

EuroCogSci 07

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FIRST CALL FOR PAPERS

We invite submissions to the second European Cognitive Science Conference, under the auspices of the Cognitive Science Society.

IMPORTANT DATES

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European regional Cognitive Science Conference jointly organized by the Cognitive Science Society and the Hellenic Cognitive Science Society

Acquisition of literacy skills in children with specific language impairment: a longitudinal investigation in French	85
<i>Filip Zourou, Jean Ecalte, Annie Magnan</i>	
Mental verbs and memory functioning in children with language difficulties and typically developing children: structural similarities and differences	86
<i>George Spanoudis, Demetrios Natsopoulos</i>	
Temporal modified speech perception in dyslexia	86
<i>Caroline Jacquelin, Fanny Meunier</i>	
Graphical perception and mental imagery: an electrophysiological examination.	87
<i>Lisa Best, Aren Hunter, Brandie Stewart</i>	

Posters

Students' difficulties with algebraic expressions containing literal symbols	88
<i>Konstantinos Christou, Stella Vosniadou</i>	
Aspects of students' rational number reasoning: a conceptual change perspective	88
<i>Xenia Vamvakoussi, Stella Vosniadou</i>	
Using animated interactive analogies for understanding the programming variable	88
<i>Dimitrios Doukakis, Maria Grigoriadou, Grammatiki Tsagonou</i>	
Conceptions and practices of university teachers in various disciplines	88
<i>Louise Langevin, Gilles Ruelke, Diane Lehec, Monik Bruneau, Catherine Gagnon, Nadine Talbot, Ilia Exposito</i>	
Catching eureka on the fly	88
<i>Paulina Lindstrom, Agneta Gult</i>	
Absence of blocking in cognitive map learning in humans	88
<i>Oliver Hardt, Lynn Nadel</i>	
Synthetic models in finswimming	88
<i>Maria Kouliadou, Stella Vosniadou, Nickas Geladas, Konstantinos Boudolos</i>	
Children's knowledge about consciousness: a developmental perspective	88
<i>Nikos Makris, Dimitris Pnevmatikos</i>	
Inference and reference in language evolution	88
<i>August Fenk, Gertraud Fenk-Oczlon</i>	
First language translations in new language learning	89
<i>Asha Smith, Michael Ramscar</i>	
Construction of assisting symbolic models based on novice users perception	89
<i>Jean-Paul Samsonnet, David Levy</i>	
Modeling diagnostic reasoning with fuzzy pattern classification	89
<i>Franziska Bocklisch, Martin R. K. Bannmann, Josef F. Krenn</i>	
Automatic classification of instantaneous cognitive states	89
<i>Rafael Ramirez, Montserrat Puiggras</i>	
Frequency trajectory effects in human and artificial neural systems with different input-output mappings	89
<i>Martial Mermillod, Patrick Bouin, Sébastien Raux, Ludovic Ferrand, Alain Meot</i>	
Semi-supervised category learning in an information integration task	89
<i>Karleen Vandier, Maarten De Schryver, Yves Raaijckel</i>	
The effects of prior knowledge on perceptual classification	89
<i>Lewis Bott</i>	
Categorization of substances in relation to explanations of changes in state of matter	89
<i>Ourania Gikopoulou, Stella Vosniadou</i>	
Solving systems of equations: a case study in analogical problem solving	89
<i>Svetlana Potashnikina, Kai-Uwe Kuhlmeier, Helmut Gert</i>	
How many exemplars do we need? A replication of Nosofsky, Clark and Shiu's (1989) "Rules and exemplars in categorization, identification and recognition"	89
<i>Maarten De Schryver, Karleen Vandier, Yves Raaijckel</i>	
Young children's recognition of commonalities between animals and plants: revisiting the role of human-based inference	90
<i>Christelle Duclercq, Florence Lubell</i>	
Motor memory: movement- and position-specific sequence representations	90
<i>Elena Babrova and Vsevolod Lyakhovetski</i>	

Aspects of students' rational number reasoning: A conceptual change perspective

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Introduction

Rational numbers are difficult for students to understand and this fact has been demonstrated in numerous studies (Smith, Solomon, & Carey, 2005). An aspect of rational number reasoning that has not been extensively investigated so far is students' understanding about the dense structure of the rational number set. In this study we investigated the development of students' understanding of density from a conceptual change perspective. A key assumption of the particular theoretical framework that we adopted (Vosniadou, in press) is that children form initial explanatory frameworks about numbers, which are tied around their understanding of natural numbers. When new information about rational numbers comes in contrast with what is already known, the conceptual change framework predicts the formation of a specific type of misconceptions, called *synthetic models*, which reflect the assimilation of new information in prior, incompatible knowledge.

The set of natural numbers consists of discrete elements which share a similar form, in the sense that any natural number is represented as the combination of a finite number of digits. On the contrary, the set of rational numbers is dense and any rational number can be represented either as a fraction or as a decimal.

We assumed that the particular characteristics of the natural numbers set mentioned above are key elements of students' initial number concept and are bound to constrain students' understanding of the dense structure of rational numbers. Prior research has provided evidence that the idea of discreteness is indeed a barrier to the understanding of density (e.g. Merenluoto & Lehtinen, 2002). It is also documented that students have many difficulties moving flexibly and effectively among the various forms of rational numbers (e.g. Khoury & Zazkis, 1994). We claim that students draw on symbolic notation to treat decimals and fractions as different, unrelated sorts of numbers and this interferes with their understanding of density. We hypothesized that students form synthetic models of the structure of rational numbers intervals, reflecting the constraints associated with their initial explanatory frameworks about numbers, as well as the assimilation of new knowledge about rational numbers. This hypothesis was tested in an empirical study.

Method

The participants of the study were 164 9th and 137 11th graders, who were administered open-ended and forced-choice questionnaires, consisting of six questions. In both cases, students were asked about the number of numbers between two pseudo-successive rational numbers (like 0.005, 0.006 or 1/3, 2/3).

Results and Discussion

According to our results, students' accounts of the rational numbers intervals reflected the expected constraints. More specifically, our participants generated the following types of synthetic models: a) intervals that preserve the discrete structure of natural numbers, while the initial numbers were considered successive, b) intervals preserving the discrete structure of natural numbers, while the initial numbers were not considered successive, c) intervals containing "infinitely many" equivalent numbers d) intervals containing infinitely many numbers, when the initial numbers were decimals (or fractions) and intervals with a finite number of numbers, when the initial numbers were fractions (or decimals), and e) intervals containing infinitely many numbers of the same symbolic representation. We draw on our results to argue that the development of rational number reasoning cannot be accomplished by mere enrichment of students' initial explanatory frameworks of number.

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