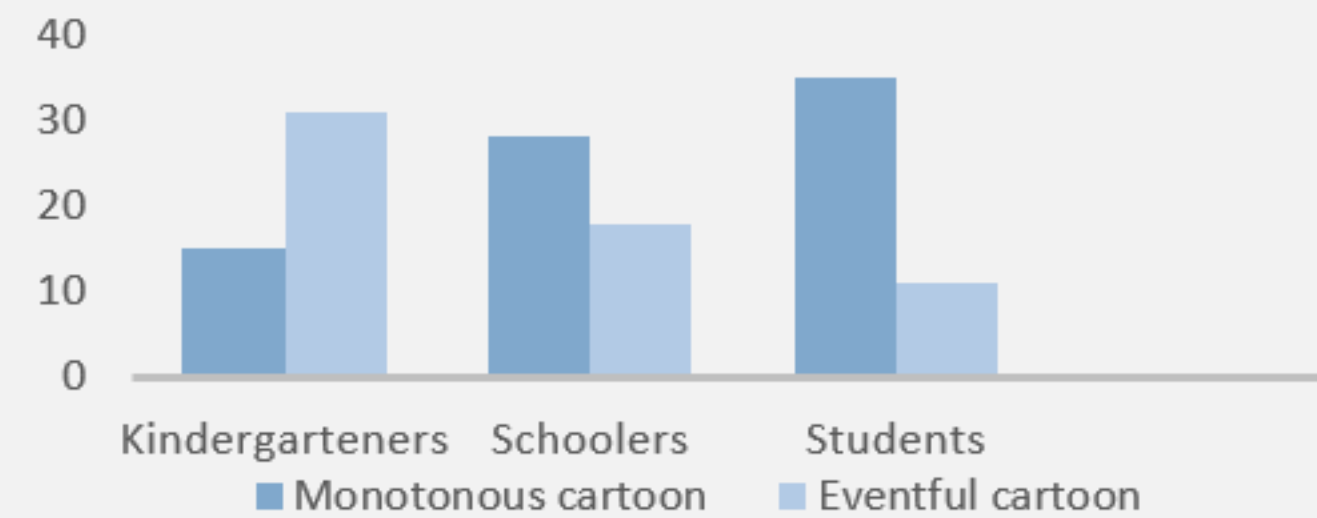


Fig. 3. A type of video estimated as longer in duration by different age-groups

Statistical analysis has shown clear-cut preferences in binary estimation $\chi^2(2, N=138) = 18.22, p < .001$. Kindergarteners estimated the action-packed video as longer, while school-age children and adults found the monotonous video as such.

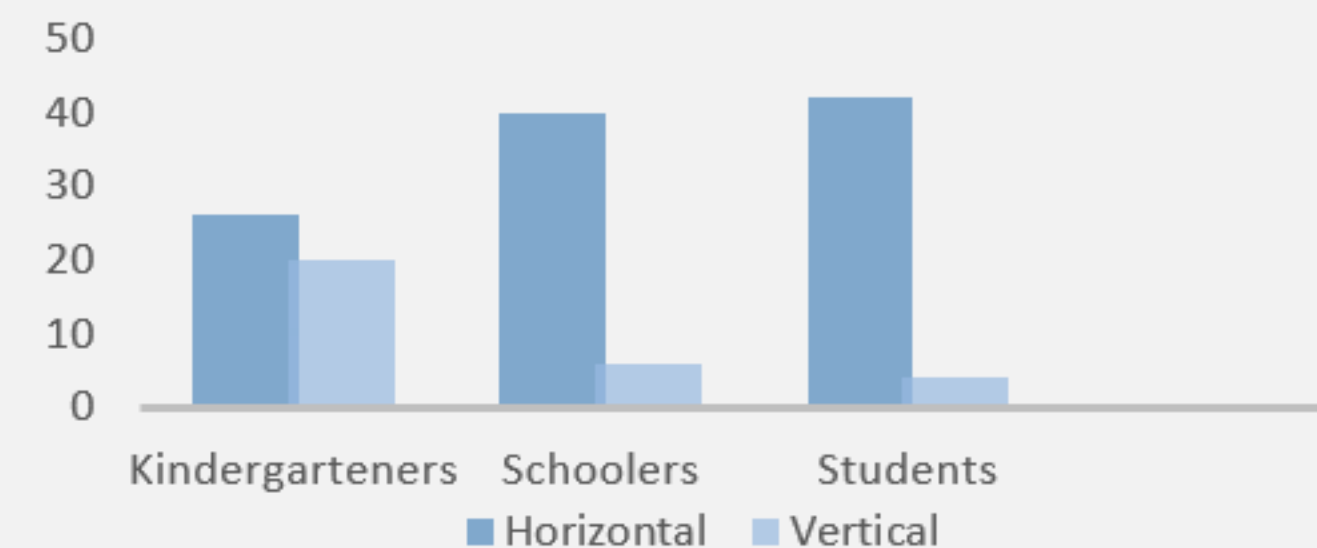


Fig. 4. The direction of orientation indicated by hand-gestures among different age-groups

The effect of age on the direction of hand gestures was also significant. Again, the middle group demonstrated the same performance as the adults and displayed a strong preference to express durations with horizontally oriented arm-spreads $\chi^2(2, N=138) = 19.42, p < .001$.

Table 1 Results of one-way ANOVA on the absolute differences of hand-spread metric data between different age-groups

	SS	df	MS	F	p	η_p^2
Group	412.915	2	206.457	.828	.439	.012

DISCUSSION:

- Children and adults perceive the two stimulus durations as distinct, but they ascertain the difference in opposite directions;
- We attribute this interaction to different heuristics underlying children's and adult's decisions: children, we hypothesize, were operating based on the availability heuristics or „how much they can talk about something“ rule, while the adults had a strong preference towards a sampling heuristics, or „how many times they were able to sample the flow of an absolute time“ rule;
- Even the youngest group showed consistency and expressed high confidence in their estimations, both verbal and hand-gestures, indicating an already established system for magnitudes and developing a “sense of time”;
- Arm-spread served as an analog response metric of the perceived magnitudes for both cartoons. Kindergarteners were using both vertical and horizontal orientation with the same proportion, while the two other groups displayed a strong preference towards the horizontal representations, exclusively. Such results could be supported within Metaphor theory postulates (Lakoff and Johnson, 1980), influences of education, and specific language constructions.

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Correspondence: sandra.stojic@ff.sum.ba