



# Understanding mathematical cognition through conceptual change and dual process theories

FOUNDING: 1 January 2017

## E-CIR SCOPE

Our E-CIR focuses on the way in which conceptual change and dual process accounts of reasoning can be usefully combined to understand mathematical cognition and improve learning.

A large part of the ongoing research centers around the development of the number concept. This lies at the heart of mathematical cognition and is greatly associated with later mathematical achievement. Our prior research has shown that the development of the number concept requires major conceptual changes, particularly as students make the transition from natural number to rational number. In this process, there is a lot of evidence for negative transfer of natural number conceptual and procedural knowledge to the learning of rational numbers, delaying the knowledge acquisition process and causing misconceptions.

For a long time researchers assumed that through a process of conceptual change a new representation of number (as rational number) is constructed which replaces the initial representation of whole number. However, recent research seems to imply that the representation of number as whole number not only continues to exist but can interfere with mathematical problem solving and reasoning even when conceptual change has been achieved. This idea is consistent with dual process theories developed to account for poor performance in reasoning and decision-making tasks.

The future work of the collaborating teams will focus on the co-existence of both prior knowledge and newly acquired conceptions, especially when they interfere with each other. The team will also address implications of this co-existence for mathematical understanding, problem solving, and teaching.

## E-CIR MEMBERS

**Dr. Wim Van Dooren** works at the Centre for Instructional Psychology and Technology of the Catholic University of Leuven in Belgium. His main teaching is in the domains of educational psychology, mathematics education, and statistics. In his research, he tries to build bridges between the domains of educational psychology and mathematics education. His main research interests are mathematical problem solving, word problem solving, statistical reasoning, the use of representations, the role of intuitions and biases in mathematical reasoning, and conceptual change in science and mathematics. Wim was vice-president of the International Group for the Psychology of Mathematics Education, coordinator of the EARLI SIG on Conceptual Change, and he currently is associate editor of Educational Studies in Mathematics.

**Dr Erno Lehtinen** is a professor of education at the University of Turku. He has worked as a teacher and researcher in several universities in Finland, other European countries and USA, and has published more than 300 scientific publications. His research has focused on development of mathematical thinking, educational technology and new forms of expertise in rapidly changing working life. Professor Lehtinen was the president of EARLI 2001-2003, the Vice-Rector of the University of Turku 2003-2010 and Academy Professor (distinguished research professorship by the Academy of Finland) 2010-2014. He was awarded the Oeuvre Award of the European Association for Research on Learning and Instruction (2009) and is currently the editor-in-chief of the Frontline Learning Research.

**Dr. Xenia Vamvakoussi** is Assistant Professor of Mathematics Education at the Department of Early Childhood Education of the University of Ioannina in Greece. She teaches courses on mathematics learning



and instruction. Her main research interests are conceptual change in mathematics learning, particularly in rational number learning; the development of multiplicative reasoning; conceptual and procedural knowledge in mathematics; learning approaches to mathematics; and educational implications of research on the psychology of mathematics learning. Xenia has served as coordinator of the EARLI SIG on Conceptual Change and she is currently the secretary of the Greek Association for Research in Mathematics Education.

**Dr. Stella Vosniadou** is a Strategic Professor at Flinders University in Australia and an Emeritus Professor at the National and Kapodistrian University in Greece. Her research interests are in the domains of cognitive science, educational psychology, and science and mathematics learning and instruction. She is well known for her research on conceptual change for which she received the 2011 International Distinguished Award from the Society for Research in Child Development. Her recent research examines the role of executive function in the learning of mathematics. Stella is a past president of EARLI and of Cognitive Science, a fellow of AERA, a founding member of the EARLI SIG on Conceptual Change, and the editor of the Educational Practices Series published by the International Academy of Education and the International Bureau of Education of the UNESCO.

**Dr. Konstantinos P Christou** is an Assistant Professor of Mathematics Education, in the University of Western Macedonia, Greece. His main teaching is in the domains of mathematics education, educational psychology, and the development of the number concept. In his research, he studies the cognitive development of concepts in the domain specific area of mathematics. His main research focus is the development of the number concept from very early on throughout the school years, students' misconceptions with the number concept and ways to treat them didactically. He mostly uses conceptual change theories to study the ways students' prior knowledge of numbers in arithmetic and their special commitment to natural numbers (*natural number bias*) may affect their interpretation of non-natural numbers, such as rational and real numbers and also the use of literal

symbols in algebra. He is currently coordinator of the EARLI SIG3 Conceptual Change.

**Dr. Lieven Verschaffel** works at the Centre for Instructional Psychology and Technology of the University of Leuven in Belgium. His main teaching is in the domains of educational psychology and mathematics and language education. His main research interests are early mathematics education, number sense and estimation, whole number arithmetic, word problem solving, and conceptual change in mathematics. He is member of the editorial board of several international journals about (mathematics) learning and instruction.

**Dr. Jake McMullen** is a Post-doctoral researcher at the Faculty of Education at the University of Turku, Finland. His research is in the domains of educational psychology, developmental psychology, and mathematics education. His main research interests revolve around how informal and non- traditional mathematical skills and attentional tendencies are related to formal mathematical development. His current work is in the development of technological tools for enhancing students' tendency to focus on mathematical aspects of their daily lives.

**Dr. Andreas Obersteiner**  
**Dr. Matthew Inglis**  
**Dr. Michael Schneider**

## E-CIR MEETINGS

- 2-3 September 2017 (Tampere, Finland)
- 13-14 October 2017 (Leuven, Belgium)
- 1-2 September 2018 (Klagenfurt, Austria)
- EARLI Conference 2019 (Aachen, Germany)
- 16-17 October 2019 (Leuven, Belgium)



## ANNUAL REPORT

[\(1\) Report 2017](#)

[\(2\) Report 2018](#)

[\(3\) Report 2019](#)

[\(4\) Report 2020](#)

[\(5\) Report 2021](#) (one year extension due to pandemic)