



## **Typical and atypical development of numerical cognition: evidence from brain & behavior- Scientific Summary**

We thank the Halbert center for the opportunity for bringing together leading scholars from Canada and Israel. The participants of the conference included two professors and two students (PhD and post doc position) from Canada and two scholars from universities in Israel, as well as an additional 35 students and faculty members. Our two Canadian professors were 1) Daniel Ansari from the Department of Psychology Brain and Mind Institute, The University of Western Ontario London, and 2) Marcie Penner Wilger from the Department of Psychology, The King's Western University of Ontario London. Two additional Canadian participants are members of Prof. Daniel Ansari's lab 1) Dr. Tali Leibovich 2) Moriah Helen Sokolowski. Prof. Daniel Ansari is one of the leading scientist in the world in the field of developmental numerical cognition and dyscalculia. Our two Israeli scholar were Prof. Avishai Henik from Ben Gurion University and Dr. Orly Rubinsten from the University of Haifa.

The support of the Halbert center allowed the creation of an excellent workshop entitled “typical and atypical development of numerical cognition: evidence

from brain & behavior". The workshop created the groundwork for future collaborations between the labs in Israel and Canada, such as sharing ideas and grant proposals. During the workshop, we discussed similarities and dissimilarities between the labs here in Israel and in Canada. We discovered that my lab in Israel and Daniel Asari's lab share a new theoretical approach about the relationship between symbolic and non-symbolic quantity representation and have both found similar results in recent studies.

The workshop included 3 different presentation opportunities: 1) short half hour session on topics which included 20 minute presentations followed by 10 minutes for discussion and questions, 2) keynote speaker presentations that were longer one hour sessions followed by 15 minutes for discussion and 3) poster presentations during lunch.

The workshop started on Tuesday, April 12th, with opening remarks by the representative of the Halbert center, Prof. Edit Doron. The first presentation was given by Prof. Avishai Henik, a leading scientist in Israel. The lecture focused on the role of size perception in numerical cognition as well as a historical overview on the field of numerical cognition field. The second part was unique because Prof. Henik is one of the first scientists in the world to have examined automatic aspects of numerical processing, back in 1982.

In the same day, we had a session on the Neuroanatomy of numerical cognition. In this session two lectures were given: the first from our Canadian guest Moriah Helen Sokolowski who give a talk about a state-of-the-art method to perform meta-analysis on functional magnetic resonance imaging (fMRI) data. The other talk was given by Dr. Isabel Arend from Ben Gurion University, who discussed a project

that is in collaboration with my lab, about the Neuroanatomy of number synaesthesias. In the same evening, we had a social dinner in the LABAN restaurant with the two Israeli scholars and our 4 Canadian scholars.

The next day, April 13<sup>th</sup>, started with a session on basic numerical processing, which included 6 presentations: 3 PhD students from Israel: Naama Katzin, Zahira Ziva Cohen and Gali Katz, 2 young faculty members from Israel: Dr. Dror Dotan and Dr. Noam Bar-Shai, and one young faculty member from Canada: Dr. Tali Leibovich. Basic numerical processing is an important topic investigated in the labs that participated in the workshop. In this session, innate abilities of understanding of quantities were discussed. Naama Katzin, Zahira Ziva Cohen, Gali Katz and Dr. Tali Leibovich talked about enumeration abilities in typical and atypical development. Dr. Dror Dotan discussed the mental representation of number on the mental number line and Dr. Noam Bar-Shai talked about quantity understanding in bees. It was a very good session with interesting questions and discussions.

Later that day after lunch, posters were presented by students. Last, three longer talks were given during that afternoon. Dr. Orly Rubinsten talked about mathematical anxiety, Dr. Marcie Penner Wilger gave a talk about finger representation and their role in numerical processing. Last, Sarit Ashkenazi gave a talk about the role of visuospatial working memory in numerical processing.

The last day, April 14<sup>th</sup>, started with 3 shorter sessions: 1) Developmental dyscalculia, 2) Mathematical functions, and 3) Development of numerical cognition. Developmental dyscalculia is generally defined as a disorder in mathematical abilities presumed to be due to a specific impairment in brain functions. In the session two faculty members from Israel gave a talk. Dr. Avital Rotem gave a talk about

development of multiplication abilities in typical developing children and children with mathematical difficulties. Dr. Dana Ganor-Stern gave a talk about estimation abilities in students with developmental dyscalculia. The second session, mathematical functions, included three presentations from Hebrew University students: Rotem Abdu, Tomer Behor and Benedetta Heimler. The last session, development of numerical cognition, included two presentations, a PhD student from the Hebrew University, Sarit Silverman, and a faculty member from Israel: Arava Kallai. Importantly, the organizer from Canada, prof. Daniel Ansari gave an outstanding talk during the third day about symbolic and non-symbolic representation of quantities. All speakers presented works-in-progress, and each presentation was accompanied by a lively discussion.

The participants enjoyed the hospitality of the renovated and well-equipped seminar room of the School of Education. We thank the Halbert Center once again for its unstinting hospitality, which resulted in stimulating academic debates. Exceptional thanks to the administrative staff, Daphna Oren, for her professional help throughout the process of planning the workshop, as well as during the proceedings themselves.

Dr. Sarit Ashkenazi

