# METACOGNITION 2012

## Proceedings of the 5th Biennial Meeting of the EARLI Special Interest Group 16 Metacognition

Milano, September 5-8, 2012
Università Cattolica del Sacro Cuore

EDUCatt

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*Proceedings of the 5th Biennial Meeting of the EARLI Special Interest Group 16 Metacognition*

— September 5-8, 2012 —

Edited by
CANTOIA M., COLOMBO B., GAGGIOLI A., GIRANI DE MARCO B.

Milan 2012

## METACOGNITION 2012 ORGANIZATION

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**EDUCatt** - Ente per il Diritto allo Studio Universitario dell'Università Cattolica
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# Table of Contents

# Foreword

After the previous successful meetings of the EARLI Special Interest Group 16 "Metacognition", which were held in Amsterdam (2004), Cambridge (2006), Ioannina (2008) and Münster (2010), we are pleased to have been asked to organise the fifth edition in Milan.

Past meetings have been attended by international experts in metacognition in learning settings, who presented high-quality research works and significantly contributed to the advancement of this field. For this reason, our universities – the Department of Psychology of the Catholic University of the Sacred Heart, and the Department of Human Sciences for Education "R. Massa" of the Milano Bicocca University – are honoured to host this prestigious scientific event.

The aim of the meeting is to provide a forum for the presentation and exchange of research findings relating to the basic processes and applications of metacognition. Metacognition is meant in a life-span perspective, ranging from infancy to adulthood, and considered both in informal and formal educational settings (school, university, professional training, on-the-job learning, and so on). The main topics covered by the meeting are:

- Theories and models of metacognition
- Metacognitive experience
- Metacognitive knowledge
- Metacognitive skills
- Confidence and judgment-of-learning
- Metacognitive monitoring, control and self-regulation
- Metacognition and reading/writing
- Metacognition and mathematics
- Metacognition and science learning
- Metacognition and learning strategies
- Metacognition in reasoning, problem solving and decision making
- Methods, instruments and procedures to assess metacognition
- Metacognition and learning technologies
- Development of metacognition
- Social processes in metacognition
- Emotional and motivational processes in metacognition
- Theory of mind
- Epistemological beliefs

The meeting also includes presentations psychopathology about not-canonical topics, such as metacognition in atypical learning and psycopathology, metacognition in arts and creativity, matacognition in play activities, neurobiological correlates of metacognition.

We were pleased by the unexpectedly large number of abstract submissions, which led us to schedule four parallel sessions for symposia and individual papers, and two poster sessions. The rich program, including 4 invited lectures, 19 symposia (for a total of 70 presentations), 72 individual papers (structured in 21 sessions) and 49 posters, gives participants the opportunity to attend the presentations that best fit their interests.

The meeting also features two types of special sessions: methodological workshops and "coffee with the experts". Methodological workshops are aimed at presenting innovative techniques to investigate metacognition and are available to a limited number of participants:

- *Studying executive functions and metacognitive control through neurostimulation (Transcranial Direct-Current Stimulation and Transcranial Magnetic Stimulation),* held by Alessandro Antonietti and Barbara Colombo;
- *Computer-based on-line tracking methods to assess metacognition*, held by Roger Azevedo;
- *Observational methods to assess metacognition in young children*, held by David Whitebread and Marisol Basilio.

In the "coffee with the experts" session (addressed to members of JURE network of EARLI) junior researchers will have the chance to discuss their research projects and get feedback from senior SIG members. The meeting also includes the *Early Career Metacognition Paper Award 2012*. The author of the best paper presented in the meeting will be awarded a prize and a certificate.

We wish to thank the members of our Scientific Committee, who diligently evaluated the submitted abstracts and adviced us on several organizational matters. We are also grateful to the members of the Organizational Committee and to Stefano Forbici, who provided support and assistance in the preparation of the conference. A special thank goes to Hamza Sati for managing the conference website. We would also like to express our gratitude to the discussants of the symposia and to the session chairs for their contribution. Finally, we gratefully acknowledge the financial support received from our Departments, EARLI, and the Developmental and Educational Psychology division of the Italian Psychological Association (AIP).

*Ottavia Albanese*
*Alessandro Antonietti*

# Invited lecturers

## *Metacognition and the development of strategic study skills*

Cornoldi, Cesare

I will present a series of studies that show the importance of considering three dimensions of strategic study skills: knowledge, actual use and coherence between knowledge and use. These dimensions were studied using a standardized battery (AMOS) we have developed in order to examine students' self-regulation and some factors underlying it. A first study with 240 undergraduates at the University of Padua shows some implications in the use of the battery and proposes a causal model of self-regulation. Self-regulation, defined with reference to the basic competencies of elaboration, organization and self-evaluation, appears critical for students' success and is related to students' implicit theories, self-attribution, academic self-efficacy and strategic skills. Two subsequent studies have examined strategic factors underlying school failure in adolescence, typically characterised by an increase in study requirements and the establishment of a systematic study method. A study tests the hypothesis that poor study skills are related to students' inadequate knowledge of good strategies and/or to their inconsistent use. From a sample of 354 students, aged between 12 and 15, on the basis of a standardised test (AMOS 8-15, Cornoldi, De Beni, Zamperlin & Meneghetti, 2005) we selected two groups of students, with good and poor study skills respectively, and we asked them to rate their knowledge and actual use of 22 good and 10 less adequate study strategies. We found that all students reported using strategies to a lesser extent than should be expected on the basis of their estimated importance, but they were all able to distinguish between poor and good strategies. However, students with poor study skills were less able to make this distinction and were less consistent in matching their knowledge to their use of strategies. In a following study with a group of 246 adolescents, aged between 14 and 18, we examined whether metacognitive factors interact with depressive attitudes in producing school difficulties. A preliminary factor analysis confirmed the centrality of the three-hypothesized aspects: motivational beliefs, depressive attitude, and self-regulation-skills. A path analysis revealed that there are important links between motivational beliefs and self-regulation and between depressive attitude and motivational beliefs. I will conclude the presentation by shortly illustrating projects carried out with Schools in order to develop better metacognitive and, specifically, better strategic study skills in large numbers of children.

## *Does teachers' training have an impact on metacognitive conceptions and practice of teachers?*

Doudin, Pierre-André; Meylan, Nicolas

Previous work has shown that pupils' success at school is positively related to their metacognitive abilities. This refers on one hand to their knowledge of their own cognitive processing as well as that of others and, on the other, to their capacity to control and regulate their problem-solving processing. Teachers play an important role in the construction of such metacognitive abilities in pupils. With regard to pre-service teacher training, it therefore seems of great importance to integrate some metacognitive concepts in order to prepare future teachers to use such approach in their classroom. However, research results suggest a week effect of such training curriculum for two main reasons: 1) pre-service teachers have built some strong beliefs before their training and these would negatively affect knowledge built during the training; 2) knowledge built within the curriculum is fragile and notions are being modified by the fact that novice teachers tend to conform to norms and practices of their new work environment. We could hypothesize that teaching concepts and practices should be similar between trained and untrained teachers. To test this hypothesis, we compared trained, untrained, novice and experimented teachers with regard to their metacognitive conceptions and practices, using a questionnaire. Results first show that conceptions and practices seem to be linked to gender with females showing more metacognitive conceptions and practices. Further analyses show that although variables such as «training» and «years of experience» have no influence when taken separately, they become significant when taken together to discriminate between trained and untrained teachers. In other words, on one hand training is not sufficient to adopt metacognitive conceptions and practices but it also requires some experience and, on the other, experience by itself is also not sufficient for such conceptions and practices since training is required. In conclusion, our hypothesis is only partially invalidated: training does indeed play a role but it must be associated with years of experience. Our results nuance the fatalism of some researches claiming the uselessness of training.

## *How does metacognition contribute to the regulation of learning? An integrative approach*

Efklides, Anastasia

When Flavell introduced the notion of metacognition, he tried to show its relevance to education by emphasizing the control students can get over their learning. After almost 40 years of research on metacognition the initial promise for the improvement of students' self-regulation of learning is still debated. There is a wealth of research findings

but also a lot of contradictory evidence on the accuracy of metacognitive monitoring and the efficiency of metacognitive control processes. On the other hand, new aspects of metacognition, e.g., socially shared metacognition, have been identified and their role in learning in collaborative context investigated. Moreover, the interaction of metacognition with affect and individual differences factors such as prior knowledge, self-concept or self-confidence has been demonstrated. All these findings call for more complex models of metacognition and self-regulation of learning that have implications for the application of metacognition research in education. The challenges for future research on metacognition will be discussed.

## *Metacognition and metaemotion in children*

Pons, Francisco

What is the relation between children's understanding and control of the mind (Metacognition) and their understanding and regulation of emotions (Metaemotion)? How do children understand this relation? How do metacognition and metemotion develop? Does one emerge before the other? Do metacognition and metaemotion share the same origins? Does one cause the other? Does the impairment of one have an impact on the development of the other? Do metacognition and metaemotion have the same consequences? Is one more needed than the other? These are examples of questions that will be discussed during the talk. Most of these questions are still widely open today because of the dominant schism in the study of (meta-) cognition and (meta-)emotion.

# Program

*Symposia*

S1 READING COMPREHENSION AND METACOGNITION

Organiser: *Palladino, Paola*
Discussant: *Minguela, Marta*

Which expert has written the text? Laypersons' ideas about the structure of expert knowledge when reading science texts
*Bromme, Rainer; Thomm, Eva; Pieschl, Stephanie*

Profiles of epistemic beliefs and knowledge when reading multiple texts
*Ferguson, Leila; Øistein, Anmarkrud; Strømsø, Helge I.; Bråten, Ivar*

The role of standards of coherence in reading comprehension
*Van den Broek, Paul*

Training reading comprehension strategies affects reading decoding: an age related effect
*Palladino, Paola; Mangiagalli, Matteo*

S2 METACOGNITION AND SELF-REGULATION IN DEVELOPING PROFESSIONALS

Organisers: *Perry, Nancy; Kramarski, Bracha*
Discussant: *Vauras, Marja*

Teacher emotion and meta-emotions during critical formative period
*Klassen, Robert; Durksen, Tracy*

Shaping preservice teachers' pedagogical SRL both as learners and as teachers
*Kramarski, Bracha; Kohen, Zehavit*

Student teachers' developing practices that promote self-regulated learning: Linking efficacy and Utility Beliefs to Effectiveness
*Brenner, Charlotte; Perry, Nancy; Collie, Rebecca*

Promoting metacognitive awareness of professional identity and values in medical students through integrated problem-based learning, clinical skills and appraisal
*Henderson, Janine; McKendree, Jean*

S3 PLAY, METACOGNITION AND SELF-REGULATION IN YOUNG CHILDREN

Organiser: *Whitebread, David*
Discussant: *Pino-Pasternak, Deborah*

Complexity of pretend play and its relation with children's self regulatory skills
*Slot, Pauline; Leseman, Paul; Mulder, Hanna*

Investigating the relationship between metacommunication, metacognition and self-regulation in preschool children's naturally occurring social pretend play
*O'Sullivan, Lisha*

Musical play and self-regulation
*Zachariou, Antonia*

S4 EXAMINING METACOGNITIVE PROCESSES USING PROCESS DATA COLLECTED DURING LEARNING WITH COMPUTERIZED ENVIRONMENTS

Organisers: *Bannert, Maria; Azevedo, Roger*
Discussant: *Wirth, Joachim*

Using artificial pedagogical agents to examine the role of metacognitive processes during learning with MetaTutor
*Azevedo, Roger; Bouchet, François; Feyzi-Behnagh, Reza; Harley, Jason; Trevors, Gregory; Duffy, Melissa; Taub, Michelle; Landis, Ronald*

Process Mining Techniques for Analysing Patterns and Strategies in Students' Self-Regulated Learning
*Bannert, Maria; Reimann, Peter*

Helping Students Develop Metacognitive Processes in a Choice-Rich Science Learning Environment
*Biswas, Gautam; Kinnebrew, John S.; Segedy, James R.*

Supporting Metacognitive Processes in Medical Reasoning using Technology
*Lajoie, Susanne P.; Naismith, Laura; Poitras, Eric*

S5 MATH AND METACOGNITION AMONG YOUNG CHILDREN: DO INTERVENTIONS REALLY HELP?

Organizers: *Shamir, Adina; Mevarech, R. Zemira*
Discussant: *David, Whitebread*

How and to what extent can children's metacognition be enhanced during mathematics problem solving?
*Mevarech, Zemira R.; Hillel, Mor*

Educational E-book with and without metacognitive guidance for supporting emergent literacy and early math of preschool children at risk for learning disabilities
*Shamir, Adina; Lifshitz, Irit; Baruch, Dorit; Goren, Ilana*

Creating supportive learning environments at primary school. Development and evaluation of teaching materials to foster self-regulated learning and mathematic achievement in regular mathematics lessons
*Perels, Franziska; Leidinger, Manuela*

S6 STUDYING THE QUALITY OF SELF-REGULATION SUPPORT IN TECHNOLOGY BASED LEARNING

Organsers: *Kramarski, Bracha; Narciss, Susanne*
Discussant: *Azevedo, Roger*

Developing SRL in TPCK context (TPCK-SRL) in a video-digital microteaching program
*Kohen, Zehavit; Kramarski, Bracha*

Promoting preservice teachers' capacity to teach self-regulated learning through analysis of both teachers' and students' behavior
*Michalsky, Tova*

Impact of interactive learning questions on SRL with a web-based learning environment
*Kapp, Felix; Narciss, Susanne; Proske, Antje; Koerndle, Hermann*

Prompting AD(H)D students during hypermedia learning
*Wachsmuth, Claudia; Bannert, Maria*

S7 NEW RESEARCH AVENUES: METACOGNITION IN PROBLEM SOLVING AND REASONING

Organiser: *De Bruin, Anique*
Discussant: *van Gog, Tamara*

The role of response conflict in monitoring intuitions and promoting analytic thinking
*Thompson, Valerie*

The blind way in which confidence in the correctness of problem solutions follows response time
*Ackerman, Rakefet*

What influences judgments about one's own knowledge about complex systems?
*Pieschl, Stephanie; Hirschfeld, Gerrit; Bromme, Rainer*

Using self-testing to improve monitoring accuracy when studying worked examples in primary education
*Baars, Martine; van Gog, Tamara; De Bruin, Anique; Paas, Fred*

S8 APPLIED EPISTEMIC BELIEFS IN READING AND EVALUATING MULTIPLE CONFLICTING INFORMATION SOURCES

Organiser: *Mason, Lucia*
Discussant: *Efklides, Anastasia*

Profiles of epistemic beliefs and knowledge when reading multiple texts
*Ferguson, Leila E.; Øistein, Anmarkrud; Strømsø, Helge I.; Bråten, Ivar*

The impact of differently affect-laden scientific discourse on recipients' epistemic assumptions and trustworthiness evaluations
*Kienhues, Dorothe; Bromme, Rainer*

The relationship between epistemic beliefs and systemic thinking in biology: Differences in epistemic judgments of German primary and secondary school teachers
*Stahl, Elmar; Kramer, Tim; Rieß, Werner*

Effects of a short-term intervention on epistemic evaluation of web-sources on controversial topics
*Mason, Lucia; Junyent, Andrea A.; Tornatora, Maria Caterina*

S9 THEORY OF MIND BETWEEN RELATIONSHIPS AND SOCIAL NORMS

Organiser: *Marchetti, Antonella*
Discussant: *Ajello, Anna Maria*

Social norms and expectations about fairness: evidence from children and adults
*Bicchieri, Cristina; Castelli, Ilaria; Chavez, Alex; Massaro, Davide; Marchetti, Antonella*

Longitudinal effects of Theory of Mind on later peer relations: The role of prosocial behaviour
*Caputi, Marcella; Lecce, Serena; Pagnin, Adriano; Banerjee, Robin*

Young children thinking about emotions in context
*Freeman, Norman H.*

The relation between children's Theory of Mind and trust beliefs in parents
*Petrocchi, Serena; Lecciso, Flavia; Marchetti, Antonella; Rotenberg, Ken J.*

S10METACOGNITIVE ACTIVITY OF GROUPS IN COLLABORATIVE LEARNING

Organisers: *Iiskala, Tuike; Molenaar, Inge*
Discussant: *Perry, Nancy*

Exploring relationships between social forms of regulation during group work, dialogue quality, and conceptual understanding: The case of Year 1 students in the UK
*Pino-Pasternak, Deborah; Whitebread, David*

Metacognitive activity and shared metacognition in inquiry based science education
*Meier, Angelika; Vogt, Franziska*

Metacognitive scaffolding during collaborative learning: A promising combination
*Molenaar, Inge; van Boxtel, Carla; Sleegers, Peter*

Socially shared metacognitive regulation during a small group's computer-supported collaborative learning process
*Iiskala, Tuike; Lehtinen, Erno; Vauras, Marja*

S11 SELF-EVALUATION, BUT NOT ONLY? ON LINKS THAT RELY SELF-EVALUATION TO (BETTER) LEARNING OUTCOMES

Organiser: *Moták, Ladislav*
Discussant: *Pieschl, Stephanie*

The impact of students' self-evaluation of competence on learning behaviour within multi-trial learning tasks
*Schnaubert, Lenka; Andrès, Eric; Narciss, Susanne; Eichelmann, Anja; Goguadze, George; Sosnovsky, Sergey*

Effects of Topic Structure, Text-Titles and the Timing of Keywording Tasks on Self-Evaluation and Learning Outcomes in Self-Regulated Learning from Text
*Lippmann, Marie; Narciss, Susanne; Schwartz, Neil; Danielson, Robert; Sarmento, David*

To train or not train? On restricted effects of a specific training in self-evaluation
*Maillard, Adeline; Moták, Ladislav; Sakdavong, JeanChristophe; Catteau, Olivier; Dupeyrat, Caroline; Huet, Nathalie*

S12 MUSEUMS, METACOGNITION AND TEACHING LEARNING PROCESSES

Organiser: *Zecca, Luisa*
Discussant: *Nigris, Elisabetta*

From experience to metacognition thought: A research in a scientific museum
*Nigris, Elisabetta*

From the atelier in the municipal preschools to the Urban and City Ateliers
*Rinaldi, Carla; Giudici, Claudia; Vecchi, Vea*

Metacognition and self-assessment of learning process: a Primary school archeological laboratory case
*Zecca, Luisa*

My Modernikon: contemporary art and the teenagers at Fondazione Sandretto Re Rebaudengo
*Palermo, Alessia*

S13 SELF-REGULATION STRATEGIES AND MOTIVATION

Organiser: *Moè, Angelica*
Discussant: *Albanese, Ottavia*

Kindergarten children's' emotions, feeling of task-difficulty and ability self-perceptions before and after performing an unfamiliar domino
*Stephanou, Georgia; Charalabidou, Maria*

Self-protective strategies and self-esteem in students
*Alesi, Marianna; Pepi, Annamaria*

Personality, motivational beliefs and contextual variables as predictors of metacognitive self-regulation of learning
*Soriæ, Izabela*

S14 THE ROLE OF GESTURES AND PRIVATE SPEECH IN YOUNG CHILDREN'S EARLY METACOGNITION AND SELF-REGULATION

Organiser: *Whitebread, David*
Discussant: *Rodriguez, Cintia*

How pre-verbal children use gestures as tools for self-regulation: Evidence from 14 to 18 months old
*Basilio, Marisol; Rodriguez, Cintia; Whitebread, David*

Temporal patterns of co-incidence between children's self-regulatory behaviour and their private speech in a naturalistic setting
*Verma, Mohini*

Self-Regulation and metacognition in 6-year-olds with Specific Language Impairment (SLI)
*Kuvalja, Martina*

S15 THE ROLE OF METACOGNITIVE SELF-BELIEFS, METACOGNITIVE AND PERSONALITY TRAITS IN COGNITIVE PERFORMANCE AND DECISION-MAKING

Organisers: *Kleitman, Sabina; Jackson, Simon*
Discussant: *Allwood, Carl Martin*

Metacognitive factors and students' academic performance in a tertiary statistics course
*Kleitman, Sabina; Costa, Daniel*

Individual differences in metacognitive feelings of confidence: The generality and predictive validity of judgement confidence and its calibration in a medical decision-making task
*Jackson, Simon; Kleitman, Sabina*

Individual differences in the ability of increasing the realism of confidence judgments
*Buratti, Sandra; Kleitman, Sabina; Allwood, Carl Martin*

Self-efficacy, anxiety, self-concept and confidence as predictors of achievement in Confucian and European countries
*Morony, Suzie; Kleitman, Sabina; Stankov, Lazar*

S16 METACOGNITION AND PSYCHOPATHOLOGY: EVIDENCE AND PROSPECTIVE

Organiser: *Rezzonico, Giorgio*
Discussant: *Castiglioni, Marco*

Is metacognition a phenomenon created in social space? A cultural perspective on reflectivity
*Veronese, Guido*

The intersubjective negotiation of joint commitment
*Morganti, Francesca; Carassa, Antonella*

A Metacognition Assessment Interview: Instrument description and preliminary results on clinical sample
*Colle, Livia; Pedone, Roberto; Carcione, Antonino; Nicolò, Giuseppe; Semerari, Antonio*

Attachment and metacognitive capacities
*Strepparava, Maria Grazia*

S17 METACOGNITIVE SKILLFULNESS: DEVELOPMENTAL TRAJECTORY FROM TODDLERS TO YOUNG ADOLESCENTS

Organisers: *van der Stel, Manita*
Discussant: *Veenman, Marcel*

Exploring self-regulation in toddlers' classrooms: Are we ready to let them take learning into their own hands?
*Basilio, Marisol; Whitebread, David; Rodríguez, Cintia*

Metacognitive monitoring and controlling in primary school children: Evidence for the emergence of a reciprocal relationship in a test taking situation
*Roebers, Claudia*

Development of metacognitive knowledge and skills in primary education
*Molenaar, Inge*

Metacognitive skills and intellectual ability of young adolescents: A longitudinal study from a developmental perspective
*van der Stel, Manita; Veenman, Marcel*

S18 CAN WE TEACH EMOTIONS? METACOGNITIVE TRAININGS ON EMOTIONAL EXPERIENCE IN TYPICAL AND ATYPICAL DEVELOPMENT

Organiser: *Molina, Paola*
Discussant: *Ottavia, Albanese*

The effectiveness of a training program in socio-emotional competence in preschool children
*Cavioni, Valeria; Zanetti, Maria Assunta; Renati, Roberta*

How to improve social cognition by training children in emotion understanding: a primary school study
*Ornaghi, Veronica; Piralli, Francesca; Cherubin, Elisa; Grazzani Gavazzi, Ilaria*

The SAS (Sviluppo Abilità Sociali) training: Validation of a new training for social abilities development in children with autism
*Bulgarelli, Daniela; Molina, Paola; Rossini, Emmanuelle; Thommen, Evelyne*

Pragmatics and emotion understanding: A training for autistic children
*Farina, Eleonora; Brambilla, Paola; Albanese, Ottavia*

S19 THE ORIGIN OF CHILDREN'S METACOGNITION: THE ROLE OF THEORY OF MIND

Organiser: *Lecce, Serena*
Discussant: *Francisco, Pons*

The role of Theory of Mind in children's development of metamemory: A training study
*Lecce, Serena; Demicheli, Patrizia; Bianco, Federica; Nola, Marta; Pagnin, Adriano*

Theory of Mind and metamemory: Longitudinal analyses on the reciprocal relationship between the ages of 3 and 7
*Lockl, Kathrin; Ebert, Susanne; Weinert, Sabine; Schneider, Wolfgang*

Metacognition and Theory of Mind: A training program of mentalist skills
*Sáiz-Manzanares, María Consuelo; Carbonero Martín, Miguel-Ángel; Román-Sánchez, José-María*

## *Individual papers*

I1 METACOGNITION AND READING

The relationship between metacognition, reading comprehension and individual differences in reading skills
*Furnes, Bjarte; Norman, Elisabeth*

Metacognitive skills and reading performance: Empirical findings from PISA 2
*Lee, Jihyun*

When rereading is not enough: The importance of self-regulation in the use of rereading procedures
*Minguela, Marta*

The contribution of the left dorsolateral prefrontal cortex (DLPFC) as metacognitive control mechanism in attentional performance. An rTMS application
*Segurini, Alessandro; Balconi, Michela*

I2 METACOGNITION AND SCIENCE LEARNING

Metacognition in and for appropriating physics knowledge: An empirical study on thermodynamics
*Fantini, Paola; Levrini, Olivia*

Unprompted student-driven metacognitive data from two distinctly different sources
*Sayre, Eleanor C.; Irving, Paul W.*

Failure to understand stock-flow thinking: Is metacognition possible explanation to this phenomenon?
*Asik, Gursu; Doganca, Zerrin*

Enhancing the trainee teachers' learning and teaching physics through metacognitive strategies
*Gaciu, Nicoleta*

I3 METACOGNITION: THEORETICAL ISSUES AND MODELS

Metacognition – The very idea. Conceptual issues of metacognition and their practical and empirical significance.
*Klausen, Søren Harnow*

The notion of metacognition: a Trojan horse for cognitivism?
*Lo Dico, Giuseppe*

The impact of metacognitive knowledge, strategy use and motivation on the achievement at Baccalaureate Schools in Switzerland
*Karlen, Yves; Maag Merki, Katharina; Ramseier, Erich*

Working on two levels: The power of metacognition in leadership learning
*Robertson, Jan*

I4 METACOGNITION AND MULTIMEDIA LEARNING

The misleading effect of illustrations on monitoring (mis)understanding of problem solutions
*Ackerman, Rakefet; Leiser, David; Shpigelman, Maya*

Delegating metacognitive control of cognitive strategy use: The effect of implementation intentions in multimedia learning
*Stalbovs, Kim; Scheiter, Katharina; Gerjets, Peter*

Metacognition in multimedia: A micro-analysis of process and judgment data
*Feyzi-Behnagh, Reza; Trevors, Gregory; Azevedo, Roger*

Enhancing geometrical knowledge, metacognitive reasoning and visual spatial skills through a playing chess laboratory
*D'Amico, Antonella; Di Paola, Benedetto; Ferro, Mario; D'Eredità, Giuliano*

I8 METACOGNITION IN GIFTED LEARNERS

Development of metacognitive skillfulness in moderately gifted students
*Veenman, Marcel V.J.; van Haaren, Marieke*

Metacognition, achievement orientation and academic success in high school gifted students
*Beretta, Angela; Zanetti, Maria Assunta; Renati, Roberta*

Critical creativity in PhD education: Acknowledging the scholarly frames
*Brodin, Eva*

I9 METACOGNITION AND MATHEMATICS

Elementary students' spontaneous metacognitive functions in different types of mathematical problems
*Mokos, Evagelos*

Mathematics classroom with Italian and Chinese students: Metacognitive experiences in an intercultural perspective
*Di Paola, Benedetto*

Judgment-of-Learning and confidence in mathematics problem solving: A metacognitive benefit for the explainer
*Mevarech, Zemira; Shabtay, Galit*

Objectivization vs. objectification subtle difference: The 'a' parameter properties case
*Santos Melgoza, David Martín*

I10 METACOGNITIVE KNOWLEDGE

The role of metacognitive knowledge in school achievement and its development from grade five to seven
*Neuenhaus, Nora*

Examining change in metacognitive knowledge and metacognitive control during motor learning: What can be learned using a qualitative focus?
*Sangster Jokic, Claire*

Declarative metacognition in primary school children: Evaluation of a new test procedure and IRT-analyses of its construct validity
*Haberkorn, Kerstin; Lockl, Kathrin; Pohl, Steffi; Ebert, Susanne*

What teachers think about self-regulated learning (SRL). An investigation of teachers' knowledge and attitude towards SRL and their effects on teachers' instruction of SRL in the classroom
*Dignath-van Ewijk, Charlotte*

I11 SELF-REGULATION

Self-regulatory skills in Greek elementary students: Relations with school achievement
*Metallidou, Panayiota; Konstantinopoulou, Eleni*

How do feedback and generation instruction influence metacognitive accuracy and self-regulation in cognitive skill acquisition?
*De Bruin, Anique; Rikers, Remy; Schmidt, Henk*

Real life or virtual world? How self-regulated learning of science contents can be supported
*Schiffhauer, Silke; Opfermann, Maria; Wirth, Joachim; Goessling, Jill; Leutner, Detlev*

Self-regulation learning in the physics laboratory: A proposal to the methodological change in the higher education
*Sáiz-Manzanares, María Consuelo; Bol-Arreba, Alfredo; Carbonero Martín, Miguel-Ángel; Román-Sánchez, José-María*

I12 METACOGNITION AND TEXT COMPREHENSION

Self-regulated learning with expository texts: An analysis of the required competencies
*Schuette, Melanie; Wirth, Joachim; Leutner, Detlev*

Metacognitive knowledge, summarization skill and text comprehension in early adolescence: A longitudinal study
*Kolic-Vehovec, Svjetlana; Roncevic Zubkovic, Barbara; Pahljina-Reinic, Rosanda*

Metacomprehension and cognitive vigilance. A multi-teachers experiment in last year of secondary school
*Leclercq, Dieudonné; Laguesse, Céline; Henrotay, Pierre*

I13 JUDGMENTS-OF-LEARNING

Activation of inaccurate prior knowledge affects primary school students' meta-cognitive judgments and calibration
*van Loon, Mariëtte; De Bruin, Anique; van Gog, Tamara; van Merriënboer, Jeroen*

Calibrating discourse: The qualitative nature of metacognitive judgments and the rhetorical effectiveness of writing by L2 graduate students
*Negretti, Raffaella; Kuteeva, Maria*

Do delayed Judgments-of-Learning of older adults base only on retrieval processes?
*Volz-Sidiropoulou, Eftychia; Gauggel, Siegfried*

I14 METACOGNITION AND COMPUTER-SUPPORTED LEARNING

Metacognitive knowledge in relation to experimentation skills and knowledge acquisition within a computer-supported inquiry learning environment
*Ristic Dedic, Zrinka*

Learning in the digital age: Comparing metacognitive accuracy for text material presented on paper, computer screens or electronic reading devices
*Norman, Elisabeth; Furnes, Bjarte*

Graph methodology to assess learning process traces in virtual environments: A preliminary experience in higher education *Cerezo, Rebeca; Nuñez, J. Carlos; Sanchez-Santillan, Miguel*

Can technology foster emotional regulation in medical students? An international case study approach
*Lajoie, Susanne; Cruz-Panesso, Ilian; Poitras, Eric; Kazemitabar, Maedeh; Wiseman, Jeffery; Chan, Lap Ki; Hmelo-Silver, Cindy*

I15 CONFIDENCE

Confidence in primary school students: A measure for self-concept?
*Fritzsche, Eva Susanne*

Behavioural differences following high- vs. low-confidence errors within a tutoring learning environment for fraction learning
*Schnaubert, Lenka; Andrès, Eric; Eichelmann, Anja; Narciss, Susanne; Goguadze, George; Sosnovsky, Sergey*

Improved accuracy of confidence for recall of an episodic memory event
*Buratti, Sandra; Allwood, Carl Martin*

I16 METACOGNITION AND LEARNING STRATEGIES

University students' knowledge about and usage of learning strategies
*Haendel, Marion; Lockl, Kathrin; Tupac-Yupanqui, Ana*

Using learning journals to support metacognition in vocational education
*Mauroux, Laetitia; Dehler Zufferey, Jessica; Jimenez, François; Gurtner, Jean-Luc*

Exploring student reactions to online metacognitive scaffolding during inquiry-based learning
*Hsu, Ying-Shao; Zhang, Wen-Xin; Wang, Chia-Yu*

I17 METACOGNITION IN SOCIAL ENVIRONMENTS

Relationship among metacognition, motivation, social-emotional learning competencies and achievement of primary children
*Ee, Jessie; Ming, Zhou Ming*

Development of metacognition in Chilean preschool children: The relationships among the type of feed-back given by teachers and the elicitation of metacognitive control behavior
*Santa Cruz, Josefina; Muñoz Arancibia, Liz Pilar*

Sense of community and self-regulation. Reciprocal interaction in a Knowledge Building Community
*Girani De Marco, Barbara; Albanese, Ottavia; Balboni, Giulia; Cacciamani, Stefano; Coscarelli, Alessandra; Farina, Eleonora; Perrucci, Vittore*

I18 METACOGNITION IN ATYPICAL LEARNERS

Metamemory and subjective memory experiences in students with learning difficulties
*Mirandola, Chiara; Ghetti, Simona; Cornoldi, Cesare*

Teaching teachers to help hospitalized children to cope with emotions
*Kanizsa, Silvia*

Theory of Mind in deaf adolescents and young adults
*Petrocchi, Serena; Baruffaldi, Francesca; Lecciso, Flavia*

I19 METACOGNITION AND CREATIVE PROCESSES

The nature of the insight: A study of general and school-related Aha-experiences
*Reber, Rolf; Haukenes, Silje B.*

Children's metacognitive awareness of the change of interpretation involved in creativity
*Pizzingrilli, Paola; Molteni, Stefania; Antonietti, Alessandro*

Objects and materials to shape children's ideas
*Guerra, Monica; Zuccoli, Franca*

I20 METACOGNITION AND EMOTION

Metacognition and reflexivity: Which role for emotions?
*Freda, Maria Francesca; Esposito, Giovanna; De Luca Picione, Raffaele; Manzo, Stefano*

DLPFC, metacognitive control and emotional expression. What role of the frontal network for emotion and cognition in memory mechanisms?
*Balconi, Michela; Ferrari, Chiara*

Meta-emotive intelligence, mindfulness and scholastic learning: A treatment study
*Terminello, Anna; D'Amico, Antonella; Chifari, Antonella; Merlo, Gianluca*

I21 METACOGNITION IN CHILHOOD

The contribution of solitary symbolic play to babies' self-regulation
*Orr, Edna; Geva, Ronny*

Narrative and self-regulation: An empirical study into mother-child reminiscing and children's metacognitive skill
*Neale, Dave*

Metacognition in learning physics and astronomy for teaching in kindergarten and primary school
*Giordano, Enrica; Rossi, Sabrina; Onida, Monica*

*Poster*

POSTER SESSION 1

Monitoring and control in children aged 5 to 7
*Destan, Nesrin; Hembacher, Emily; Roebers, Claudia; Ghetti, Simona*

Metacognition and feedback monitoring rTMS (repeated transcranial magnetic stimulation) applied on dorsolateral prefrontal cortex affects feedback processing
*Balconi, Michela*

Has the error detection automatically driven in the calculation?
*Okamoto, Masahiko; Amano, Shogo*

The effects of delayed-JOL, sentence generation and self-explanation instructions on metacognitive judgments
*van Loon, Mariëtte; De Bruin, Anique; van Gog, Tamara; van Merriënboer, Jeroen*

Interaction of self-efficacy and abilities while predicting the use of metacognitive strategies
*Jõgi, Anna-Liisa; Aus, Kati; Kikas, Eve*

Effects of subliminal mere exposure on the study time allocation
*Amano, Shogo; Okamoto, Masahiko*

Metacognition as a resource for study method
*Ruggi, Simona; Gatti, Monica; Daffi, Gianluca*

An Empirical Study on Assessing Critical Success Factors of Knowledge management implementation in Indian B-Schools
*Ranjan, Jayanthi; Sharma, Vandna; Ranjan, P.P.*

Memory and metacognitive strategies in mathematical learning
*Costa, Hiwet Mariam; Passolunghi, Maria Chiara*

Metacognitive scaffolding in physical versus online inquiry activities
*Chen, Sufen; Tsai, Cheng-Yue; Chen, Mei-Rong Alice; Chang, Judy Wen-Hua*

Analysis of learning competences in Industrial Engineering students: A metacognitive intervention proposal
*Sáiz-Manzanares, María Consuelo; Montero-Garcia, Eduardo; Carbonero-Martín, Miguel-Ángel; Román-Sánchez, José-María*

A Brain Workout Routine for Thinking in a Second Language From Chinese to English – from topic to subject prominent: A descriptive study
*Chen, Leighanne Jamie*

The undergraduate students' performance of critical thinking in the context of reading science related news
*Lin, Shu-Sheng*

Metacognitive instruction to improve reading comprehension: An experimental research study
*Feucht, Florian; Burke Lefever, Jennifer*

Metacognitive and cognitive factors underlying the understanding of the text
*Pepi, Annamaria; Maltese, Agata; Scifo, Lidia*

Fostering a metacognitive attitude in creativity training
*Antonietti, Alessandro; Scarantino, Claudia*

Children understanding art
*Gilli, Gabriella; Ruggi, Simona; Gatti, Monica; Savazzi, Federica*

What preschoolers think about the power of artists
*Freeman, Norman H.*

Metacognitive strategies for a Smart Museum
*Rozzi, Francesca*

Implementation and evaluation of a hypermedia tool applied to learning difficulties in mathematics
*González-Pienda, Julio; Núñez, J. Carlos; García, Trinidad; Cueli, Marisol; Cerezo, Rebeca*

Training self-regulated learning through presential and virtual formats: Differential efficacy in higher education
*Cerezo, Rebeca; Suarez, Natalia; Nuñez, J. Carlos*

«Videogames make me feel/improve...»: Metacognitive consciousness in the videogaming experience
*Cantoia, Manuela; Milani, Luca; Pennati, Alessandro*

Do socio-cognitive conflicts enhance metacognitive skills? A pilot study in educational robotics
*Castiglioni, Marco; Datteri, Edoardo; Zecca, Luisa; Businaro, Nicoletta; Laudisa, Federico*

Educational robotics and science education in primary schools
*Datteri, Edoardo; Zecca, Luisa; Laudisa, Federico; Castiglioni, Marco*

POSTER SESSION 2

The role of implicit and explicit knowledge in metacognition and early years' language acquisition
*Xu, Chenyan*

Understanding the effects of early childhood adversity and proximal parenting processes on children's developing self-regulation of attention and behavior: Implications for school readiness
*Skowron, Elizabeth A.; Cipriano-Essel, Elizabeth A.; Rodríguez-González, Martiño*

Bowen Family Systems Theory as a framework for advancing cross-disciplinary research on self-regulation development in early childhood. Current developments and future directions
*Rodríguez-González, Martiño; Skowron, Elizabeth A.; Noone, Robert J.*

Self-regulated learning in late primary school: What can we learn from think aloud protocol analysis?
*Vandevelde, Sabrina; Van Keer, Hilde*

Efforts to display metacognitive and self-regulatory skills of young children: A Turkish case
*Adagideli, Fahretdin Hasan; Ader, Engin*

Shared-regulation episodes within group-work activities in primary schools and their relation to individual self-regulation: A temporal analysis
*Grau, Valeska; Freire, Paulina*

Metacognition and mindreading: A developmental study
*Paulus, Markus; Proust, Joelle; Tsalas, Nike; Sodian, Beate*

Learning and thinking with analogies: Exploring the role of self-regulated learning in analogical reasoning
*Lin, Yen-Ju; Wang, Chia-Yu*

Metacognitive awareness, self regulation and conceptions of learning in secondary schools
*Cera, Rosa; Bellingeri, Mara; Landi, Mariarosaria; Mancini, Michela; Morganti, Luca; Antonietti, Alessandro*

Effectiveness of a self-regulation learning programme with high school student
*Fernández, Estrella; Tuero, Ellián; Bernardo, Ana; Cerezo, Rebeca*

Self regulated learning and emotions in high school students (first/fifth grades, scientific/technical schools): Are there any differences?
*Businaro, Nicoletta; Modica, Debora; Albanese, Ottavia; Gabola, Piera*

Problem behaviours or emotion disorders? Regulating emotion in the middle school years
*Sinclaire-Harding, Lysandra; Whitebread, David*

Explanation of embarrassment and cognitive emotion regulation in early adolescence
*Valle, Annalisa; Cavalli, Giulia; Marchetti, Antonella*

Telling emotions felt by another person: The case of anger and sadness
*Biassoni, Federica; Ciceri, Rita*

The relations between children's social understanding and social reputation in Italian school age children
*Fiorilli, Caterina; De Stasio, Simona; Di Chiacchio, Carlo*

Peer tutoring groups as metacognitive learning environments?
*De Backer, Liesje; Van Keer, Hilde; Valcke, Martin*

Socially shared metacognition in Swiss Vocational Education and Training system
*Motta, Elisa; Cattaneo, Alberto*

A metacognitive approach to empower children with behavioural difficulties
*Alvarez, Lionel*

Metacognition at school: Relationships between metacognitive approach in different school areas in early adolescence
*Magistro, Daniele; Settanni, Michele; Magno, Francesca; Rabaglietti, Emanuela*

Teenage pregnancy: Competencies of US teenagers to use news text as a knowledge source
*Feucht, Florian; Maziarz, Lauren; Hany, Susan; Ziegler, Nathan*

The analysis of the construct of literacy emerging in the construction of a "risk profile"
*Pepi, Annamaria; Maltese, Agata; Scifo, Lidia*

Metacognitive functioning in neglectful parents
*Di Pasquale, Roberta; Rivolta, Andrea; Zanchi, Valentina; Baccanelli, Nadia*

An Italian validation of the Metacognition Awareness Inventory (MAI): Factorial structure and associations to self-esteem and anxiety
*Colombo, Barbara; Balzarotti, Stefania; Beretta, Angela*

Development of an instrument to investigate metacognition in French, Spanish and Vietnamese languages
*Escorcia, Dyanne*

*Workshops*

W1. Studying executive functions and metacognitive control through neuro-stimulation (Transcranial Direct-Current Stimulation and Transcranial Magnetic Stimulation)
*Antonietti, Alessandro; Colombo, Barbara*

W2. Computer-based on-line tracking methods to assess metacognition
*Azevedo, Roger*

W3. Observational methods to assess metacognition in young children
*Whitebread, David; Basilio, Marisol*

# Abstracts of the presentations

## SYMPOSIA ABSTRACT

### READING COMPREHENSION AND METACOGNITION

Organiser: *Palladino, Paola*
Discussant: *Minguela, Marta*

Reading comprehension is a complex skill mediated by several cognitive and metacognitive processes. A crucial variable could be the calibration of university students' notions about which expert might have written a science text on a certain topic. Such pertinence judgments could be considered as a kind of metacognition about others' cognition and, therefore, it could significantly influence reading comprehension of scientific texts. Another important variable to study may be readers' ability to judge the validity of knowledge claims, as well as their knowledge about the subject, in order to investigate student profiles and study how different students performed on multiple-text comprehension. An essential component of successful comprehension of a text is to establish coherence between the various events in the texts and between those events and their background knowledge. Some of these processes are automatic, whereas others are strategic. A crucial factor concerns the extent to which a reader engages in the additional and effortful strategic processes. Finally, could be relevant in understanding the relationship between metacognition strategic knowledge and reading comprehension to use a training methodology. It would allow to assess direct and transfer effects of a metacognitive training in different ages. The symposium will discuss through the different contributions the role of these specific metacognitive variables on reading comprehension.

#### *Which expert has written the text? Laypersons' ideas about the structure of expert knowledge when reading science texts*

Bromme, Rainer; Thomm, Eva; Pieschl, Stephanie

Modern societies are based on a division of cognitive labor: To make knowledge-based decisions about issues of private and public life (e.g., health care or opinion making on question about environment protection), individuals increasingly have to handle science-based information. While the Internet has nowadays simplified the accessibility and availability of information about any science-based topic, the great challenge lies in

the selection and evaluation of the varieties. Therefore, laypersons must evaluate the text's source in terms of its credibility and pertinence considering the topic at hand. In this paper we will focus on laypersons capabilities to assess the pertinence of experts of online texts. However, science-based text information frequently contains scientific concepts which are too complex to be deeply understood by a layperson from different disciplines for certain topics. We conceive such pertinence judgments as a kind of metacognition about others' cognition. The developmental psychologist Frank Keil (2010) has recently shown that even preschool-children have realistic notions about who might be an expert for what topic, even if they themselves have only a coarse understanding of the topic. In the same vein we assess the calibration of university students' notions about which expert might have written a science text on a certain topic. Today many science topics are based on research from different disciplines and therefore the disciplinary background of the experts who might have done the research is not immediately evident. Undergraduate students of different fields of study read short depictions of scientific findings. The texts stemmed from the domains of physics, medicine, psychology and climate change and were based on original scientific articles (e.g., published by Nature). Participants estimated to what extent experts of different disciplines (e.g., biology, physics) might have contributed to the presented texts and thus might be ascribed the pertinent expertise. The calibration of these estimations was established by using bibliometrics of the original articles. We analyzed the gradual multidisciplinary allocation of each article to different domains and compared them with the participants' subjective judgments on the experts' pertinence. The influence of further variables (e.g., self-assessed knowledge) on the pertinence judgments was also tested. Results show that laypersons have appropriate assumptions about who might (or should) have contributed to the text information and hence, about the pertinence of experts for science-based topics, regardless of their own knowledge about the topic. In conclusion, laypeople may overcome their own lack of comprehension by deferring to their notions about the source's pertinence and thus, by drawing on their ideas about the division of cognitive labor. The relevance of this kind of metacognition about others cognition for reading in settings of informal learning will be discussed.

## *Profiles of epistemic beliefs and knowledge when reading multiple texts*

Ferguson, Leila; Øistein, Anmarkrud; Strømsø, Helge I.; Bråten, Ivar

Reading tasks involving multiple information sources may depend on readers' ability to judge the validity of knowledge claims, as well as their knowledge about the subject matter. Prior studies have demonstrated relationships between different dimensions of epistemic beliefs and multiple-text comprehension (Bråten, Britt, Strømsø & Rouet, 2011). In the present study we wanted to examine different profiles of justification beliefs (Greene, Azevedo & Torney-Purta, 2008) and knowledge in relation to multiple-

text comprehension. We adopted a person-centred approach, allowing individual patterns of epistemic beliefs and knowledge to emerge from the data. Thus, we were able to investigate student's profiles and study how different groups of students performed on tests of multiple-text comprehension. Participants were 220 Norwegian 11th-graders. Before reading, students' epistemic beliefs about science were assessed using an 18-item measure that captured three dimensions pertaining to ways in which students believe knowledge claims should be validated, specifically by personal justification, justification by authority and justification by multiple sources. A 20-item multiple choice test was also administered to assess students' prior knowledge. Students read five authentic texts providing conflicting information on the health effects of sun exposure. After reading, participants answered short-essay questions designed to measure multiple text comprehension. We identified two meaningful clusters. A MANOVA with clusters as IV and epistemic beliefs and prior knowledge as DVs, indicated significant differences ($\eta^2 = .71$). Univariate analyses revealed that students in Cluster 1 (N = 131) achieved statistically significantly higher mean scores than students in Cluster 2 (N = 87) on prior knowledge (15.4 vs 10.7, $\eta^2 = .61$), justification by authority (7.8 vs 7.1, $\eta^2 = .05$) and justification by multiple sources (7.0 vs 5.8, $\eta^2 = .09$), whereas Cluster 1 had significantly lower scores than Cluster 2 on personal justification (3.2 vs 3.7, $\eta^2 = .04$). Regarding multiple text comprehension, a one-way ANOVA indicated that students in Cluster 1 achieved a statistically significantly higher score than students in Cluster 2 ($\eta^2 = .03$). The relationships identified in this study may be domain and/or task specific. However, our findings suggest that the specific configurations of students' epistemic beliefs and knowledge played a role in their comprehension of a complex scientific issue presented in multiple texts. High prior knowledge students seemed to believe more in the need to justify knowledge claims using authoritative sources of information and to corroborate multiple information sources, and less in validating knowledge claims by personal opinion than low prior knowledge students did.

## *The role of standards of coherence in reading comprehension*

VAN DEN BROEK, PAUL

An essential component of successful comprehension of a text is that the readers establish coherence between the various events depicted in the texts and between those events and their background knowledge. In constructing such a representation, readers draw on a wide range of processes to identify objects and relations. Some of these processes are automatic, whereas others are strategic. A crucial factor in success and failure to comprehend concerns the extent to which a reader limits him/herself to the automatic processes or engages in the additional and effortful strategic processes. In this presentation we discuss how the reader's meta-cognitive standards of coherence determine whether strategic processes are initiated in a particular reading situation and,

therefore, what the quality of the resulting mental representation will be. In the first section of the presentation, we provide a theoretical review of standards of coherence and place them in the context of current theoretical models of on- and off-line comprehension. We illustrate how these standards vary as a function of reader properties (such as reading goals, attentional resources), text properties (such as genre, difficulty), and the context in which reading takes place. In the second section we review empirical evidence for standards of coherence, both from existing literature and from our own line of research. In the final section, we discuss implications for text design and educational practice, and outline future research directions.

## *Training reading comprehension strategies affects reading decoding: an age related effect*

Palladino, Paola; Mangiagalli, Matteo

Reading comprehension is a complex skill mediated by several cognitive and metacognitive processes (Cornoldi & Oakhill, 1996). Between metacognitive components affecting reading comprehension, strategic knowledge is a crucial one. Several effective metacognitive trainings on reading comprehension are based on reading comprehension strategic knowledge and use (see for example Johnson Glenberg, 2000; for a review see also Gersten, Fuchs, Williams & Baker, 2001). However, as highlighted by Gersten et al. (2001), "assessment of transfer effects is a critical area for further research" (p. 312). Furthermore in children in their first school years could be important to understand transfer effects within the reading skill, and in particular looking at the relationship between reading decoding and comprehension. In the present study we wanted to examine the direct and transfer effects of a reading comprehension strategic training (De Beni & Pazzaglia, 1996) on children in second and fourth grades. We examined children's knowledge about reading comprehension strategies, reading comprehension and reading decoding skills as well as math skills immediately before and after the training and also 10 months later. Participants were 82 children, 35 second graders (19 males) and 47 fourth graders (27 males) from respectively two school classes for each level. One class had the training activity, the other one was the control class. Strategic training was focused on reflective activities of analysing, selecting and applying strategies more effective in different cognitive tasks related to reading comprehension. Training was applied on a class, twice a month for about 50-60 minutes, and lasted for four months (February-May). It was based on two Italian programs, "Controllare la mente", Friso, Palladino & Cornoldi and "Lettura e metacognizione" (De Beni & Pazzaglia, 1991) and each activity was adapted to children age. Before, immediately and 10 months after the training, participants were tested in the following skills: reading comprehension strategic knowledge, reading comprehension, reading speed and accuracy, math skills. Results showed that both age groups had benefit from the training.

Trained groups improved compared to control groups in their knowledge and sensitivity about reading comprehension strategies in both age groups. Improvement was still significant 10 months later. Significant effects and interactions with age were obtained in reading comprehension and/or reading decoding. No effect was observed for math skills. Results will be discussed according to their implications for theoretical perspective and educational practice, and future research directions will be outlined.

## S2 METACOGNITION AND SELF-REGULATION IN DEVELOPING PROFESSIONALS

Organisers: *Perry, Nancy; Kramarski, Bracha*
Discussant: *Vauras, Marja*

Metacognition and self-regulation are associated with success in and beyond school, but a significant minority of learners in primary and secondary school, university, and the workplace struggle to develop these critical abilities (Rimm-Kauffman et al., 2009; Winne et al., 2003). Therefore, enhancing learners' awareness and control over cognition, motivation, affect, and action should be a goal for all levels of education. The papers in this symposium examine efforts to prepare professionals who exercise metacognition and self-regulation in learning and working contexts (Klassen & Durksen; Kramarski & Kohen; Hendersen & McKendree), and who can promote self-regulation in other learners (Kramarski & Kohen; Brenner, Perry & Collie). They mix quantitative and qualitative methods to provide rich descriptions of group and individual level data. Together, they represent important advancements in studying and promoting metacognition and self-regulation, an area in which the discussant, Marja Vauras, has exceptional expertise.

### *Teacher emotion and meta-emotions during critical formative period*

KLASSEN, ROBERT; DURKSEN, TRACY

In this longitudinal study we analyze the weekly emotions and meta-emotions of 150 pre-service (trainee) teachers during a 9-week teaching practicum. Meta-emotion refers to higher-order (or secondary) thoughts and feelings about one's own emotions and the emotions of others (Gottman, Katz & Hooven, 1997). For example, a teacher who feels shame at showing anger to students is displaying higher-order emotion about a primary emotion. Analyzing meta-emotions in addition to primary emotions provides insight into pre-service teachers' cognitive and emotional framework. Building an understanding of pre-service teachers' emotions and meta-emotions during the practicum is important because early teaching experiences influence career decisions (Rots, Aelterman, Vlerick & Vermeulen, 2007). Sutton & Wheatley (2003) called for further research to investigate teachers' emotions and meta-emotions in order to

understand the factors related to successful teaching. We investigated the balance of pleasant and unpleasant emotions, and the cognitive and emotional (i.e., meta-emotional) interpretation of these emotions. Based on Gottman et al.'s (1997) theoretical models, we hypothesized that unpleasant emotions would decline over time during the practicum, and that emotional and cognitive interpretations of emotional states would provide insight into pre-service teachers' emotional lives. The sample included 150 pre-service teachers in their final year of teacher preparation. We collected weekly quantitative and qualitative data on emotions and meta-emotions. Data were coded for hedonic valence, e.g., pleasant (happiness, love, contentment) and unpleasant (anger, anxiety) emotions and meta-emotions. Declining trajectories from Week 1 to Week 6 for frequencies of pleasant and unpleasant emotions were observed. Qualitative analysis provides insight into participants' meta-emotions, e.g., "My students' excitement increases my energy and enthusiasm," and "I can't deny or ignore my exhaustion, but I also consider this stress to be mostly positive." Participants' interpretations of emotional states (i.e., meta-emotions) showed a positive, functional bias; that is, unpleasant primary emotional states were most often positive and functional (e.g., My stress motivates me) rather than negative (e.g., I feel my mentor teacher is getting a kick out of watching me struggle). Our findings showed that the frequency and intensity of pre-service teachers' emotions declined over time. The decline in unpleasant emotions was expected; the decline in pleasant emotions may reflect participants' flattening affect over the course of the practicum. Qualitative findings provide explanations related to meta-emotions, with higher-order cognitions and emotions showing an overall positive and functional bias.

## *Shaping preservice teachers' pedagogical SRL both as learners and as teachers*

Kramarski, Bracha; Kohen, Zehavit

There are inherent challenges in shaping teachers' self-regulated learning (SRL), for themselves (i.e., as the learner), and for their students (i.e., as the teacher) when helping them obtain SRL. Our study focused on two questions: (1) How can pre-service teachers' SRL in pedagogical context, i.e., pedagogical SRL, be promoted both as a learner and as a teacher? (2) How does SRL support in teacher-training programs affect both learner and teacher roles? Ninety-seven Israeli pre-service teachers participated in a microteaching course as part of a two-year pre-service training program. Participants were exposed to a reflective training (28 h), with or without self-regulated learning support (SRL vs. no-SRL). The SRL support was based on explicit discussion of (1) The role of SRL in teachers' education for both roles (e.g., Kramarski & Michalsky, 2009, 2010; Kramarski & Revach, 2009); (2) Metacognitive and motivational/emotional components of SRL; and (3) Using prompts that direct students' attention to understand what, when, why, and how to implement SRL in pedagogical context. Pre-

service teachers were asked to plan a 20-minute lesson and teach it to the other participants. The presenter was then asked to rate their lesson planning (i.e., self-feedback) and compare it to its implementation. The other participants also assessed the presenters' lesson (i.e., group feedback), and then the instructor held a reflective discussion with the participants about the presented lesson. Every lesson was videotaped. Four measures were used to assess pedagogical SRL in both the learner and the teacher roles: (1) As a learner: Self perceived SRL (pre/post questionnaire, MSLQ, 1992) regarding aspects of metacognition (planning, monitoring and evaluation) and motivation/emotion (task value, interest, self-efficacy and anxiety); (2) As a teacher: SRL behaviors exhibited during the lesson (assessed similar to learner's SRL), as well as teachers' self-feedback and group feedback on the quality of planning and implementation of the lesson. Participants who received SRL support outperformed those who did not receive SRL support on most components of pedagogical SRL in both roles (as learners and as teachers) and on the feedback measures. No significant correlation was found between measures of the two roles. As learners, the greatest improvement was seen in measures of monitoring and self-efficacy; as teachers, their lesson displayed higher motivation to engage students in interesting tasks, more metacognitive considerations and less anxiety. Quantitative and qualitative data of pedagogical SRL will be elaborated and implications for both aspects will be discussed.

## *Student teachers' developing practices that promote self-regulated learning: Linking efficacy and Utility Beliefs to Effectiveness*

Brenner, Charlotte; Perry, Nancy; Collie, Rebecca

We examined how student teachers' (STs) perceived efficacy for teaching and promoting self-regulated learning (SRL), and valuing of SRL-promoting practices, relate to their teaching effectiveness and stress throughout their practicum. SRL involves metacognition, motivation, and strategic action (Winne & Perry, 2000). SRL-promoting practices include involving students in complex tasks, self-evaluation, making choices, and controlling challenge, and making support for SRL available (Perry et al., 2002). These practices support differentiated instruction, reduce problem behavior, and engage students in meaningful learning. STs learning to promote SRL should experience higher efficacy for teaching, lower stress, and be more effective. However, STs struggling to implement practices advocated in their professional programs may judge those practices are ineffective and reject them (Cabaroglu & Roberts, 2000). Also, lack of congruency between beliefs, practices, and program values may increase stress and decrease performance. Optimizing STs' effectiveness in promoting SRL requires attending to STs' beliefs about and implementation of SRL-promoting practices. STs choosing to participate in a cohort focused on the promotion of SRL participated in our 3-years teacher motivation study. Here we synthesize findings from Years 1 (N = 13)

and 2 (N = 15) and elaborate findings for 2 STs with different effectiveness profiles. Questionnaire, interview, and observation data link evidence about STs' (a) perceived efficacy for teaching and promoting SRL and (b) valuing of their SRL focus with (c) perceived stress and (d) actual effectiveness. In Year 1, STs in the SRL Cohort experienced higher perceived teaching efficacy and lower stress than STs with a more general focus. Their beliefs about the utility of SRL-promoting practices correlated .43 with perceived efficacy and .38 with SRL effectiveness. In Year 2, STs indicated their SRL focus helped their teaching generally and their SRL effectiveness correlated .83 with general teaching effectiveness. The two STs reported high efficacy and moderate-high support for SRL-promoting practices post practicum. The ST with the higher effectiveness profile began her practicum with lower perceived efficacy, but attributed challenges to her developing practice and persisted. The ST with the lower effectiveness profile reported high perceived efficacy throughout her practicum and attributed her low effectiveness to external, uncontrollable factors. These findings corroborate research indicating moderate levels of efficacy and utility beliefs that consider personal limitations prompt openness to alternative practices and lead to greater effectiveness (Bandura & Locke, 2003). Our research shows the benefits of helping STs to develop SRL promoting practices and suggests it may be possible to predict who is most likely to develop those practices early in their teaching careers.

## *Promoting metacognitive awareness of professional identity and values in medical students through integrated problem-based learning, clinical skills and appraisal*

Henderson, Janine; McKendree, Jean

Several UK medical schools now have PBL based programmes; these vary widely in group processes, background of tutors, number of years in the curriculum etc., along with fundamental similarities e.g formulation of problems used, integration within curriculum (McKendree, 2010). What has been explored less is how PBL sessions integrate with other skills of self-directedness and professional values that students must acquire, but which may be taught by a wider variety of staff. For instance, communication and physical examination skills require practice, feedback, and modelling of the ethical and professional values that underpin them. Most PBL schools have sessions on these topics, but often these are taught by a variety of staff with potentially divergent outcomes. Doctors must ultimately develop knowledge, skills and the underpinning values in a coherent and integrated personal and professional identity. As has been reported in the literature, students often have a tenuous grasp of the aspects contributing to their nascent professional identity and there are claims that there is a limited potential for the formation of professional identity in the early years (Niemi, 1997; Vågan, 2009). At HYMS, we believe that early years are critical for laying the foundations of self-awareness of identity. We aim to facilitate development of these

multi-faceted aspects by tightly integrating the students' PBL learning outcomes, associated activities and resources with clear modelling of the entirety of professional identity by providing clinician-facilitators to facilitate PBL sessions, teach communication and clinical skills, and explicitly model and discuss their own experiences of how these aspects are manifest in practice. In the first two years of the HYMS curriculum, a small group of 32 tutors, who are all clinicians, facilitate delivery of the core curriculum via PBL sessions, and clinical skills sessions comprising communication and examination skills. They also conduct 1-on-1 meetings with each student twice a year that include reflective exercises and peer, self and tutor appraisals, working with their student group for a full academic year. These tutors meet regularly to review the PBL cases, conduct peer observations, hold action learning sets, and develop the curriculum, strengthening their own identities as core HYMS tutors. Thus, they support an integrated development in each student of the knowledge, skills and professional values of review, self-reflection and feedback to others that underpin the many facets of the identity of being a doctor from the very beginning of the student experience. We have conducted preliminary focus groups exploring peer assessment and reflection; we aim to conduct further qualitative studies exploring and analysing the development of the students' meta-cognitive skills in this particular PBL environment, through analysis of students' written submissions and further focus groups.

## S3 PLAY, METACOGNITION AND SELF-REGULATION IN YOUNG CHILDREN

Organiser: *Whitebread, David*
Discussant: *Pino-Pasternak, Deborah*

The papers in this symposium build on the established research demonstrating the role of playful contexts in supporting the development of metacognitive and self-regulation skills in young children (Berk, Mann & Ogan, 2006; Whitebread, 2010). Slot, Leseman & Mulder report on a study exploring the relationship between the complexity of pretend play and self-regulatory skills among 2-3 year olds in day-care centres and pre-schools in the Netherlands. O'Sullivan reports on a study with slightly older kinder-garten children in Ireland. This focuses particularly on the role of metacommunication within complex social pretend play in developing young children's metacognitive and self-regulatory skills, and on the methodological challenges associated with researching metacommunication in naturally occurring social pretend play. Zachariou reports on a study with 6 year olds in Cypriot primary schools. In this case the focus is on the provision of musical play, and the examination of the opportunities this affords for the development of metacognition and self-regulation in this age group. The use of coding frameworks to analyse play behaviours and metacognitive and self-regulatory skills via video-recorded observational data is a common methodological theme within the three papers.

## *Complexity of pretend play and its relation with children's self regulatory skills*

Slot, Pauline; Leseman, Paul; Mulder, Hanna

Several studies have shown the importance of self-regulation in predicting children's academic and social-emotional outcomes. Self-regulation develops rapidly in the first three years and depends highly on the guidance and nurturing of the caregiver. According to Vygotsky pretend play is very important in children's self-regulatory development because this allows them to specify their own challenges, objectives and actions toward their goals. In pretend play children have to follow social rules and coordinate their behavior in accordance with these rules in order to sustain a satisfactory play episode with peers, and therefore provides a platform for children to develop self-regulatory skills. Few studies have provided support for the relation between pretend play and self-regulation. This paper seeks to extend the existing studies by providing more insights in the relation between pretend play and self-regulation in two- and three-year-old children. An in-depth study was conducted in about 64 ECEC groups of daycare centers and preschools. Two different play settings were videotaped for about 15-20 minutes. The first is a free play setting in which children were free to choose in which play corner they wanted to play and with whom. The second was a more structured play setting in which the researcher asked the caregiver to select some children and provided her with some kitchen play materials and asked them to play with it as usual. Using an observational instrument the children's (N = 100) behaviour was coded afterwards. With this observational instrument, based on the Smilansky Scale for Evaluation of Sociodramatic Play, the complexity of children's pretend play was coded, focusing on imitative role-play, make believe with objects and actions, children's persistence and (verbal) interaction with peers and caregivers. Also the caregiver's role was coded on the same aspects of pretend play. Furthermore, children were given a test battery of self-regulation measures adapted for Dutch toddlers. Four different measures were used: a visual search task assessing selective attention, a task to assess visuospatial working memory, a memory for location task to assess visuospatial memory span, and a gift and snack delay task to assess self-control. Complexity of children's pretend play will be related to their self-regulatory skills and the results will be discussed in light of the different play settings and the caregiver's role. Implications for classroom practices will be discussed as well.

## *Investigating the relationship between metacommunication, metacognition and self-regulation in preschool children's naturally occurring social pretend play*

O'Sullivan, Lisha

Although pretend play is entwined with social interaction, from its beginnings, the term social pretend play has traditionally been used to refer to pretend play between peers. Social pretend play develops gradually during the preschool period, peaking in complex social pretend play where children enact complex scenarios and engage in on-going collaboration in an attempt to sustain enactments. It is complex social pretend play, rather than pretend play per se, that seems to have the leading edge in terms of supporting self-regulated learning in the early years (Elkonin, 2005; Karpov, 2005; Bodrova & Leong, 2011). Engaging in social pretence promotes the type of intentional learning (Whitebread, 2010) that requires children to regulate their own thinking and behaviour, in addition to both understanding and regulating co-players', allowing for collective pretence to be established and maintained. Metacommunication, defined as 'communication which refers to communication', is an aspect of social pretend play that may be particularly important for young children's developing self-regulation and metacognition. While a robust research base already indicates a relationship between the representational aspects of pretence and a range of social and cognitive gains, the potential of metacomunication to support children controlling their own cognition and behaviour, and that of play partners, has received limited research attention. Just as pretend play develops over time, metacommunication skills also seem to develop gradually. As social pretend play has different functions at various points in development, it may be similarly plausible that metacommunication has different functions during social pretend play development. Drawing on preliminary pilot data from a mixed methods project, this paper will explore how metacommunication develops during the preschool years and make some tentative hypotheses as to its functions for young children's developing metacognition and self-regulation. The methodological challenges associated with researching metacommunication in naturally occurring social pretend play will also be considered.

## *Musical play and self-regulation*

Zachariou, Antonia

The proposed paper presents a pioneering attempt to bring together the notions of Musical Play and Self-regulation. The theoretical underpinnings for this research were set by Vygotsky (1978), who argued that play provides the grounds for the cultivation of children's self-regulatory abilities. Musical play is one of the first manifestations of musicality. Musicality is a very fundamental aspect of human functioning, significantly

related to important aspects of human development, like thinking, social and emotional skills (Trevarthen, 2000). On the other hand, self-regulation is crucially important in children's learning. Self-regulatory abilities flourish in playful contexts (Bruner, 1972); specific characteristics of play, like its intersubjectivity, its rule-based nature, and the opportunities afforded by it for self-regulated language and emotional regulation, promote the development of children's self-regulation (Berk, Mann & Ogan, 2006). These two strands of literature could be brought together, since Musical play appears to accumulate all these characteristics (Tarnowski, 1999; Young, 2004; Gluschankof, 2005; Pound, 2010) and the universal, innate and inherent nature of Musical play (Pond, 1980; Papousek, 1996; Lew & Campbell, 2005; Young, 2005) makes it an ideal type of play where to study the emergence of self-regulation. However, the relationship between musical play and self-regulation has been under-researched. Given the scarcity of research on this area, an initial undertaking to explore, identify and describe the nature this relationship was attempted through my MPhD dissertation. This was a case study of a specific class, observing ten 6-year-old children engrossed in musical play. A mixed methods approach was adopted and both qualitative and quantitative data were collected. Children's musical play was video-recorded and the self-regulatory behaviours apparent during it were identified and coded on the basis of an already constructed and validated coding framework. Data on the children's general self-regulation were also collected, through an observational checklist, completed by the music teacher. The results indicate that musical play allows for self-regulatory behaviours to emerge, in all the possible domains of self-regulation (Metacognitive Knowledge, Metacognitive Regulation and Emotional/Motivational Regulation). The subsequent analysis suggests that different categories of self-regulatory behaviours appear at different rates during musical play. Moreover, different types of musical play seem to encourage different kinds of self-regulatory behaviours. Finally, children's general self-regulatory ability is associated with their self-regulatory behaviour during musical play. Nonetheless, due to the small scale of this study, all the findings remain tentative. Hence, further research aiming to expand the evidential base and allow for plausible claims was considered essential and it is currently underway as part of my PhD.

## S4 EXAMINING METACOGNITIVE PROCESSES USING PROCESS DATA COLLECTED DURING LEARNING WITH COMPUTERIZED ENVIRONMENTS

Organisers: *Bannert, Maria; Azevedo, Roger*
Discussant: *Wirth, Joachim*

Understanding the real-time deployment of key SRL processes is a condition precedent to foster the development of SRL theories and the design of adequate instructional support. This symposium brings together a panel of international researchers who are currently developing and testing online methods and analytical

techniques to examine the temporal role of metacognitive and SRL processes, such as analyzing, planning, monitoring, and evaluating of one's own cognition, emotions, and motivation. The primary goal of this symposium is to examine metacognitive processes using process data collected during learning with CBLEs. A second goal is to compare different methodological approaches (e.g., log files, thinking aloud data, eye tracking) and analytical techniques (e.g., process mining, sequential analysis, educational data mining) and their contributions towards augmenting contemporary frameworks, models, theories, and methods used in metacognition and SRL. Lastly, we present how the results can be used to guide the design of CBLEs aimed at fostering SRL.

## *Using artificial pedagogical agents to examine the role of metacognitive processes during learning with MetaTutor*

Azevedo, Roger; Bouchet, François; Feyzi-Behnagh, Reza; Harley, Jason; Trevors, Gregory; Duffy, Melissa; Taub, Michelle; Landis, Ronald

Understanding the complex nature of cognitive, affective, and metacognitive (CAM) processes during learning with multi-agent learning environments is key to understanding how these processes impact learning about conceptually-challenging topics (Azevedo et al., 2012; Bannert et al., 2009; Biswas et al., 2010; Lajoie, 2008). Current methodological approaches to studying SRL processes have several weaknesses as opposed to capturing real-time deployment of SRL processes (see Azevedo et al., 2010, 2011). As such, our approach has been to use MetaTutor (an intelligent, hypermedia multi-agent system) to collect rich trace data of CAM processes during learning. Seventy-two college students took part in a 2-day experiment with MetaTutor to learn about the circulatory system. They were instructed to use several key SRL processes during their learning session (e.g., assess their emerging understanding [JOL]). Participants were randomly assigned to one of three instructional conditions: control, prompt, or prompt and feedback. During the 2-hour lesson session with MetaTutor, we collected the following data from each participant: concurrent think-alouds, eye-tracking, video recording of the face (for affect detection and classification), text log files (including in particular quiz results, summaries and metacognitive judgments) and notes and drawings. We also collected pretest and posttest data and several self-report measures on agent likeability and metacognitive knowledge about specific SRL processes. Our results will focus on describing, using multiple-level trace data, participants' self-regulatory behaviors and how they are related to learning outcomes. For example, micro-level data provides information on: (1) fluctuations in affect, (2) eye-tracking processes, and (3) log-file data which details the duration and sequencing of specific behaviors. Mid-level data (1) represents learners' accuracy in making metacognitive judgments; (2) provides information on the deployment of cognitive and metacognitive processes from the concurrent think-aloud protocols; (3) illustrates their emotion regulation during

different phases of learning; (4) provides information on their regulatory processes associated with adaptive changes during the learning session; (5) reveals their knowledge integration across representations of information; and, (6) exemplifies changes in their self-regulatory processes based on learner-agents dialogue moves. Macro-level data provides information on changes in students' learning based on their pretest-posttest scores. The data sources will provide evidence that has the potential to advance current conceptual, theoretical, methodological, and analytical frameworks related to SRL processes. These advances will in turn allow researchers to design more effective multi-agent learning environments that are sensitive and responsive to students' CAM needs during learning.

## *Process Mining Techniques for Analysing Patterns and Strategies in Students' Self-Regulated Learning*

Bannert, Maria; Reimann, Peter

Referring to research on self-regulation in individual learning (Boekaerts, Pintrich & Zeidner, 2000; Efklides, 2008) we see individual regulation as a set and specific sequence of regulatory activities which have to be performed. Ideally, successful students perform different regulatory activities such as analyzing, planning, monitoring and evaluating cognitive and motivational aspects during learning. Research of self-regulated learning reveals that many learners have difficulties in performing these activities spontaneously which most probably results in lower learning outcomes (Azevedo, 2005; Bannert, 2009; Veenman, 1993). Whereas most research has concentrated on frequency analysis, so far little is known about the student's processes of self-regulation. Thus, the aim of our presentation is to explore the temporal order of spontaneous individual regulation during a computer-based learning task. In our empirical study 38 university students participated. The students' task was to learn the basic concepts and principles of operant conditioning within 35 minutes. Students were completely free in navigation, however they had to read and think aloud during their learning sessions, which were videotaped. Immediately afterwards learning outcome was obtained on different levels (recall, knowledge, transfer). The think aloud data were coded post-hoc via a coding scheme derived from Bannert (2007) which includes analyzing, planning, monitoring and evaluation activities. By means of frequency analysis we found that students with higher percentage of regulation activities during computer-based learning received higher knowledge acquisition scores at the end of learning. This finding confirms the basic assumption of self-regulated learning theory which postulates a significant impact of regulatory activities during learning on actual learning performance. In this presentation, we will analyse the data more precisely by taking the temporal order of individual regulatory activities into account. Goal of these process analyses of self-regulation is to

gain insight whether successful and less successful students differ in their regulatory activities and how students could be scaffolded.

## *Helping Students Develop Metacognitive Processes in a Choice-Rich Science Learning Environment*

Biswas, Gautam; Kinnebrew, John S.; Segedy, James R.

This paper discusses how middle school students learn about science topics (e.g., climate change, thermoregulation) in a choice-rich open-ended computer environment as they teach a virtual agent that they create. The learning and teaching task combines reading and understanding a set of hypertext resources with constructing a causal map that accurately models the science phenomena. The open-ended nature of this task requires students to learn, teach, and monitor their teaching, which presents significant challenges for middle school students. We have developed a combined cognitive and metacognitive model that models desired learning activities and learning strategies like planning, monitoring, and targeted reading that students need to perform to achieve success in their teaching and learning tasks. To help students navigate their difficult tasks and to help them learn appropriate strategies, a mentor agent provides feedback and strategy advice that helps students acquire the relevant strategy information in a timely manner. We examine students' learning activity traces from a recent study with the learning by teaching system. In particular, the analysis employs learning activity trace analysis to compare learning behaviors of students who achieved success with those who struggled to complete their causal maps. This analysis focuses on students' actions and strategies leading to changes in their causal maps. We further analyze which actions led students to make correct versus incorrect changes to their causal map. The results of this analysis suggest future directions in the design of feedback and support for similarly complex, choice-rich learning tasks.

## *Supporting Metacognitive Processes in Medical Reasoning using Technology*

Lajoie, Susanne P.; Naismith, Laura; Poitras, Eric

Current models of SRL (Azevedo et al., 2010; Boekaerts, 1997; Pintrich, 2000; Winne, 2001; Zimmerman, 2000) situate students' regulation of their cognition, behavior, affect, and environment within disciplinary-based practices. In this paper, we outline constructs that account for how medical students monitor and adaptively control the cognitive and affective processes that mediate diagnostic reasoning processes and outcomes in the context of BioWorld (Lajoie, 2009), a technology rich environment in which students diagnose virtual patient cases. We discuss the methodological and analytical approaches used to draw inferences in relation to how novices become more

proficient in regulating such processes. Data were collected and analyzed from 47 medical students and 5 physicians through log-file entries, screen captures, and think-aloud protocols. Data were analyzed by comparing how novices and experts selected, prioritized, and summarized evidence pertaining to their final diagnoses. When diagnosing cases in BioWorld, novices were found to become more proficient over time in solving cases and more self-regulatory in their use of evidence to support their diagnoses. Using sequential pattern mining techniques, we analyzed several indicators of metacognitive and self-regulatory processes and their effect on diagnostic processes and outcomes. This data provides insights into the role that technology plays in facilitating self-regulation.

## S5 MATH AND METACOGNITION AMONG YOUNG CHILDREN: DO INTERVENTIONS REALLY HELP?

Organizers: *Shamir, Adina; Mevarech, R. Zemira*
Discussant: *David, Whitebread*

In the context of lifelong learning, mathematical knowledge is a crucial competence. The literature on the teaching of Math over the past twenty years indicates that promoting students' metacognitive skills is effective for improving children's math skills (Veenman, Van Hout-Wolters & Afflerbach, 2006). Despite these investigations, inconsistent findings have been obtained to date regarding the age at which young children can activate meta-cognitive processes (e.g., Shamir, Mevarech & Gida, 2009). Further investigation of when, how and in within which content area young children's metacognition can be enhanced is therefore needed. The purpose of the proposed symposium is to shed light on these issues. To do so it will serve as a platform for the presentation of several studies aimed at promoting young children's (aged 5-10) Math by means of metacognitive interventions.

### *How and to what extent can children's metacognition be enhanced during mathematics problem solving?*

Mevarech, Zemira R.; Hillel, Mor

Although much research has focused on the development of metacognition in young children, there is still much disagreement on the extent to which kindergarten children can implement metacognitive processes during problem solving. Recent studies indicated that even children at the age of 3-5 years can articulate the way they carry out metacognitive processes in various situations, including mathematics problem solving. These findings raise the question of the extent to which appropriate intervention can improve children's metacognition. The present study was designed to address this issue.

In particular, the purpose of this study was twofold: (a) to design an intervention for kindergarten children that would facilitate their mathematical skills; and (b) to examine the effects of the intervention on children's metacognition and mathematical problem solving. Participants were 49 kindergarten children (age 4-5 years old) who studied in two Israeli kindergartens. Both kindergartens studied the mathematical operation "division" for the same duration of time. Children were first introduced to the general concept of division, then to division into two equal groups, and finally to division into two equal groups with a reminder. Intact kindergarten classrooms were randomly assigned into one of two interventions: one was exposed to IMPROVE (N = 24) and the other (N = 25) to traditional instruction. IMPROVE is a metacognitive instructional method that trains children to address four kinds of self-addressed metacognitive questions: comprehension (e.g., what is the problem all about?), connection (e.g., how is the problem at hand similar to or different from the problems solved in the past? Why?), strategy (what strategy I plan to use in solving the problem? Why?), and reflection question (e.g., does the solution make sense? can I solve the problem differently? Why?). Children were encouraged to plan ahead the solution process and describe their planning activities. The findings indicate that although the two kindergarten groups scored similarly on mathematics achievement prior to the beginning of the study, the IMPROVE children outperformed the control group on planning. In addition, the IMPROVE children were better able to articulate their metacognitive thoughts and were also better able to make generalizations and justify their reasoning than the control children. No significant differences, however, were found between boys and girls, but as expected significant differences were found between the four and five year old children on all variables. The study has both theoretical and practical implications that will be discussed at the conference.

## *Educational E-book with and without metacognitive guidance for supporting emergent literacy and early math of preschool children at risk for learning disabilities*

Shamir, Adina; Lifshitz, Irit; Baruch, Dorit; Goren, Ilana

Today the growing introduction of computer programs such as electronic book (e-books) into the learning environment of kindergartens provides ample opportunities for computer use to support of children's development. E-books that usually includes multimedia effects, (eg., written text, oral reading, oral discourse, music and animations) have been found to support young children emergent literacy (Shamir, Korat & Barbi, 2009). However, the literature about young children at risk is in its infancy (Zucker, Moody & McKenna, 2009). Given that metacognitive thinking affects children's learning achievements in subjects such as reading and arithmetic (eg., Veenman, Van Hout-Wolters & Afflerbach, 2006) we were encouraged to explore whether preschool children at risk for LD can also benefit from metacognitive guidance. In the current

study therefore, we investigated the effects activity with an educational e-book with Math content on the emergent literacy and early math of kindergarteners at risk of LD. Seventy-seven kindergartners aged 4.5-7.0 years participated in the study. The subjects were randomly divided into three groups: a) e-book with metacognitive guidance (N = 26), b) e-book without metacognitive guidance (N = 25), and C) regular kindergarten activities (control) (N = 26). Children's Essence of Numbers and rhyming level were examined pre-and post the intervention. The findings indicate a significant improvement in Essence of Numbers and rhyming among the two experimental groups compared to the control group. The greatest improvement in rhyming was found in the group that received metacognitive guidance. However, the group that received metacognitive guidance did not exhibit greater improvement in Essense of Numbers than the other experimental group. The findings will be discussed at the symposium.

## *Creating supportive learning environments at primary school. Development and evaluation of teaching materials to foster self-regulated learning and mathematic achievement in regular mathematics lessons*

Perels, Franziska; Leidinger, Manuela

The aim of the study was to improve self-regulated learning in regular mathematic classes at primary school. According to Zimmerman's self-regulation model (2000), self-regulated learning was depicted by particular components such as task analysis, self-motivation beliefs, self-control, self-observation, self-judgement, and self-reaction. With respect to these components, particular strategies were focused to develop teaching materials which were implemented into regular mathematics lessons. In the framework of the study a quasi-experimental control-group design combined with a time-series design was implemented. Thereby, two groups were involved: an experimental group, which was trained in self-regulated learning strategies and also asked to fill out a learning diary as part of the training (experimental group), and a group without training or diary (control group). Altogether, the study was conducted with 151 fourth graders (mean age = 9.26, SD = 0.55; female 49.70 %). For a period of six weeks the students in the experimental group received a training referring to the abovementioned components of the process model of self-regulation (Zimmerman, 2000). Within the framework of this training, students had to work on several teaching materials during regular classes. These materials were instructed by the teachers. The intervention was evaluated longitudinally by using standardised self-regulation questionnaires as well as a standardised mathematic test (DEMAT 3+). The questionnaire consisted of 49 items and showed satisfactory reliability coefficients (Cronbach's $\alpha > .60$). In order to measure individual data, the students of the experimental group were also asked to fill out paper-pencil diaries for a period of six weeks. The diary was to fill out before and after doing homework. Regarding

split-half reliability of the learning diary (odd-even coefficient), all variables correlated highly significantly ($p = .00$). By the results of the pretest-posttest evaluation, it could be pointed out that for the experimental group compared to the control group the overall scale self-regulated learning increased in the expected direction ($F(1,149) = 5.54$, $p < .05$). Regarding the mathematical competencies, the results showed an enhancement for the experimental group ($t = -5.29$; $p < .05$) as well as for the control group ($t = -4.53$, $p < .05$). As the students of the experimental group showed higher improvement in their mathematic achievement in the pre-/posttest, it could be pointed out, that they benefited from training their self-regulatory abilities during regular classes. Furthermore, interrupted time series analyses revealed significant training effects on the level of process data (e.g., motivation). In summary, the developed teaching materials were successfully implemented in the regular classroom situation and were beneficial with regard to fourth grade students' self-regulated learning as well as to their mathematical achievement.

## S6 STUDYING THE QUALITY OF SELF-REGULATION SUPPORT IN TECHNOLOGY BASED LEARNING

Organisers: *Kramarski, Bracha; Narciss, Susanne*
Discussant: *Azevedo, Roger*

In modern societies learners need to be proficient in self-regulated learning (SRL). Thus, a major concern of school educators is how teachers and students acquire expertise to positively develop their SRL in technology based learning. Our symposium addresses this issue with four presentations:

- Zehavit Kohen and Bracha Kramarski's study investigated effects of the unique TPCK-SRL model for supporting preservice teachers self regulation for infusing technology in a pedagogical context.
- Michalsky's study attempted to promote mathematics preservice teachers' recognition and categorization of videocases of classroom SRL events by analyzing both teachers' and students' behavior.
- Kapp, Narciss, Proske and Koerndle investigate how interactive learning questions affect learners' cognitive and metacognitive activities in web-based learning.
- Wachsmuth and Bannert developed and evaluated a hypermedia learning environment with metacognitive prompts for ADHD-students.

Roger Azevedo will discuss the implications of these studies for further research and practice.

## *Developing SRL in TPCK context (TPCK-SRL) in a video-digital microteaching program*

Kohen, Zehavit; Kramarski, Bracha

TPCK – Technological Pedagogical Content Knowledge is an extended conceptual framework of Shulman's (1987) term of PCK, claiming that knowledge of technology (T) in the context of teaching should be an integral part of a teacher's professional knowledge. There are some approaches in training TPCK. The transformative approach (Angeli & Valanides, 2009) suggests targeting TPCK exclusively as a distinct, unique body of teacher knowledge that can be developed and assessed. These researchers recommend explicit actions for infusing technology into the required content using student-centered learning pedagogies. The TPCK-SRL approach (Kramarski & Michalsky, 2009, 2010) recommends focusing on teachers' SRL as a springboard for comprehensively and systematically integrating all three knowledge components (T, P, and C) simultaneously into one single, distinct body of knowledge. SRL allows teachers to think about a technique or experience within each component, assimilate it, relate it to other components, and take action to change or adapt it to each component's goal, thus giving further leverage to the transformative approach's conceptualization of TPCK. Our study focused on two questions: (1) How can pre-service teachers' TPCK-SRL, be promoted?; and (2) how TPCK-SRL can be assessed while conducting a video-digital microteaching lesson? Participants included 89 pre-service teachers who were randomly assigned to one of two TPCK groups in a video-digital microteaching course (28 h), with SRL support (TPCK+SRL) and without SRL support (TPCK). Both groups were exposed in a WBLe for TPCK conceptual framework, video cases examples of lessons and forum discussions about the implementing lessons. Both groups were prompted to "think about" infusing technology in their lessons in different ways. The TPCK group was prompted with the "what" question (e.g., what is the goal?), whereas the TPCK+SRL group was prompted with the SRL "what, how, when and why" questions. Lessons were videotaped and analyzed with the TPCK-SRL scheme built for this study (Kohen & Kramarski, in press). The scheme allows to map SRL considerations (what, how, when, and why) and decisions about integrating the three knowledge components (T, P, and C). Scores varied from 1 to 3 (why justifications). For example: "The teacher shows an interactive simulation that illustrates the smoke's path in the body, straight to the lungs" (Score 3; using clear why consideration). Findings indicated that the TPCK+SRL group demonstrated in their lessons frequent use of high considerations of SRL which referred to what, how, when, and why to infuse technology for pedagogical uses, comparing to the TPCK group who demonstrated frequent use of low considerations of SRL, such as what technology tool to use in teaching. Qualitative analysis on two teachers selected randomly from each group (i.e., one from each group) illustrated the differences on the TPCK-SRL development in each group.

## *Promoting preservice teachers' capacity to teach self-regulated learning through analysis of both teachers' and students' behavior*

Michalsky, Tova

A major concern of teacher educators is how teachers acquire expertise to positively develop students' self-regulated learning (SRL). Accordingly, teachers are asked to understand the role of SRL in their pedagogical content knowledge, to plan materials and strategies for infusing SRL into lessons, and finally to reflect on their actions and decisions in order to evaluate goals, processes, and efforts (Putnam & Borko, 2000). However, research findings suggest that SRL is difficult to attain by preservice teachers (e.g., Perry et al., 2007; Kramarski & Michalsky, 2010), who lack experience in producing knowledge in new situations and who lack skills as analytical competency practitioners (Schön, 1995). Methods of digital video case-based learning are considered to have great potential for promoting reflective and problem-solving abilities as well as other higher level cognitive competencies related to analytical competency (e.g., Lundeberg, 1999). This study attempted to promote teachers' recognition and categorization of classroom SRL events by analyzing both teachers' and students' behavior. Preservice mathematics teachers (N = 132) analyzed three videotaped, authentic, mathematics-teaching vignettes in three groups. The "fully-supported" group had access to an edited clip explicitly focusing on reciprocal teacher-student interactions, and to two separate close-up clips of teachers and students. The "partially-supported" group had access to an unedited wide-angle whole-class clip and the two close-up clips (teacher, students). The control group had access only to the whole-class clip. All groups used digitized interface for viewing, and all received a rubric for categorizing the SRL events' three components (cognition, metacognition, and motivation). Results indicated that fully-supported preservice teachers improved more in their actual teaching of SRL strategies and in their actual arrangement of SRL environments, compared to the other two groups. The control group remained lowest. The current study reinterprets the instructional-reflective framework of teacher education programs to include explicit focus on the reciprocal interactions between teachers and students that lead to SRL behavior, as means of developing preservice teachers' capacity to promote students' SRL.

## *Impact of interactive learning questions on SRL with a web-based learning environment*

Kapp, Felix; Narciss, Susanne; Proske, Antje; Koerndle, Hermann

This paper investigates how interactive learning questions can support learners in coping with the self-regulation demands they have to face in web-based learning. Interactive learning questions are learning tasks which require students to perform a

series of cognitive processes and actions in order to respond to a question or a problem. According to Proske, Narciss and Koerndle (2012), learning tasks may foster learners' active engagement in knowledge construction on a cognitive as well as on a metacognitive level. On the cognitive level they may for example stimulate cognitive processes necessary for understanding the information presented by the Web-LE. On the metacognitive level they may serve as cues for self-regulation. In contrast to SRL-prompts or other direct means of SRL-support, learning questions are related to the knowledge domain represented by the Web-LE. They may attract learners' attention to specific aspects of the domain to be learnt and serve as a basis for monitoring and self-evaluation. Therefore feedback is playing an essential role. The advantages of learning questions are thus twofold: First, by guiding the learners through a necessary set of cognitive operations the construction of a valid mental model is fostered. Second, metacognitive information on the learning process is provided to the learners (Proske et al., 2012). Based on these theoretical assumptions we consider interactive learning questions as tools which have great potential for fostering successful self-regulated learning. To illustrate our theoretical assumptions we present results of an online study comparing a CBLE on the topic "Berlin Wall" with interactive learning questions (experimental group: N = 23) to a version without learning questions (control group: N = 25). We analyzed learning achievement and process data regarding the two research questions: 1) Do interactive learning questions have a positive effect on achievement in a computer-based learning environment and 2) Which cognitive and metacognitive processes are linked to different learning outcomes. Furthermore we investigated if the learning effect is reduced to parts of the knowledge domain explicitly covered by the learning questions. The experimental group ($M = 7.6$, $SD = 1.8$) outperformed the control group ($M = 6.3$, $SD = 2.2$) in the post knowledge test ($t(46) = 2.14$, $p < .04$, $d = .6$). The results of this study suggest that interactive learning questions support self-regulated learning. Interestingly, participants of the experimental group achieved in particular better results on those items of the knowledge test which were not addressed by learning questions during the SRL-phase. This finding attracts attention to the issue of how learning questions influence SRL on a metacognitive level.

## *Prompting AD(H)D students during hypermedia learning*

Wachsmuth, Claudia; Bannert, Maria

The main purpose of the study was to support ADHD students during hypermedia learning. More specifically the effects of metacognitive prompts during hypermedia learning of ADHD-students were investigated. Based on earlier research on metacognitive prompting (Bannert, 2009) and on a training programme for children with ADHD (Lauth & Schlottke, 2004), a computer assisted learning environment was developed. It included metacognitive prompts by which students were explicitly

instructed to conduct different metacognitive activities, e.g., making a plan, specifying learning goals etc. It was hypothesized that this support should activate student's repertoire of metacognitive knowledge and skills which should further enhance learning and transfer. To test this assumption an experimental pre-post-test design was used. The sample consisted of ADHD students of classes 7-9 of the HEBO private school Bonn. In a first session relevant covariates (e.g., prior knowledge, verbal intelligence, computer self-efficacy, retentiveness) were relevated by questionnaires. The second session started with an attention test. After that students of the experimental group (N = 24) learned about geography with metacognitive prompts. Students of the control group (N = 20) were not given metacognitive but design prompts which asked students to design different screen features for an optimal readability (e.g., colour of text or of background). Both groups were prompted four times within a thirty minutes learning session. The student's task was to learn about climate zones and how to interpret climate graphs. Students were completely free in navigation and student's logfiles were recorded. Immediately after the learning session learning outcome and transfer as well as motivation were obtained by questionnaire. Post hoc analysis showed no treatment effects according to students' prior knowledge, intelligence, verbal intelligence, computer self-efficacy, attention and verbal strategy knowledge. Against our assumption students of the experimental group showed neither better performance in knowledge of facts nor better transfer performance compared to the control group. Class specific analysis showed that control group students of class seven showed better learning performance instead. But regarding only classes eight and nine the experimental group show better transfer performance in tendency (effect size d = .46) than the students of the control group. These results are in line with another series of experiments where university students were supported by metacognitive prompts (Bannert & Mengelkamp, in press). Moreover logfile analysis revealed that those ADHS-students of the experimental group who did comply with the metacognitive prompts showed higher motivation and verbal intelligence compared to the prompt ignorers of this group. Possibilities of motivational incentive in combination with metacognitive prompts are discussed as one major implication for further investigation.

## S7 NEW RESEARCH AVENUES: METACOGNITION IN PROBLEM SOLVING AND REASONING

Organiser: *De Bruin, Anique*
Discussant: *van Gog, Tamara*

Metacognition research has strongly focused on verbal learning tasks, such as texts, key concepts, or foreign language word pairs. Recently, research has been directed at two novel, but educationally highly relevant domains, namely problem solving and reasoning. In this symposium, four presentations will provide and discuss data from different

studies in these domains. The first presentation concentrates on metacognitive judgments in reasoning tasks, also termed the "Feeling of Rightness" (Thompson). The final three presentations discuss work on problem solving. The first of these examines the hypothesis that learners use solution time as a metacognitive cue when judging problem solving performance (Ackerman). The second presentation addresses the illusion of explanatory depth, or the finding that metacognitive judgments drop when learners are asked to give causal explanations (Pieschl). The final presentation examines the effect of timing (immediate versus delayed) and self-testing on metacognitive judgments in worked examples (Baars). The discussant will synthesize the findings and elaborate on possible parallels and dissimilarities between metacognition research in problem solving and reasoning, compared to metacognition research on verbal learning tasks.

## *The role of response conflict in monitoring intuitions and promoting analytic thinking*

Thompson, Valerie

Although studied extensively in other domains, the role of metacognitive processes in reasoning have been relatively neglected. However, it is almost certain that they play the same kind of role as they do in other judgments: to provide a means to assess the output of one's cognitive processes and determine whether further action is needed. Thompson, Pennycook & Prowse Turner (2011) provided evidence for a model of metacognition and reasoning in which a metacognitive cue, called the Feeling of Rightness (FOR) accompanies the initial response to a reasoning problem. When fluently delivered, the FOR is strong, creating a compelling intuition that the initial response is correct. Thus, when the initial answer comes to mind quickly, the answer "feels right". Moreover, this intuition, or FOR, is the reasoner's cue to look no further afield for the answer rather than rethink it. In the current study, we examined a second variable that might contribute to the strength of the FOR, based on the work of De Neys and colleagues (e.g., De Neys & Glumicic, 2008). De Neys has proposed that reasoners monitor response conflict, e.g., when a response based on prior belief that conflicts with one based on a more appropriate cue, such as probability or logic. The presence of conflict is known to cue analytic engagement. Our goal was to show that analytic engagement is mediated by the strength of the FOR generated to an initial response. Participants (N = 123) completed four reasoning tasks having conflict and non-conflict versions of each problem. Using the paradigm developed by Thompson et al., participants gave two responses to each problem: a fast, intuitive response and a second, more considered response. They provided FOR judgments for each response and also completed a standard measure of cognitive capacity. Consistent with the hypothesis that participants are able to monitor conflict, we found that FOR judgments were higher for the non-

conflict than the conflict problems. That is, conflict apparently created a sense of unease, lowering FOR judgments. Measures of analytic engagement were also higher for conflict than non-conflict judgments; most importantly, this engagement was mediated by FOR judgments. We also observed that high and low IQ participants were equally good at monitoring conflict, that is, the FOR judgments for both groups were sensitive to conflict. However, the consequences of that sensitivity was different for the two groups: the higher IQ participants took longer rethinking their responses to the conflict than the no-conflict items and were similarly more likely to change their initial answers. This pattern was attenuated for the low IQ participants. Surprisingly, however, neither group benefited from their reconsiderations: participants were just as likely to change a wrong answer to a right one as vice versa. In future studies, we will examine manipulations that will increase the effectiveness of this rethinking time.

## *The blind way in which confidence in the correctness of problem solutions follows response time*

Ackerman, Rakefet

For answering a test question, people rely on their confidence in the correctness of the considered answer option when deciding whether to continue to invest more effort or provide this answer. Confidence is known to be sensitive to the fluency with which answers come to mind. One aspect of fluency is response time. The time it takes to come up with an answer is usually a valid predictor of accuracy and there is a negative correlation between them – correct answers tend to come to mind more quickly than incorrect answers, and confidence typically reflects this trend. The present study examined the independent sensitivity of confidence to fluency in problem solving by using tasks in which response time is absolutely not predictive, predictive in a medium level, or highly predictive of solution accuracy. In all tasks an emphasis was placed on using only natural testing procedures. The problems used in Experiment 1 were all misleading math problems, some of them taken from preparation booklets for the Graduate Management Admission Test (GMAT). All problems tended to elicit initial wrong solutions, but they all required only basic math knowledge, clearly available to the target population of undergraduates, for finding the correct solutions. Testing took place by free entry of the solutions for one group (N = 34) and by multiple-choice test format for the second group (N = 35). As expected, response time had absolutely no validity as a predictor of accuracy under the free entry format: prompt solutions had about the same chance of being correct as solutions produced after more thorough thought. Under a multiple-choice test format, response time predicted accuracy better. Despite this difference between the test formats, confidence was persistently sensitive to response time, showing a significant negative correlation, in both groups to the same extent. In Experiment 2, undergraduates (N = 28) faced non-misleading word problems

(compound remote associates) by free answer entry. Here response time was highly reliable in predicting accuracy with strong negative correlation between them. Confidence reflected this negative correlation almost perfectly and was highly reliable. However, breakdown into correct and wrong solutions allowed examination of the independent reliance of confidence on response time, because response time necessarily had absolutely no validity when all solutions were either correct or wrong. Confidence was persistently sensitive to response time even among correct only or wrong only solutions. The results suggest that when response time happens to be a reliable predictor of accuracy, confidence is reliable. No adjustment is made, however, for situations in which response time has no predictive value. The blind way in which confidence follows fluency should be taken into account by teachers and students alike who aim to develop reliable assessment of the chances of success in problem-solving tasks.

### *What influences judgments about one's own knowledge about complex systems?*

Pieschl, Stephanie; Hirschfeld, Gerrit; Bromme, Rainer

Accurately judging one's own knowledge is a prerequisite for challenging tasks like problem solving. Subjects initially overestimate their knowledge regarding complex systems (technical devices or natural phenomena). But when asked to give causal explanations, their metacognitive judgments drop systematically – an effect coined the "illusion of explanatory depth" (IOED, Rozenblit & Keil, 2002). This study explores how epistemic beliefs about the nature of knowledge are related to the IOED. Students (N = 60) answered questionnaires about their epistemic beliefs. Then they answered questionnaires about four complex systems (toasters, helicopters, X-ray machines, and rainbows): They gave Metacognitive Judgments (MK) about their own knowledge at three points of time (T1, T2, and T3). In-between T1 and T2 they generated causal explanations, for example about how a toaster works. In-between T2 and T3 they answered more specific questions. A repeated-measure MANOVA of the MKs showed a significant multivariate effect of time, that was univariately significant for toasters ($F(2,118) = 40.56$, $p < .001$, $\eta^2 = .41$) and rainbows ($F(2,118) = 35.16$, $p < .001$, $\eta^2 = .37$), with significant drops from T1 to T2 ( = drop 1) and from T2 to T3 ( = drop 2). Thus, we partly replicated the IOED effect. Additionally, we found effects of epistemic beliefs regarding rainbows: Beliefs in personal experience as justification for knowledge were associated with high MKs at T1 ($r = .34$, $p = .008$) and with high drops 1 ($r = .34$, $p = .008$). Furthermore, beliefs in questioning authorities (source of knowledge) were associated with high drops 2 ($r = .32$, $p = .012$). The epistemic beliefs core dimensions of sources and justification were significantly related to the IOED. Those who believe in personal experience as valid source for knowledge are more susceptible to an initial overestimation of their own knowledge and therefore might not consult experts even if needed. However, the same persons also flexibly adjust their

judgments when confronted with their lack of knowledge. This calls for more such experiences in educational contexts and indicates on a conceptual level that epistemic beliefs are indeed relevant for judgments about one's own knowledge. These results also contribute to the recent debate about using testimony from others as a way of coping with the division of cognitive labor. This study is part of an ongoing study series about IOEDs. In further studies we also investigated if the frame of reference (for whom the causal explanation was written) or if the domain of the complex phenomena are relevant for one's metacognitive judgments. These issues will also be addressed in this paper.

## *Using self-testing to improve monitoring accuracy when studying worked examples in primary education*

Baars, Martine; van Gog, Tamara; De Bruin, Anique; Paas, Fred

Research has shown that monitoring accuracy, measured by judgments of learning (JOLs) is important for self-regulated learning (e.g., Metcalfe, 2009). When learning from text, monitoring accuracy can be enhanced by generation instructions (e.g., Thiede et al., 2009). The present study extends the research on the effects of generation instructions on monitoring accuracy to a new field: acquiring problem-solving skills from worked examples (i.e., worked-out problem solutions). Self-testing after example study requires generation, and can be done either directly after studying a worked example (i.e., immediate self-test) or at a delay (i.e., delayed self-test). Because an immediate self-test involves retrieval of procedural information from working memory, whereas a delayed self-test mainly relies on retrieval of previously stored information from long-term memory, which is also required on the final test, it was expected that a delayed self-test would lead to higher JOL accuracy than an immediate self-test or no self-test. Primary school children (grade 5) studied 6 worked examples (WE) demonstrating how to solve water jug problems and gave JOLs either directly after studying a worked example (WE-JOL), after each immediate self-test (WE-self-test-JOL), or after each delayed self-test (WE-delayed self-test-JOL). Subsequently, they indicated which examples they would want to restudy and then took a test consisting of problems isomorphic to those explained in the worked examples. No significant difference between conditions in mean bias (i.e., overconfidence or underconfidence in JOLs compared to test performance) was found ($F(2,73) = 1.83$, $p = .17$). However, mean absolute accuracy of JOLs compared to test performance, regardless of the direction of the deviation, did differ between conditions ($F(2,73) = 3.07$, $p = .05$). Post-hoc tests showed that absolute accuracy was lower in the immediate self-test than in the delayed self-test condition ($t(51) = 2.31$, $p = .025$). Accuracy of restudy choices did not differ between conditions ($F(2,77) = 1.01$, $p = .37$). To conclude, in line with our expectation, the opportunity to take a delayed self-test seems to enhance monitoring accuracy compared to an immediate self-test. The difference with the no self-test

condition was not significant, however. Future research should follow up on this finding, and given that restudy accuracy did not differ between the conditions, future research should also investigate in more detail how restudy choices are related to monitoring when acquiring problem-solving skills from worked examples.

## S8 APPLIED EPISTEMIC BELIEFS IN READING AND EVALUATING MULTIPLE CONFLICTING INFORMATION SOURCES

Organiser: *Mason, Lucia*
Discussant: *Efklides, Anastasia*

This symposium deals with beliefs about knowledge and knowing, namely epistemic beliefs, when they are activated while reading and evaluating multiple information sources regarding scientific controversies. The symposium comprises a coherent set of empirical studies for a deeper understanding of the nature and role of epistemic beliefs, which can influence source reading and evaluation, but may also be influenced by these activities. Relevant theoretical and practical issues are addressed in the four contributions, which involve participants of different age levels, from ninth grade to teacher level. The variety of methodologies reported in the studies will highlight how different approaches can be used to investigate the impact of/on epistemic beliefs in the interaction with multiple sources in today's information-saturated contexts. The processes and products documented will be considered in the light of epistemic theory and research, with implications for instructional practice.

### *Profiles of epistemic beliefs and knowledge when reading multiple texts*

Ferguson, Leila E.; Anmarkrud, Øistein; Strømsø, Helge I.; Bråten, Ivar

Reading tasks involving multiple information sources may depend on readers' ability to judge the validity of knowledge claims, as well as their knowledge about the subject matter. Prior studies have demonstrated relationships between different dimensions of epistemic beliefs and multiple-text comprehension (Bråten, Britt, Strømsø & Rouet, 2011). In the present study we wanted to examine different profiles of justification beliefs (Greene, Azevedo & Torney-Purta, 2008) and knowledge in relation to multiple-text comprehension. We adopted a person-centred approach, allowing individual patterns of epistemic beliefs and knowledge to emerge from the data. Thus, we were able to investigate student profiles and study how different groups of students performed on tests of multiple-text comprehension. Participants were 220 Norwegian 11th-graders. Before reading, students' epistemic beliefs about science were assessed using an 18-item measure that captured three dimensions pertaining to ways in which students believe knowledge claims should be validated, specifically by personal justification, justification

by authority and justification by multiple sources. A 20-item multiple choice test was also administered to assess students' prior knowledge. Students read five authentic texts providing conflicting information on the health effects of sun exposure. After reading, participants answered short-essay questions designed to measure multiple text comprehension. We identified two meaningful clusters. A MANOVA with clusters as IV and epistemic beliefs and prior knowledge as DVs, indicated significant differences ($\eta^2 = .71$). Univariate analyses revealed that students in Cluster 1 (N = 131) achieved statistically significantly higher mean scores than students in Cluster 2 (N = 87) on prior knowledge (15.4 vs 10.7, $\eta^2 = .61$), justification by authority (7.8 vs 7.1, $\eta^2 = .05$) and justification by multiple sources (7.0 vs 5.8, $\eta^2 = .09$), whereas Cluster 1 had significantly lower scores than Cluster 2 on personal justification (3.2 vs 3.7, $\eta^2 = .04$). Regarding multiple text comprehension, a one-way ANOVA indicated that students in Cluster 1 achieved a statistically significantly higher score than students in Cluster 2 ($\eta^2 = .03$). The relationships identified in this study may be domain and/or task specific. However, our findings suggest that the specific configurations of students' epistemic beliefs and knowledge played a role in their comprehension of a complex scientific issue presented in multiple texts. High prior knowledge students seemed to believe more in the need to justify knowledge claims using authoritative sources of information and to corroborate multiple information sources, and less in validating knowledge claims by personal opinion than low prior knowledge students did.

## *The impact of differently affect-laden scientific discourse on recipients' epistemic assumptions and trustworthiness evaluations*

Kienhues, Dorothe; Bromme, Rainer

Scientific controversies are everyday routine in empirical sciences. They usually arise from a topic-inherent cognitive conflict underlying the controversy and not because opponents spoil for a fight, although they might involve conflicts between persons. In our studies, we focused on laypeople's cognitive processing of scientific controversies. We investigated how information about the emotional status of scientists involved in a scientific controversy impacted on lay understanding of the topic-inherent conflict at stake. Dependent variables included recipients' evaluation of experts' trustworthiness and recipients' epistemic assumptions regarding variability and structure of scientific evidence (pre-post comparison of the CAEB). In study 1 (N = 42, mean age 23.67 years), we compared the impact of a newspaper article where a discussion between experts (on the pros and cons of a fictitious anesthetic) was described as emotional and contentious with an article that did not contain information about the experts' emotionality. Results reveal that participants rated experts' trustworthiness significantly lower and perceived scientific evidence to be less variable and unstructured when experts' negative emotions were mentioned that when they were not (as indicated by repeated

measures ANOVAs for the CAEB factors). In study 2 (N = 50, mean age 22.16 years) we compared a newspaper article containing information about positive emotions in the discussion with one with no emotional information. Results did not show significant differences across the dependent variables, indicating that study one's results originate from the negativity of affect between the experts and not from emotionality as such. In study 3 (N = 44, mean age 22.80 years) we investigated whether different explanations provided for the contentious emotions in study 1 might alter the effects found in study 1: A focus on the topic-inherence of scientific controversies (group 1), in comparison to a focus on experts' irascible and pejorative discussion behavior and thereby negative emotionality (group 2), helped participants to consider the scientific conflict as "truly there":participants in group 1 perceived scientific evidence to be significantly less variable and unstructured; there were no effects on trustworthiness. We will discuss implications of our studies (and thereby of research on epistemic beliefs and related constructs) for laypeople's understanding of scientific controversies with a focus on the understanding needed to be active members of our knowledge society. The results of our studies furthermore suggest recommendations for communicating scientific controversies.

## *The relationship between epistemic beliefs and systemic thinking in biology: Differences in epistemic judgments of German primary and secondary school teachers*

Stahl, Elmar; Kramer, Tim; Rieß, Werner

Systemic thinking and the qualification to teach systemic thinking should be a basic competence of (German) biology teachers, e.g., in the context of education for sustainable development. Dealing with different (biological) systems requires to deal with highly complex contents, interdependency of elements, and controversial information. Therefore, it requires to accept non-linearity, uncertainty and – to a certain degree – unpredictability. For this reason, we assume that teachers' competence of systemic thinking and the competence to teach systemic thinking should interact with their personal epistemic beliefs. Further on, we assume that such complex biological systems present a reasonable field to examine applied epistemic beliefs in more detail. In an interdisciplinary research project, sponsored by the German Federal Ministry of Education and Research, we aim to develop didactical concepts how to teach systemic thinking and education for sustainable development. Within this project sophisticated epistemic beliefs are seen as an important prerequisite of systemic thinking and therefore as an explicit part that has to be considered in the didactical concepts. In a first phase of the project we examine epistemic judgments of biology teachers working in different German primary and secondary school types (Gymnasium, Realschule, Hauptschule, Grundschule) in the context of systemic thinking. As theoretical background we use the idea of a generative nature of epistemic judgments presented by Bromme, Kienhues & Stahl (2008) and Stahl (2011). We are especially interested to understand how the

teachers justify their epistemic judgments and whether systemic differences in the justifications can be found in relation to the school types. In a first step (qualitative research) we used a semi-structured interview and asked teachers to judge statements and dilemmas dealing with complex and controversial issues concerning biological systems (N = 21). Further on we examined how important the teachers judged systemic thinking and epistemic beliefs for their own lessons. In the next step (quantitative research) we will refine the interview and transform it into an internet-based questionnaire based on a conjoint-analysis (planned: N = 200). First results show differences between the groups of teachers in their epistemic judgments in relations to the school type – especially concerning the types of arguments that the teachers used to justify their epistemic judgments. Conclusions on their epistemic beliefs, the stability/ flexibility of epistemic beliefs and therefore the definition of "sophisticated epistemic beliefs" will be drawn. Furthermore, recommendations for teachers training and education in the field of systemic thinking and education for sustainable development are discussed.

## *Effects of a short-term intervention on epistemic evaluation of web-sources on controversial topics*

Mason, Lucia; Junyent, Andrea A.; Tornatora, Maria Caterina

Effectively accessing and using Internet-based material for academic assignments is not only a question of formulating efficient search queries and applying appropriate reading strategies (Rouet & Coutelet, 2008; Walraven, Brand-Gruwel & Boshuizen, 2009). It is also a question of evaluating the authoritativeness of Web sources and the veracity of information offered (Brand-Gruwel, Wopereis & Walraven, 2009; Hofer, 2004; Mason, Boldrin & Ariasi, 2010). Research, however, has documented that when judging the credibility of an electronic resource, students might not take into account its authority (Clark & Slotta, 2000), and may rely on naïve criteria (Mason, Ariasi & Boldrin, 2011), or express more evaluative judgments only when prompted (Gerjets, Kammerer & Werner, 2011). This study aims to extend current research by focusing on the effectiveness of a short-term instructional intervention on how to evaluate the reliability of online sources (Wiley et al., 2009). The study involved 150 9th graders (F = 75, mean age = 14.8), randomly assigned to the instruction or no-instruction group. The instruction group received information about critical aspects to be considered when evaluating the reliability of a website. Both groups were given the same multiple Internet sources on two controversial topics: the potential health risks of mobile phones and genetically modified food. The online sources varied for authoritativeness and stance. At pretest, data were collected about reading comprehension ability, prior knowledge of the topics, epistemic beliefs regarding scientific knowledge, and personal position on the topics. There were no statistically significant differences for these individual

characteristics between the two groups of participants. At posttest, data were collected about the time spent on each site and sequence of visits during the navigation, reliability ranking of each site, justifications for reliability judgments, and learning as revealed by a sentence-verification task and written essays. Quantitative analyses revealed that the instruction group performed better regarding the time spent on some websites and reliability ranking for both topics. In addition, the instruction group learned more about the topic of genetically modified food. Qualitative analyses showed that instruction group appealed to more sophisticated epistemic criteria in source evaluation about both topics and produced better arguments in the written essays regarding genetically modified food. The study provides evidence that the crucial ability of epistemic evaluation of sources may improve significantly after a short-term instructional intervention, which is both feasible and economical. These are two important features for its application in the real learning context of the classroom. Education can therefore be powerful in developing the ability of epistemic evaluation, which can help learners become sophisticated consumers of information in the digital era.

## S9 THEORY OF MIND BETWEEN RELATIONSHIPS AND SOCIAL NORMS

Organiser: *Marchetti, Antonella*
Discussant: *Ajello, Anna Maria*

The psychological literature shows an on-going debate about the relationship between Metacognition and Theory of Mind – ToM. ToM, which is recognised in its more explicit components as a cognitive tool and in its more implicit ones as an affective tool, has a social and relational valence, as it allows to take part to social interactions efficently (Antonietti et al., 2006; Liverta-Sempio & Marchetti, 2001; Marchetti & Massaro, 2002). The aim of this Symposium is to focus on the role of ToM between relations and social norms, to highlight the adaptive value of this competence in social life. Two contributions will focus on the role of ToM development in the relationships within different contexts: peers at school (Caputi et al.) and significant family caregivers (Petrocchi et al.), and on its links with other abilities, respectively prosocial behaviour and interpersonal trust. The other two contributions will try to point out the role of ToM in the understanding of implicit emotions (Freeman) and of social norms and expectations for decision-making (Bicchieri et al.), which are crucial to become effective members of the society we live in.

## *Social norms and expectations about fairness: evidence from children and adults*

Bicchieri, Cristina; Castelli, Ilaria; Chavez, Alex; Massaro, Davide; Marchetti, Antonella

Theory of Mind (ToM) has come to be considered a prerequisite for decision-making in strategic games involving monetary exchanges (Marchetti et al., 2011). One of the most commonly used games is the Ultimatum Game (UG): a proposer (P) makes an offer about the division of an amount of money and a responder (R) decides to accept (both P and R earn something) or to refuse (both P and R earn nothing). Behavior in the UG systematically contradict the predictions of classical economic theories; in fact, generous and often equal splits are proposed by P and offers around 20% of the amount are rejected by R half of the time. In social interactions involving money, payoff maximization is not the only motive. People also care about reducing inequality or obeying norms of fairness (Bicchieri, 2006). Following a norm, in particular, depends upon the expectations that people have about other people's compliance with the norm, as well as their normative expectation that the norm ought to be obeyed. Behavior in the UG can be explained referring to what players expect others to do (empirical expectations) and what they believe others think ought to be done (normative expectations). Research on adults and on children examined whether manipulating expectations about fairness norms through informational asymmetries about the offers available to P in the UG leads to behavioral changes. Specifically, three modified UG (possible choices: 5-5, 8-2, coin flip) were administered in different conditions: 1) Full Information (FI): P and R knew about the coin flip; 2) Private Information (PI): only P knew about the coin flip; 3) Limited Information (LI): R did not know whether a coin was flipped, and its outcome. Questionnaires were submitted to test P's beliefs about fairness (salient condition for half of P) and P's and R's normative expectations (all P and R). Children were tested on ToM through classical false belief tasks to understand its role when the understanding of informational asymmetries is crucial for a decision. P and R show a degree of agreement in their beliefs about fairness, but when a norm can have several interpretations, they tend to choose the interpretation that best serves their interests. Moreover, when normative expectations about fairness are present but there are no sanctions, so that such expectations can be violated at no cost, adults as well as children evade the norm, since the victim will not be able to distinguish an intentional action from a chance event. Finally, what makes children's decisions similar to adults' is their level of ToM, i.e., the ability to optimize the management of the perspectives of P and R.

## *Longitudinal effects of Theory of Mind on later peer relations: The role of prosocial behaviour*

Caputi, Marcella; Lecce, Serena; Pagnin, Adriano; Banerjee, Robin

Theory of mind refers to the ability to recognize the existence of mental states and to predict and explain social behavior on the basis of these mental states. In the present paper, we investigated whether and how individual differences in children's theory of mind predict later children's relationships with peers. More precisely, we examined the role of prosocial behaviour in mediating the association between early theory of mind and later peer relationships.The study of the relation between children's theory of mind and their social interactions represents a hot topic in developmental psychology. Despite the progress in theoretical and empirical works, existing literature on theory of mind and social relationships is at present rather limited and far from conclusive. Studies on typically developing children are relatively few in number, and we are only just beginning to piece together the connections between social cognition and social relations. The present study had two main hypotheses, based on our theoretical formulation. First, we expected to find a longitudinal association between early theory of mind and later peer relationships, independently of the role of verbal ability. Second, we hypothesized indirect paths from early theory of mind to subsequent peer relationships, via differences in prosocial behaviour. Crucially, we investigated these associations between children's theory of mind, prosocial behaviour, and peer relationships using a longitudinal design. We followed 70 children across the transition to primary school. At Time 1 (age 5), Time 2 (age 6), and Time 3 (age 7), children were individually assessed on their theory of mind, prosocial behaviour, and verbal ability. In addition, at Time 2 and at Time 3, we gathered peer nominations in the classrooms. The analyses revealed that individual differences in children's early theory of mind significantly predict later prosocial behaviour. In addition, children's prosocial behaviour at age 6 significantly predict later peer relationships. Thus, children who showed higher prosocial behaviour in the first year of primary school were more likely to be accepted (and less rejected) by their classmates one year later. Furthermore, cross-lagged analyses revealed that prosocial behaviour mediates the relationship between theory of mind and peer rejection and that prosocial behaviour and theory of mind both contribute to predicting peer acceptance. In view of the fact that poor peer relations during childhood are implicated in the etiology of later deviance (Hoglund et al., 2008), our study may provide an impetus to the efforts of researchers and practitioners focusing on intervention and training to enhance theory-of-mind skills and thereby promote more positive social behaviours and peer relationships.

## *Young children thinking about emotions in context*

FREEMAN, NORMAN H.

Having an emotional life is not just a matter of experiencing emotions but of having thoughts about the emotions and about their contexts. We ran structured interview with 6-year-olds about how they thought that their family expressed emotions. We then tested the child's understanding of implicit emotions in age-appropriate stories. The two were linked, explaining 29% of the story-test variance. Another 11% was explained by a family-structure social variable previously identified as affecting theory-of-mind development. The role of social norms is discussed.

## *The relation between children's Theory of Mind and trust beliefs in parents*

PETROCCHI, SERENA; LECCISO, FLAVIA; MARCHETTI, ANTONELLA; ROTENBERG, KEN J.

The study examined the relation between children's theory of mind (ToM; Wimmer & Perner, 1983) and their trust beliefs in parents. The latter was conceptualized with respect to Rotenberg's (2010) BDT framework as reliability, emotional, honesty trust beliefs in a familiar and specific target (i.e., parents). Two principles guided the research hypotheses. First, children's general trust in parents is regarded as part of Internal Working Model of a secure attachment and research has shown that such an IWM is associated with ToM (Sharp & Fonagy, 2008). Second, children's emotional trust in parents is an index of the emotional climate of the family which would promote emotional discourse. Researchers have found that emotional discourse is associated with, and longitudinally predicts, ToM development (Dunn, Brown & Beardsall, 1991; Ruffman, Slade & Crowe, 2002). It was hypothesized that children's ToM abilities would be associated with their trust beliefs in their caregivers but specifically with their emotional trust in parents as a latent variable representing emotional climate of the family. One hundred and sixty-eight children (79 boys) from 8 years to 11 years–5 months (M = 9 years-6 months, SD = 7 months) completed the: Italian version of the Children's Generalized Trust Beliefs Scale – ICGTBS – (Rotenberg et al., 2005) to evaluate trust beliefs; Look and Say Prediction (Liverta Sempio et al., 2005) to assess the understanding of second-order false belief; Strange Stories (White, Hill, Happè & Frith, 2009) to assess advanced ToM skill. There were significant correlations ($r > .16$, $p < .05$, dfs from 158 to 166) between children's general trust beliefs in parents and ToM scores. The SEM confirmed the hypothesized path between ToM ability and the latent variable concerning children's emotional trust beliefs in parents as an index of family emotional climate, $\div^2(7) = 4.03$, $p = .78$, CFI = 1, RMSEA = 0. The findings yielded support for the two hypotheses. As expected, children's ToM abilities were associated with trust beliefs in their caregivers. Also, the findings confirmed that children's ToM abilities were associated with their emotional trust in parents as a latent variable representing

emotional climate of the family. When the quality of emotional climate is high, as opposed to low, relations are nonthreatening and supportive of the disclosure of personal information. Family members can share each other personal details and talk about emotions and those extended conversational exchanges promote ToM reasoning. The findings yielded unique insight into the role that children's trust beliefs in parents could contribute to their theory of mind and underline the protective role of the primary educational environment.

## S10 METACOGNITIVE ACTIVITY OF GROUPS IN COLLABORATIVE LEARNING

Organisers: *Iiskala, Tuike; Molenaar, Inge*
Discussant: *Perry, Nancy*

This symposium aims to contribute to the still scarce evidence of metacognitive activity of groups in collaborative learning. The need for exploring the topic is based on the view that a group's collaborative learning differs from an individual's solo learning (see Iiskala, Vauras & Lehtinen, 2004; Iiskala, Vauras, Lehtinen & Salonen, 2011; Molenaar, van Boxtel & Sleegers, 2010; Vauras, Iiskala, Kajamies, Kinnunen & Lehtinen, 2003). The symposium presents recent evidence of metacognitive activity during groups' collaborative learning. Pino-Pasternak and Whitebread explore the relationship between social forms of regulation, quality of dialogue and conceptual understanding in groups' collaborative problem-solving. Meier and Vogt analyze metacognitive activity when students work as teams in an inquiry based science education. Molenaar, van Boxtel and Sleegers examine the interaction of students around metacognitive activities and the effects of scaffolding on this collaboration. Iiskala, Lehtinen and Vauras focus on an in-depth analysis of socially shared metacognitive regulation during a small group's computer-supported collaborative learning process. The discussant Nancy Perry will provide comments on the studies and will take a view of research on metacognitive activity in collaborative learning.

### *Exploring relationships between social forms of regulation during group work, dialogue quality, and conceptual understanding: The case of Year 1 students in the UK*

Pino-Pasternak, Deborah; Whitebread, David

Research concerning the quality of students' group-work has identified successful collaborative processes as those characterised by the presence of mutual regulatory exchanges between members that attempt to achieve a shared understanding of the goals and contents of the tasks at hand (King, 1998; Goos et al., 2002; Volet et al., 2009). The value of these transactional and mutually regulated processes has been highlighted by researchers within the self-regulation literature (Iiskala et al., 2011; Rogat &

Linnenbrink-Garcia, 2011; Vauras et al., 2003) as well as by those investigating forms of group dialogue and collaboration that lead to positive academic outcomes (Howe et al., 2007; Mercer & Littleton, 2007; Tolmie et al., 2010). However, fine distinctions between what constitutes shared regulatory processes versus collaborative processes of co-construction of understanding through dialogue are yet to be clearly established. From a developmental perspective, we also lack an understanding of how these processes emerge early in development, and more importantly, what are the key characteristics of contexts that facilitate the emergence of these forms of interaction. The aim of this paper is therefore to explore the presence of relationships between young children's (5 to 6 year olds) social forms of regulation during group activities and the quality of dialogue and understanding evidenced in the groups' exchanges over time. The activity of 10 groups (N = 30) of Year 1 students in the UK was video recorded during 4 activities, 2 of which related to the use of dialogue for thinking together in the classroom and 2 that related to the understanding of scientific concepts involving size and weight. Activities had a problem-solving nature and took place in the course of 6 months allowing the study to explore the presence of transitions across time. The analysis involved identifying episodes of individual and social regulation with the latter being categorised as other-regulation or shared-regulation on the basis of the direction and reciprocity of the regulatory utterances or actions (Iiskala et al., 2011). Relationships between social regulation and the quality of dialogue were explored using Mercer's (2000) framework, identifying episodes of productive (exploratory) versus less productive forms of dialogue (disputational & cumulative). So far, the analysis of example cases (Pino-Pasternak & Whitebread, 2011) has suggested the presence of group transitions towards shared-regulation, with shared episodes coinciding with child-initiated forms of exploratory talk. On the basis of these examples and prior research, we expect that the analysis of a larger cohort will reveal similar associations showing an increase in shared regulatory activity accompanied by more extensive use of exploratory forms of dialogue. Theoretical and practical implications of these findings will be discussed.

## *Metacognitive activity and shared metacognition in inquiry based science education*

Meier, Angelika; Vogt, Franziska

Metacognition has been shown to be an important factor in learning in general (Pressley & Harris, 2006) and in the domain of science learning (Veenman, 2012; White & Frederiksen, 1998). This study investigates metacognitive activity and shared metacognition in an activity-oriented learning arrangement in the natural sciences. Within science education the concept of inquiry based learning has gained considerable attention in the past decades (Minner, Levy & Century, 2010). For inquiry based learning several levels can be distinguished depending on the amount of information given: confirmation, structured inquiry, guided inquiry, open inquiry (Bell, Smetana &

Binns, 2005). In this study we focused on teams working with structured compared to guided inquiry. By definition, inquiry learning is not only about performing certain procedures but also about working in community (Scott, Asoko & Leach, 2007). Although many students assume that doing science is a solitary endeavor (Linn & Eylon, 2006), collaboration is key to the field. Recent research on shared regulation and metacognition contributes to the growing awareness of the importance of learning and working in teams (Volet, Vauras & Salonen, 2009). Twenty teams of primary school students were video-recorded while working on an experimental task on the topic of climate change. After working on the task, students were shown excerpts of the video and interviewed about the regulation of their learning process (video-recall). The questions for the video-recall are based on Pintrich's (2004) model of self-regulation. The assignments for the task were systematically varied between structured (where a problem is given and the procedure provided) and guided (where only the problem is given). For the present study 8 high achieving teams were selected according to their score in the pretest. The transcripts of the videos and the video-recalls were coded for metacognitive activity, i.e., metacognitive experiences and metacognitive knowledge (Efklides, 2001; Flavell, 1979). The research addresses the following research questions: Does guided inquiry allow for more metacognitive activity than structured inquiry? Does this metacognitive activity lead to more episodes of shared metacognition in guided inquiry than in structured inquiry? What kind of metacognitive knowledge is expressed in the video-recall? How do students employ their metacognitive knowledge when working on the task? Using multiple sources of data (video and video-recall), this study gives insight into the different aspects of individual and shared metacognition. It also examines the distinct effects of two types of task in science learning on metacognitive activity.

## *Metacognitive scaffolding during collaborative learning: A promising combination*

Molenaar, Inge; van Boxtel, Carla; Sleegers, Peter

The metacognitive literature did not adequately attend to the social nature of collaborative learning (Hadwin & Oshige, 2011; Iiskala et al., 2011). There is little knowledge about how metacognitive activities are embedded in interaction between the group members. Collaborative learning research indicates that the quality of cognitive activities during collaborative learning is positively influenced by interaction in which group members relate to and engage in each other's contributions (Weinberg & Fischer, 2006). It is expected that this is also the case for metacognitive activities embedded in interaction, but this has yet to be established. Some studies did find that interaction between the group members positively influences metacognitive activities (Goos et al., 2002; Iiskala et al., 2011; Lin & Sullivan, 2008). However, these studies mostly focused on full reciprocal interaction among the group members, which is fairly rare in

collaborative learning (Dillenbourgh, 1999). Therefore the goal of this study is to further enlarge our understanding on how metacognitive activities are embedded in interaction during collaborative learning. Moreover, interaction among students can be supported with different instructional designs, such as scaffolding, scripts, Jigsaw and role play (Rummel & Spada, 2005). We do know that scaffolding stimulates the group's metacognitive activities and could consequently influence the type of interaction around these metacognitive activities. Therefore, the second goal of this study is to discover the effect of computerized scaffolding with different scaffolds (structuring vs. problematizing) on the way metacognitive activities are embedded in interaction among group members during collaborative learning. We investigated occurrence of different types of interaction around metacognitive activities of 18 triads (6 control, and 6 structuring and 6 problematizing groups). We found that metacognitive activities can be ignored, accepted, shared and co-constructed among the group members. As expected, metacognitive activities embedded in more intensive form of interaction (from ignored to co-constructed) were more likely to facilitate the group process compared to activities in less intensive interaction. We found that groups receiving scaffolding showed significantly more co-constructed metacognitive activities. Groups receiving problematizing scaffolds showed significantly less ignored and more co-constructed metacognitive activities compared to groups receiving structuring scaffolds. These findings confirm that interaction between the group members can positively influence the quality of metacognitive activities. Additionally scaffolding positively influenced the way metacognitive activities were embedded in the groups' interaction. Therefore future research should consider how to design scaffolds that support metacognitive activities embedded in more transactive interaction.

## *Socially shared metacognitive regulation during a small group's computer-supported collaborative learning process*

Iiskala, Tuike; Lehtinen, Erno; Vauras, Marja

There are scarce analyses of metacognition in real-time collaborative learning compared to various important conceptual and empirical analyses of metacognition in individual learning (Iiskala et al., 2004, 2011). Further, computer-based learning environments, such as computer-supported collaborative learning (CSCL), have been used in order to promote learning. However, it has been suggested that effectiveness of these environments can be achieved only if learners regulate their learning processes (see Azevedo, 2005). In this study, the concept of socially shared metacognitive regulation (SSMR) is used to refer to the consensual monitoring and regulation of joint cognitive processes in demanding collaborative learning situations (Iiskala et al., 2004, 2011; Vauras et al., 2003; see also Molenaar et al., 2010; Whitebread et al., 2007). Previous studies (Iiskala et al., 2004, 2011; Vauras et al., 2003; Whitebread et al., 2007) have

found that SSMR appears in face-to-face collaborative learning environments. Thus, this study explores whether SSMR appears during a pupil small group's asynchronous CSCL process and whether involvement in SSMR differs between the pupils. The study involved 16 small groups (N = 68 pupils). The focus of this paper is on the in-depth analysis of one small group consisting of 4 girls. The girls were 12 years old and attended the 6th grade. The theoretical idea of learning process as collaborative inquiry was applied (see Brown et al., 1993; Hakkarainen, 2003; Scardamalia & Bereiter, 1994). The small group worked on complex ill-defined questions in the domain of science during 22 lessons. The pupils collaborated in an asynchronous CSCL environment, and the process was partly phased. Pupils' notes, that is written productions (N = 640), in the CSCL process were used as data. In order to study SSMR, the unit of analysis was a set of notes, that is, a thread in which case pupils had to jointly monitor and regulate a learning process towards a common goal focusing on the task and the mutual cognitive activity. The function of each thread was analyzed (see Iiskala et al., 2011). Findings indicated that SSMR appeared during a pupil small group's asynchronous CSCL process. The appearance of threads is qualitatively illustrated. Further, quantification of the data is used. There was a significant relationship between the number of notes in the SSMR thread and the phase of the process. There was also a significant relationship between the function and the phase in which case SSMR had different functions in the different phases of the process. Analysis of differences in pupils' involvement in SSMR is in progress. To conclude, this study continues our exploratory analysis of SSMR by focusing on a pupil small group's asynchronous CSCL process because previous research has mainly neglected to examine metacognitive regulation as socially shared in collaborative learning. Thus, this study is seen to have conceptual and practical significance.

## S11 SELF-EVALUATION, BUT NOT ONLY? ON LINKS THAT RELY SELF-EVALUATION TO (BETTER) LEARNING OUTCOMES

Organiser: *Moták, Ladislav*
Discussant: *Pieschl, Stephanie*

This symposium offers some deeper insight into presumably straightforward relationship between both metacognitive process of self-evaluation and learning outcomes. Data collected on more than 400 students suggest that the manner they self-evaluate their competencies matters not only for their cognitive performance, but also for their motivation to persevere within interactive learning environments (Schnaubert et al.). Yet, while self-evaluation and self-regulated learning outcomes may differ following the proposed text and learning task-related cues (Lippmann et al.), the efforts to enhance students' self-evaluation accuracy sometimes fail as it may interfere with motivation (Maillard et al.). Besides the presented variety of approaches to the

assessment of self-evaluation, this symposium not only further supports the expected relationship between self-evaluation and self-regulation, but also emphasizes the role of motivation in the interplay between self-evaluation and learning outcomes.

## *The impact of students' self-evaluation of competence on learning behaviour within multi-trial learning tasks*

Schnaubert, Lenka; Andrès, Eric; Narciss, Susanne; Eichelmann, Anja; Goguadze, George; Sosnovsky, Sergey

Evaluating one's competence is crucial for planning and regulating learning behaviour. In different lines of research, domain-specific self-evaluations were found to influence behaviour and students' reactions to feedback (e.g., Eckert et al., 2006). Our aim was thus to compare behavioural patterns of students with high versus low perception of competence (PoC) within web-based multi-trial learning tasks. We hypothesized that students with high PoC would skip comparably less and succeed more, especially after experiencing failure. We based our analyses on the work of Schnaubert et al. (2011), but – in contrast – used data that was balanced with regard to students and task-characteristics. We included behavioural data of 101 6th and 7th graders, each completing a set of eight tasks-with-typical-errors (TWTE) within the domain of fractions. TWTE are learning tasks which contain an error, the students were asked to correct in a multi-trial procedure assisted by tutoring feedback. We conducted a median split regarding pre-assessed PoC (scale adapted from Narciss, 2006) to separate students with high from those with low PoC and plotted the students' task-completions separately for those groups, discriminating system provided trials (1st, 2nd, 3rd) from the learners' reactions (no input = skip/fail, incorrect solution = try/fail, correct solution = try/succeed). We conducted $Chi^2$-tests to test for differences in behaviour in general as well as after failure, defined as try-fail-combination. In line with our hypotheses, we found that high-PoC students solved significantly more tasks and skipped fewer steps. Yet, we did not find behavioural differences after failure. These results suggest that students' evaluation of their competence has an impact on their behavioural patterns. Students with a comparably high PoC solved more tasks, indicating that they might actually be more competent. They also skipped steps less often, indicating more favourable motivational strategies. Contradicting prior findings, we did not find evidence that this was due to students' reaction to failure. In this study we show how graphing two dimensions of learning behaviour (skip/try, fail/succeed) can provide a deeper insight of what students do while working in interactive technology-enhanced learning environments.

## *Effects of Topic Structure, Text-Titles and the Timing of Keywording Tasks on Self-Evaluation and Learning Outcomes in Self-Regulated Learning from Text*

Lippmann, Marie; Narciss, Susanne; Schwartz, Neil; Danielson, Robert; Sarmento, David

Self-regulated learning is a complex process. Thus, it is important to know and understand factors that influence successful self-evaluation and self-regulated learning. Learners who apply both, accurate self-evaluation and self-regulation, presumably achieve better learning outcomes. However, effective self-regulated learning may occur in various contexts and may be based on different support features. In respect to text-based self-regulated learning, topic structure and titles (that is, components of expository texts) have been argued to serve as instructional prompts by indicating relevance (Bannert, 2009): Information stated first in a text and information that is related to the title of a text is perceived to be more relevant and more likely to be remembered (Ritchey et al., 2008). Yet, besides the properties of the expository texts, self-regulated learning is assumed to also depend on learning tasks. For instance, while students are invited to summarize the contents of a studied text in a set of keywords, self-evaluation and learning outcomes may differ, depending on whether the keywords are generated immediately after reading, or after a delay (Thiede et al., 2003). The present study investigated effects of topic structure, text titles and the timing of keywording tasks on self-evaluation and learning outcomes in a partially self-regulated learning setting. The preliminary results, which are based on the data of more than 200 American students showed significant interactions between the three factors. Immediate keywording led learners to rate their text comprehension higher and prompted them to focus on initially mentioned information, even if the text title referred to information stated later on in the text. Delayed keywording led to a more global understanding of the whole text that was not limited to initially mentioned information. For instructional designers, those results suggest to state important information first, rather than open-ing a text with an introductory paragraph. Moreover, the results imply encouraging immediate keywording if initially mentioned information is particularly important. If important information is spread out throughout a whole text, delayed keywording should be encouraged.

## *To train or not train? On restricted effects of a specific training in self-evaluation*

Maillard, Adeline; Moták, Ladislav; Sakdavong, JeanChristophe; Catteau, Olivier; Dupeyrat, Caroline; Huet, Nathalie

An accurate self-evaluation (that is, an accurate estimation of one's knowledge) is a necessary step for students searching help in an effective manner. It appears also that the better the self-evaluation, the better the self-regulation and, importantly, cognitive

performance itself. Less is known, however, about how the students' self-evaluation may be enhanced. In our study, 50 students enrolled in business data processing Master's Degree first answered a set of questionnaires including: i) their predictions of performance; ii) the problem solving itself; iii) their confidence judgments in their answers' accuracy; iv) a questionnaire of strategies for learning (MSLQ); v) the self-efficacy in respect to several computer science domains; and vi) the perception of metacognitive help. The problem solving task served as the indicator of the initial performance, and the initial accuracy of students' self-evaluation was assessed via the standardized residual scores issued from the regression analyses between both predictions vs. performance and performance vs. confidence judgments. Afterwards, while we invited half of participants to complete a filler task, the second half underwent a specific metacognitive treatment aiming to enhance their self-evaluation. This involved three different aspects, recognized thus far to commit participants with higher-order (metacognitive) thinking (Azevedo et al., 2004; Berardi-Coletta et al., 1995): prompts (e.g., "Please, write down the concepts underlying the question at hand"), self-explanation (e.g., "Why do you think the chosen answer is right?" or "Why do you think you have underestimated your knowledge?"), and finally self-reflection, namely in respect to the employed strategies (e.g., "What are the strategies you really used to solve the problem / you find useful now?"). In order to evaluate the benefits of this treatment, all participants fulfilled the second phase of questionnaires, permitting an assessment of performance and self-evaluation in both near and far transfer tasks. Preliminary results suggest that the experimental treatment yield no significant benefit in respect to metacognitive or cognitive performance. However, although performance is not correlated with perceptions of metacognitive help, it is correlated with other variables related to the students' motivation. Thus, both cognitive and metacognitive performance is presumably moderated by motivation-related variables and these latter must be taken into account when aiming a self-evaluation enhancement.

## S12 MUSEUMS, METACOGNITION AND TEACHING LEARNING PROCESSES

Organiser: *Zecca, Luisa*
Discussant: *Nigris, Elisabetta*

The symposium proposes a reflection on the possibility of the creation of teaching and learning courses which have as their main purpose the solicitation of metacognitive processes in the context of museum activities. We present some researches in educational field, investigating this subject, analyzing experiences in learning context very different from each other (educational services, schools, workshops, atelier, museums, traveling exhibitions, temporary exhibitions,) which are the result of collaboration between school and museum. Researches, involving different disciplines and different Museums or International Centers, (archaeological, scientific, artistic...) and various professional

figures (museum operators / guides, teachers, educators) in relation to educating people of different age groups. In particular we consider the relationship between communication strategies, teaching methodologies and socio-cognitive and meta-reflexive processes developed by children.

### *From experience to metacognition thought: A research in a scientific museum*

Nigris, Elisabetta

The methodological innovation which has involved scientific museums locally and internationally has brought about a real transformation of museum activities, experiences and strategies in order to introduce the non expert public to scientific topics and concepts. This museum revolution has brought big changes to the way permanent and temporary exhibits have been thought. The he most important museums have also been asked to open specific educational labs with an experiential learning approach. At the same time, the increasing collaboration between schools and museums has required a great deal of research to investigate how to produce formal learning, starting from informal experiences and contexts (connected to institutionalized school curriculum), integrating the hands on approach with a minds on one and transforming intuitive learning through cognitive and meta-cognitive reflection. Moreover, the school-museum collaboration requires a clear definition of the roles of museums and schools in their contribution to pupils' cognitive and meta-cognitive learning processes and in the shaping of their scientific knowledge. A qualitative research project is presented by the Department of "Scienze Umane per la Formazione Riccardo Massa" at the University of Milano Bicocca, in collaboration with the Regione Lombardia, the Cariplo Foundation and the Regional School District, where the "school museum practices" of primary schools and science museums in Milan are examined. The researchers have applied an ethnographic method integrated with the narrative inquiry method, using participatory observation and video observation, teachers' diaries, pupils' works, and focus groups for primary school teachers and museum educators. The main results, gathered either in the school context or in museums, showed that the main strategies which can help in the construction of scientific formal learning in primary school are the following:

- Activities/experiences which promote heuristic reasoning
- Enigmas and problems which can create social-cognitive conflicts
- Questions which lead to doubts and meta-cognitive thinking
- Teachers/learners communication processes which help to systematize intuitive thoughts through meta-cognitive reasoning.

Numerous examples will be described and discussed in order to illustrate our results.

## *From the atelier in the municipal preschools to the Urban and City Ateliers*

Rinaldi, Carla; Giudici, Claudia; Vecchi, Vea

Since the late '60s in the municipal preschools of Reggio Emilia, each school has a space called the atelier and the figure of the atelierista, a "teacher" with an arts background. A revolutionary choice, at that time but also today, because it changes a common way of thinking about learning and about knowledge. Ateliers are places of meeting, discovery, experimentation and research. Places that stimulate the pleasure of making and the joy of learning through metacognitive experiences. Extraordinary opportunities of creative knowledge, in an environment where creativity is not a separate mental faculty, but a characterization of the way of thinking, learning and choosing of the man and child; where it is possible for children to encounter, in a new way, opportunities of acting, experimenting, creating, with happiness and pleasure; where "art" and "science" are not disciplines to be learned but languages that belong to child's experience. One of the most original tracts of this philosophy is the poetic languages (graphic, painting, clay, music, dance) not only as an added value, but important in the relation between teaching-learning and in the formation of the knowledge building process. The meaning and value we give to the poetic languages and to aesthetic have an important role not only in the final products realized by the children, but especially in the ways of doing school and therefore in the learning process of children and teachers, and of the educational philosophy in general. The Atelier is a physical space full of tools and materials where it is possible to make projects, to explore, to invent, to produce, but it is also a metaphor of a metacognitive way of knowing and learning where brain, hands, sensitivity, rationality, emotions and imagination work in close cooperation. In childhood, the culture of Atelier is strongly linked with the learning processes and with the construction of knowledge. In the adult age and in the old age it can become a precious tool to keep perceptions and creations active and alive. In Reggio Emilia the atelier has found new forms, also outside the preschools, in the Urban Ateliers and in the traveling exhibitions (developing experiences at national and international level). The ateliers of the preschools are offered to the city, inviting children, youth and adults to build, research, and investigate on different topics and thus become "Urban Ateliers" designed for citizens of all ages. City Ateliers can be found in different places of the city, open to people of different age. The project is entitled "From 0 to 99. Park of the 100 languages" and it offers contexts where to experiment creativity and to learn through metacognitive experiences. The wish and the objective is to try to preserve also in the adult age some characteristics typical of the childhood and of the atelier: curiosity, tension to the concept of research, courage, creativity, empathy, and vital energy.

## *Metacognition and self-assessment of learning process: a Primary school archeological laboratory case*

Zecca, Luisa

The survey takes place in the fourth class of San Biagio (MN) Primary School having as subject the experiential archeology laboratory managed by an educator of Archeological Park of Forcello in november 2011. The laboratory shows to 9-10 year old children experiential knowledge through a reconstruction in form of a creative tale of aspects of pre-historical man life. Through the experimental "method hands-on minds-on" the laboratory has the purpose of forming a critical attitude and a scientific analysis methodology proposing unusual experiences that "challenge" the children to build "with their hands and mind", even if they haven't peculiar technical skills. The laboratory approach includes acquiring a method, experimenting and mastering the process of learning and the relation among context elements and the activated individual and group processes. The laboratory is a place of demonstration of concepts or of proven or "observed theories", and it is not even the place of performance-driven training: it is the place where one can go over and build again queries, hypothesis, information, problem typologies, ways of posing and solving them that are typical of a given "object" of knowledge of a given discipline together with others. In which way this laboratory is forming the meta-thoughtful thought? The survey is a case study on the didactic conditions which stir meta-thoughtful thoughts about the experience of museum and school encounter. Aim of study is checking the consistency between the laboratory initial project and its achievement in respect to the conditions of context that allow the activation in the children of metacognitive thoughts during the lesson, during the building laboratory, at the end of experience. It is a qualitative survey of idiographic type, using an ethnographic approach inspired by the grounded theory, a methodological trend which better performs in catching a system of phenomena in their uniqueness. Its material consistency between the project elements and the educating intervention appears, except for some passages of the talked lesson. The discussions produce arguments that are built in the debate itself, the dialogue open chances of thinking and the connections between experiences cause metacognitive thoughts. The meta-thoughtful dialogues that took place during the experience help to clarify the process, to evidence the problem and the found obstacle so to solve it most of the time. In team work, though any of them is following his personal project, the children are watching, helping, supporting each other often using the same strategies the adults are using with them, and they are standing by each other on different levels, it is to say on a emotive level (console, urge, praise) and on a strategic level. In the writings of individual self-assessment metacognitive thoughts emerge about their personal process of learning in which affective, aesthetical, creative and motivational elements are intrinsically connected.

## *My Modernikon: contemporary art and the teenagers at Fondazione Sandretto Re Rebaudengo*

Palermo, Alessia

The Education Department of Fondazione Sandretto Re Rebaudengo offers educational and training programs focusing on different ways of approaching contemporary art. The Foundation is ongoing, varied and multi-layered exhibiting activity is a unique opportunity to introduce different aspects of artistic creation and develop creative thought, a sense of observation, and a critical approach to contemporary culture. In recent years the Department has intensified work with senior high school institutes, promoting series of meetings that focus on approaching contemporary art. My Modernikon is an educational project designed to facilitate young people's approach to contemporary art, giving them the right tools to analyse and understand it. The project involved 3 groups of students, aged 14 to 15, from a Communication High School in Torino, and it ended with an open meeting with the Fondazione's audience, during the museum's opening hours. The students worked in small groups and they literally "adopted" one artwork from the exhibition "Modernikon Contemporary Art from Russia", turning themselves into contemporary art mediators and giving guided tours to the audience, their friends and families, and proposing their personal point of view and approach to the artworks, in an informal, emotional and interactive way. To reach this level of knowledge and awareness, a three months long programme of visits, lectures and practical workshops inside the exhibition space has been realized. The students have been put in the position of interacting with the artworks, investigating their formal features, understanding their statements, and comprehending their various levels of meaning. The monitoring and analysis about the students' learning in the museum space and about the effectiveness of the methodology have been carried out all along the project, and not only in its final part. Every analysis is designed to verify the participants' learning practices through a meta-cognitive reflection, and it reveals precise informations about their learning experience, such as the satisfaction, the acquired familiarity with the tools and languages proposed during the activities, the acquisition of specific skills, the reflection about their way of thinking and learning (how to read an image, visual and conceptual association ability, information storage...). Some results:

- comprehension of the different languages proposed during the activities acquisition of new skills and knowledge and the right tools to communicate it;
- acquisition of familiarity with the Fondazione and its spaces;
- acquisition of familiarity with the contemporary art languages;
- expression of peculiarities and abilities;
- confrontation and open dialogue between the individual and the group;
- awareness about the personal learning process through the peer to peer confrontation and by measuring against an audience;

The positive and negative outcomes improve the future projects' design and planning.

S13 SELF-REGULATION STRATEGIES AND MOTIVATION

Organiser: *Moè, Angelica*
Discussant: *Albanese, Ottavia*

Self-regulation is a very important aspect of metacognition. Students self-regulated achieve better and are less at risk of drop-out. Research on self-regulation has examined a wide range of predictors. Here are considered some motivational aspects. To be self-regulated is also a matter of motivation. Three studies examine this issue by considering different perspectives and populations from kindergarten to high school. The results confirm the importance of motivational aspects as ability self-perceptions, learning goals, self-efficacy, values, and self-protective strategies. Both contextual and individual motivational variables affect the development of self-regulation and metacognition. Instructional practices will be discussed to enhance metacognition which also consider motivational aspects.

## *Kindergarten children's' emotions, feeling of task-difficulty and ability self-perceptions before and after performing an unfamiliar domino*

STEPHANOU, GEORGIA; CHARALABIDOU, MARIA

Most investigation on student emotions and how they interact with cognitive, metacognitive and motivational processes, such as self-beliefs and feeling of task-difficulty, in classroom learning has focused on literacy and mathematics. Furthermore, such research is very limited in kindergarten, although the high importance of this period in children's future academic and whole development. Kindergarten schooling effects are, almost exclusively, evident for some components of children's literacy and mathematical developing, despite the fact that kindergarten learning is related to various game-related activities such as filling in a puzzle or performing a domino. This study, being involved in unfamiliar domino (12 pieces in a row) for the participating kindergarten children, aimed to examine (a) children's experienced emotions, ability self-perceptions and perceptions of task-difficulty in pre domino performance condition and in post domino performance condition, (b) the effects of students' ability self-perceptions and perceptions of task-difficulty on their experienced emotions in pre- and post- domino performance condition, and (c) the role of children's ability beliefs and feeling of task- difficulty in the impact of the emotions on domino performance. The participants were 180 kindergarten students, 96 girls and 84 boys, age from 69 to 73 months, and they came from 25 classrooms of twenty different Kindergartens from various regions of Greece, and they represented various parental socioeconomic levels. All scales were in Greek Language, and all alpha values were above .72. The children were interviewed individually during a regular class in a quite classroom in their kindergarten.

The interviewers, initially, exhibited the domino performance to the children, and, then, asked them to perform the domino. The participants were administrated the questionnaire twice, in pre- and after- domino performance. In both conditions, the children responded, first, to the emotions scale and, then, to the other scales. The results revealed (a) the variability of the intensity of the emotions within and between the pre- and post- domino performance, (b) children felt better in post- than in pre- domino performance, particularly in self-, task- and future activity- related emotions, (c) they estimated their ability as higher in post- than in pre- domino performance, (d) ability self-perceptions, compared to feeling of difficulty, was a more powerful formulator of most the emotions, particularly in pre- domino performance, and (e) the students' pre-performance emotions, perceived task- difficulty, and, mainly, ability beliefs influenced their domino performance, while the feeling of difficulty and, particularly, ability beliefs enhanced the impact of the emotions on domino performance. The findings are discussed for their applications in children development and education, emphasizing the association of metacognitive awareness with self-regulated learning.

## *Self-protective strategies and self-esteem in students*

Alesi, Marianna; Pepi, Annamaria

There is growing body of studies in the literature to demonstrate how scholastic achievement depends on the reciprocal enhancement of students' cognitive abilities and emotional-motivational attributes. In particular recent research focuses on the role of school self-esteem and self-handicapping strategies in the learning abilities. According to the Self-Worth Theory of Motivation (Covington, 1992) students need to protect themselves or enhance a positive self-esteem and self-image when faced with a threatening task by employing defensive strategies such as self-handicapping (Jones & Berglas, 1978). Examples of self-handicapping strategies are: to procrastinate or put off doing school work until the last minute, to make excuses, to get drugs or alcohol before an exam, don't try hard. These strategies are proactive and involve both motivational and metacognitive processes, such as anticipation of behavioural outcomes, affects, planning of and investing effort in the task, monitoring behaviour (Alesi, Rappo & Pepi, 2010). An interesting relationship has been found between self-handicapping and causal attributions regarding their temporal dimension and their role in the personal defensive system of students. Given these theoretical premises, this study aims to examine two specific research questions: 1. Do gender and school level influence the employ of defensive strategies? 2. To what extent are correlated the self-protective strategies and the school self-esteem level? The subjects in this study were 242 attending the 3th or the 5th final years of high school (humanistic, scientific, technical and professional schools). With regard to gender, there were 145 females and 97 males. The medium socio-economic level was predominant. Subjects were given a Questionnaire aimed at

evaluating the Defensive Strategies consisting of 20 items, 10 for the proactive excuses and 10 for the retroactive ones (Alesi & Pepi, 2011). The students' self-esteem was measured by the Self-Esteem Scale (Rosenberg, 1965) All the test were administered by group. On the whole, boys were found to employ both proactive and retroactive defensive strategies more than did girls. Moreover we found significant relationships between both proactive and retroactive excuses and self-esteem. In line with a metacognitive approach, it should be possible to plan multifaceted intervention programs that encourage the development of self-regulated learning, which causes the student to reflect on what is happening and what is needed to reach the objectives which have been set. At the same time it's crucial to structure education settings and improve teaching styles aimed at developing cooperative learning and internal attribution styles (Rhodewalt & Vohs, 2005).

## *Personality, motivational beliefs and contextual variables as predictors of metacognitive self-regulation of learning*

Soriæ, Izabela

Self-regulated students are those who are metacognitively, motivationally and behaviorally active participants in their own learning process (Zimmerman, 2001). Research revealed that the effects of metacognitive strategy training are not well maintained or transferred. Zimmerman and Moylan (2009) warned that use of these metacognitive processes is not only a question of competence, but is also a question of motivation. Accordingly, in present study we investigated contribution of motivational beliefs to the metacognitive strategies use. One of doubts about self-regulated learning concerns whether self-regulated learning could be considered a learnable characteristic or characteristic associated with stable personality traits (Bidjerano & Yun Dai, 2007). Therefore, we decided to test whether personality traits predict using of metacognitive strategies. School context could have an essential influence on metacognitive development. The role of parents in metacognitive development of their children is also rarely studied. Hence, we tried to examine contribution of parental goal orientation and classroom goal structure to learner's using of metacognitive strategy. Marchant et al. (2001) indicated that two contexts could be either in conflict or complement each other in terms of their relations with the outcomes of the child. A congruent effect of classroom and family context is expected to have better implications on the student's metacognition than the incongruent effect of these contexts.

S14 THE ROLE OF GESTURES AND PRIVATE SPEECH IN YOUNG CHILDREN'S EARLY METACOGNITION AND SELF-REGULATION

Organiser: *Whitebread, David*
Discussant: *Rodriguez, Cintia*

As part of the burgeoning research literature concerned with the early emergence of metacognitive abilities and self-regulation skills in young children, the role of gestures (Cook & Goldin-Meadow, 2006; Cook, Mitchell & Goldin-Meadow, 2008) and private speech (Winsler, Fernyhough & Montero, 2009) in these early developmental processes are becoming increasingly recognised. The papers in this symposium build on this research and present evidence from studies of the self-regulatory functions of gestures and private speech in young children. Basilio, Rodriguez & Whitebread report on a study of 14-18 month year olds interacting with a parent and three different toys. Evidence is reported of ostensive, indexical and symbolic gestures used by children in this age range for self-regulatory purposes. Verma reports on a study of 3-5 year olds' use of private and social speech for self-regulatory purposes. Recognising the limitations of previous correlational studies, she reports on an innovative methodology designed to examine the temporal co-occurrence of speech acts and self-regulatory behaviours. Kuvalja examines the hypothesis concerning private speech and self-regulation through a study comparing their patterns of co-occurrence among typically developing 6 year olds and others with Specific Language Impairment, during episodes of constructional and pretend play.

## *How pre-verbal children use gestures as tools for self-regulation: Evidence from 14 to 18 months old*

Basilio, Marisol; Rodriguez, Cintia; Whitebread, David

The role of language as a tool for self-regulation (SR) is widely acknowledged but the role of pre-linguistic communication in the early development of SR remains largely unexplored. Recent evidence shows how children (from 4 years old) use gestures similarly to language as a tool for SR (Cook & Goldin-Meadow, 2006; Cook, Mitchell & Goldin-Meadow, 2008). In this paper we extend Vygotsky's ideas to a pre-linguistic level to argue that pre-verbal signs also fulfil a self-regulatory function earlier in life. In this longitudinal study we analysed children's pre-verbal communicative behaviours in relation to challenging tasks with objects and instruments from a semiotic and pragmatic perspective (Rodríguez & Moro, 1999, Rodríguez, 2007). We videotaped 16 children three times at 14, 16 and 18-months old interacting with one of their parents and three different toys. The toys provided were objects and instruments aimed to present children with a cognitive challenge. We coded for attempt/success of conventional uses of the objects, e.g., stacking geometrical pieces and inserting keys in their locks. We used a

multi-level coding scheme to analyse children's gestures and their cognitive functions. We first coded children's communicative utterances: gestures, vocalisations and first words. Gestures were coded following previous research (Rodríguez & Palacios, 2007; Basilio & Rodríguez, 2011), in three categories, ostensive (e.g., showing, giving), indexical (e.g., pointing gestures), symbolic (e.g., clapping, nodding the head). We determined if children's communicative behaviours had a self-regulatory purpose by analysing their relation to the uses of the objects in terms of content and temporal occurrence (before, during, after uses of objects). We classified these gestures according to their SR function in relation to the uses of objects in: planning, monitoring, control, and evaluation. Finally, we coded the gestures according to whom they were directed to – as other-directed, if they were clearly directed towards the parent or the observer, or as self-directed or private if there was not a clear intention to communicate with another person. We found that the three objects engaged children and presented them with cognitive challenges that required SR. We describe observations of children using gestures with SR functions – directed to others, e.g., indicating requesting help to achieve their goals, and private, directed to themselves, e.g., clapping for themselves evaluating positively when they achieve their goals. We developed non-verbal indicator that show children engaged in different self-regulatory processes planning their actions, monitoring their progress and adjusting their actions towards their goals, and evaluating their performance. From a longitudinal point of view, we found these behaviours at the three observations times at 14, 16 and 18 months of age, but symbolic gestures were more frequent at 18 months old.

## *Temporal patterns of co-incidence between children's self-regulatory behaviour and their private speech in a naturalistic setting*

Verma, Mohini

While examining the role of various aspects of language use in mediating self-regulation in children, particular attention has been paid to the phenomenon of private speech – the audible and at times whispered, self-directed speech of children, produced while they are engaged in any kind of activity. Vygotsky hypothesized that private speech mediates self-regulation in children as behaviour increasingly changes from other to self-regulation. Several empirical studies have attempted to corroborate this association by finding a positive correlation between the amount of private speech produced and the degree of self- regulation required or employed in a task indicated by the task difficulty and task performance respectively. However, correlational findings do not reveal underlying mechanisms of mediation. Moreover, it might not be the amount but the content of private speech utterances produced during challenging situations, which may be crucial in determining how self-regulatory behavior is verbally mediated. Hence, the reported study aimed to examine the actual instances when speech (social and private

speech) occurs during moments of difficulty wherein children exhibit goal-directed self-regulatory behaviour while also investigating the effects of the contexts in which they occur. Children in preschool and reception classes were video-recorded during their daily self-selected classroom activities. Significantly recurring temporal patterns of coincidence between various types of cognitive self-regulation and semantic categories of private and social speech were extracted from these videos using a "t-pattern" search algorithm. Variations of these temporal patterns across age, peer context, adult involvement and type of play-activity were further analysed. Based on preliminary results which highlighted certain instrumental contextual factors, participants were subsequently video-recorded while engaged in play-based tasks designed to specifically examine the effect of those instrumental factors. Preliminary findings confirmed the presence of the aforementioned temporal patterns. An in-depth contextual analysis of these temporal patterns may indicate those instances where speech utterances seem to be influencing self-regulatory behaviour by either bringing about a change, supporting an on-going strategy, focussing one's attention and ignoring distractions, maintaining motivation or contributing in other ways. The study attempts to address several methodological issues in private speech research. Moreover, the innovative method of observing temporal patterns of self-regulatory behaviour in young children will also provide crucial empirical evidence to the extant models of self-regulation which have hitherto relied mostly on the data from introspective reports and questionnaires from older children and adolescents.

## *Self-Regulation and metacognition in 6-year-olds with Specific Language Impairment (SLI)*

Kuvalja, Martina

Specific language impairment (SLI) is a term applied to children whose language capability is below age level, for no apparent cause (Bishop, 1997). The impairment is not attributed to low intelligence, hearing loss, neurological condition, bilingual background, physical disability and is not associated with a syndrome (Snowling, 1998; Stothart et al., 1998; Zangwill, 1978). Children with SLI gain 'normal' range non-verbal intelligence scores (Bishop, 1997; Sturn & Johnston, 1999) and their language is acquired within a typical social environment. Language can be viewed as a tool for self-regulation and generally as a tool for successful academic, social and behavioural achievement. A number of studies have reported that children with SLI demonstrate poor behavioural autonomy, behavioural difficulties and deviance on some non-linguistic tasks and executive function's tasks. It has been suggested that some of these difficulties might be due to a verbal mediation failure. Verbal mediation is very often 'visible' as private speech (self-directed speech). Indeed, children with specific language impairment offer a unique opportunity for exploring the role of language in self-

regulation. This PhD study examines private speech, self-regulation and the failure of self-regulation in SLI children. Sixteen SLI and sixteen typically developing 6-year-old children were observed during a planning task, and during constructive, symbolic and socio-dramatic play in the classroom. Children's private speech and self-regulatory behaviour was observed and analysed. Rather than just counting frequencies of behaviour, repetitive and significant patterns of co-occurring behaviour were identified using THEME-5 software. Theme-5 analysis uses a specific pattern detection method and identifies any significant pattern across different events, which is necessary to fully understand a certain behaviour (Magnusson, 2004). Finally, having identified particular patterns in videos, the data were analysed more qualitatively.

## S15 THE ROLE OF METACOGNITIVE SELF-BELIEFS, METACOGNITIVE AND PERSONALITY TRAITS IN COGNITIVE PERFORMANCE AND DECISION-MAKING

Organisers: *Kleitman, Sabina; Jackson, Simon*
Discussant: *Carl Martin Allwood*

This symposium will present findings from four studies investigating the links between key self-beliefs trait Self-confidence and self-concept/efficacy and decision-making and learning outcomes. Participants were asked to provide on-task confidence judgments as an index of metacognitive Self-confidence, allowing several metacognitive variables to be derived: bias and discrimination. The studies attempt to account for individual differences in Self-confidence and its derivatives in different contexts. Paper 1 examines the predictive relationship of metacognitive variables and academic results in the University of Sydney Advanced Statistics course. Paper 2 looks at the generalisability and predictive validity of these variables in a novel medical decision-making context. Paper 3 investigates whether cognitive styles, decision-making styles, and personality predict the ability to increase confidence judgment realism in an experimental feedback condition. Paper 4 investigates the latency and cultural (in)variance of self-beliefs in relation to mathematics achievement using 9 countries in East Asia and Europe.

### *Metacognitive factors and students' academic performance in a tertiary statistics course*

Kleitman, Sabina; Costa, Daniel

Prior research into the area of metacognition has demonstrated evidence of the stable and reliable construct of Self-confidence in the cognitive domain. Few studies, however, have demonstrated evidence of the predictive validity of Self-confidence and other metacognitive constructs in educational settings. The current study investigated the confidence levels assigned to performance of university students, enrolled in a senior

level statistical course, across nine formative statistical quizzes (N = 214). The students also completed the Big-6 Personality Inventory, the Individual Learning Profile questionnaire, and a newly developed measure capturing key motivational aspects of metacognition. An integrative path model is proposed. The results from this study were three-fold. Firstly, they demonstrated that doing quizzes was beneficial for overall course performance (a number of attempts as well as the accuracy/confidence levels), and accuracy/confidence levels inform prediction of the exam mark. Secondly, prediction of the exam mark informed the actual mark, and even a small degree of engagement with quizzes improves the realism of the exam mark prediction. Thirdly, psychological factors that played a role were: perceived time management, perceived numeracy/stats skills and need for feedback. The poorest performing students reported to benefit most from the confidence assignment procedure. Such results support the importance of metacognitive factors for academic achievement.

## *Individual differences in metacognitive feelings of confidence: The generality and predictive validity of judgement confidence and its calibration in a medical decision-making task*

Jackson, Simon; Kleitman, Sabina

Identifying the psychological processes that lead to optimal decision-making holds great promise for a vast range of domains. Making optimal decisions requires individuals to first make accurate judgements about the world around them. The present study focused on the metacognitive assessment of judgement accuracy: judgement confidence and its accuracy (discrimination). The first aim was to investigate whether broad metacognitive Confidence and Discrimination factors would emerge when a novel medical decision-making test (MDMT) was included within a battery of cognitive ability tests. Further aims were to establish the predictive validity of these factors on decision-making behaviour: from both within the MDMT, and outside it when obtained exclusively from three cognitive tests. A total of 193 undergraduate students completed the MDMT and three cognitive tests, accompanied by confidence ratings after each question, as well as personality questionnaires. The results showed that broad Confidence and Discrimination factors emerged across the decision-making and cognitive domains. Confidence and discrimination acquired within the MDMT were strong predictors of key post-diagnosis decision tendencies, predicting individual differences in optimal, adequate, wasteful, and fatal decision-making. Furthermore, confidence and discrimination acquired exclusively in the cognitive tests also predicted these tendencies within the MDMT, albeit to a lesser extent. The implications of these findings are that habitual patterns in decision-making behaviour generalise across decision-making contexts as a result of stable Confidence and Discrimination

constructs. These findings also demonstrate that confidence estimates acquired within practical scenarios – such as the MDMT – could provide useful insight into decision-making tendencies, helping to select better decision-makers, or train individuals where they demonstrate metacognitive deficits.

## *Individual differences in the ability of increasing the realism of confidence judgments*

Buratti, Sandra; Kleitman, Sabina; Allwood, Carl Martin

The aim of the study was to investigate whether people are able to increase the realism of their confidence judgments for a general knowledge task (semantic memory), by being given the possibility to regulate their confidence judgments. Realism referred to in this research is defined in terms of correspondence between assigned confidence level and the accuracy of the performance. In the study, the participants were asked to answer 40 general knowledge questions and make confidence judgments regarding how confident they were that their answer was correct (using a percentage scale from 0% to 100% with 10% increments). The participants were then asked to adjust the confidence judgments they believed were the most unrealistic, in order to increase the realism in their confidence judgments. That is, if the participant feels that they provided unrealistically low/high confidence estimate, and were then asked to correct it, they may want to increase/decrease it in the second stage of the project. Furthermore, the present study aimed to investigate whether individual differences such as cognitive styles, decision making styles and personality can predict the ability to increase the realism of confidence judgments.

## *Self-efficacy, anxiety, self-concept and confidence as predictors of achievement in Confucian and European countries*

Morony, Suzie; Kleitman, Sabina; Stankov, Lazar

This study investigates the structure and cultural (in)variance of mathematical self-beliefs in relation to mathematics achievement in two world regions: Confucian Asia and Europe. Extending previous cross-national work in education that identified such constructs as the best non-cognitive predictors of academic performance, we examine the relationship to math performance of self-efficacy, self-concept, and anxiety, together with (post-test) confidence and performance estimates. This is done both pan-culturally and at a multigroup-level, employing multiple regression analysis and Structural Equation Modeling on a sample of 7167 students (modal age 15.1) from nine countries in East Asia and Europe. Replicating the findings of PISA 2003, the Confucian countries were lower on self-concept and higher on math anxiety than European countries. In contrast, confidence, a relatively new measure of self-belief, shows small

differences between regions. However, a derived measure of calibration (bias) shows pronounced differences between the regions, mostly because of overconfidence among the participants from lower scoring European countries (Serbia and Latvia). Confidence is the single most important predictor of math accuracy both within each country and pan-culturally, and accounts for most of the variance explained by the other self-constructs combined. It has excellent psychometric properties and is simple to administer. Self-efficacy adds only a very small amount of incremental validity when confidence is in the equation. We discuss possibilities for wider applications of confidence judgments in education, including diagnostic purposes for teachers, metacognition training for learners, and even analysis of motivation in assessment.

S16 METACOGNITION AND PSYCHOPATHOLOGY: EVIDENCE AND PROSPECTIVE

Organiser: *Rezzonico, Giorgio*
Discussant: *Castiglioni, Marco*

Metacognition is a topic that acquired more and more interest in psychopathology, mainly in the explication and clarification of some aspect of personality disorders. However sometimes the focus on this concept can be overemphasized losing the role of intersubjectivity, cultural and relational aspects in psychopatology. The aim of this symposium is to critically discuss the role of metacognition, in particular favouring the comparison among different perspectives.

## *Is metacognition a phenomenon created in social space? A cultural perspective on reflectivity*

Veronese, Guido

Metacognition refers to higher order thinking that involves active control over the cognitive processes engaged in learning. Activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of a task are metacognitive in nature. In other words, metacognition could be defined as a self-reflective process enabling the "thinking of thinking". The term "deutero-learning", coined by Gregory Bateson (1972) to describe the ability and the process of "learning to learn", seems to be closely related to the current construct of metacognition. For Bateson and in general for proponents of the systemic approach, this kind of learning occurs not only in the purely "cognitive" field, but also within clinical and psychotherapeutic processes. Deutero-learning is conceived as an "ecological" process regarding both the individual and his/her social context. Coming from a social-constructionist perspective we argue that reflectivity is a co-constructed process arising from intersubjectivity and from the mutual interaction of individuals as situated actors

in social space. We analyze a case of intercultural interaction that produced knowledge and mutual understanding through coordination of meanings. We conclude that intersubjective processes play a key role in facilitating self-reflectivity and metacognitive functions.

## *The intersubjective negotiation of joint commitment*

MORGANTI, FRANCESCA; CARASSA, ANTONELLA

Joint activities, collective beliefs and all other kinds of genuinely social phenomena involve the engagement of a number of subjects in a common enterprise (Carassa, Colombetti & Morganti, 2008). According to Margaret Gilbert (1989) this can be defined as "joint commitment" and it usually arises as a result of explicit agreements by which every party expresses his or her readiness to be committed. These agreements are done by overt communication through a wide variety of expressive means, not necessarily based on the use of language (Carassa & Colombetti, 2009). On one side, even if we are not prone to accept that overt communication is always "metacognitive", we stress that overtness is the necessary ground to make interpersonal processes available for metacognition, and especially for the shared reflection on what has been jointly done (e.g., we have decided that, you proposed that). On the other side, we propose that the readiness to engage in the common enterprise and to create and maintain a joint commitment through communication necessarily involves a pre-reflective inter-subjective dimension of negotiation (Morganti, Carassa & Riva, 2008). It is based on the primary ability to directly perceive and respond to other's psychological states in processes of interaction, without explicitly representing them and reasoning upon (e.g., even if we have decided that way, I feel scarcely convinced about our joint commitment given the strange expression on your face). According to an enactive approach to intersubjectivity, in which mental processes are considered as embodied in sensory-motor processes and situated, we analyzed 35 interactions in 3 different phases: the creation, the maintenance and the violation of a joint commitment. Embodied behaviours – such as movement synchronicity, pre-reflective actions and face expressions – were analyzed to understand how the intersubjective negotiation of commitment between two agents occurs. Although we focus on the analysis of interactions between non-clinical subjects, we believe that identifying the pre-reflective signals at play in the negotiation of joint commitment may shed new light on the dynamics created within the clinical setting for the construction of the therapeutic alliance between patient and therapist.

## *A Metacognition Assessment Interview: Instrument description and preliminary results on clinical sample*

Colle, Livia; Pedone, Roberto; Carcione, Antonino; Nicolò, Giuseppe; Semerari, Antonio

Metacognition is a multi-facet concept. One definition of metacognition refers to the ability to reason and ascribe intentions, desires, believes and state of mind to oneself and to others. Deficits in metacognitive are associated to low social functioning, low quality of life, psychopathology and symptoms in several psychiatric disorders and seems to predict worst treatment's responses (Lysaker et al., 2010; Fonagy et al., 2006). However the lack of reliable and sensitive instruments for evaluating metacognition limited the clinical application of this concept. The aim of this work is to present a new semistructured interview for assessing metacognition, Metacognition Assessment Interview (MAI, Semerari et al., 2012), and to provide preliminary results on a clinical sample of PDs. The interview's structure reflects the theoretical model of Metacognitive abilities proposed by Semerari (2007), valuating different sub-functions independently. We measured patient's performance in MAI at the beginning of a cognitive psychotherapy treatment and six month later. The results will be discuss in light of different theoretical models of metacognition and of the effectiveness of treatments focused such abilities.

## *Attachment and metacognitive capacities*

Strepparava, Maria Grazia

Attachment theory is a common ground for many different approaches in psychotherapy, e.g., psychodynamic and cognitive-behavioural psychotherapy. The link between the attachment style and the development, or inhibition, of the different dimensions of metacognitive capacities it is widely investigated. Under the label of "metacognitive capacities" we can list the awareness of self and others mental and emotional states, the availability of restricted/flexible emotion regulation strategies, the emotion dysregulation processes, the adequate/inadequate mental representation of interpersonal goals in social interaction. A general review on this issue from a clinical point of view will be presented and implication for the clinical practice will be discussed.

## S17 METACOGNITIVE SKILLFULNESS: DEVELOPMENTAL TRAJECTORY FROM TODDLERS TO YOUNG ADOLESCENTS

Organisers: *van der Stel, Manita*
Discussant: *Veenman, Marcel*

This symposium focuses on the developmental trajectory of metacognitive functioning in a wide range of age. Flavell (1992) related the concept of metacognition to Piaget's formal-operational stage and indicated that Piaget would not expect metacognition to show up before this stage. More recently, however, it was found that young preschoolers already start to develop some metacognitive activities (Blöte et al., 2004; Whitebread et al., 2009). Contributions to this symposium address the development of metacognition with data from cross-sectional and longitudinal studies with participants varying from toddlers to adolescents. Basilio et al. studied self-regulatory skills in toddlers. Roebers investigated development in monitoring and control skills in 9 and 11 year-olds. Molenaar focused on developmental differences in metacognitive activities between 9, 10, and 11 year-olds. Finally, van der Stel and Veenman studied the generality vs. domain specificity of metacognitive skills in 12 to 15 year-olds.

### *Exploring self-regulation in toddlers' classrooms: Are we ready to let them take learning into their own hands?*

Basilio, Marisol; Whitebread, David; Rodríguez, Cintia

In the last few decades, educational policy has emphasized preparing children for school in the Early Years. Self-regulatory skills have proven to be particularly relevant for learning and academic achievement, and therefore promoting self-regulation before school entrance is seen as a key goal within the Foundation Stage. Nevertheless, research on the development and learning of self-regulation in formal educational contexts typically focuses on school-aged children, leaving a gap in our understanding of the development of these skills in the early years. Research by Whitebread and colleagues (Whitebread et al., 2007, 2009) has been an exception, studying self-regulation in educational contexts in children from the age of 3 up to the first years of school and taking into account both verbal and non verbal indicators of self-regulation in their observational tools. In the study reported in this paper, we took a socio-cultural and cognitive approach to the development of self-regulation and, following recent research (Rodríguez & Palacios, 2007; Basilio & Rodríguez, 2011; Valloton, 2009), we observed very young children, even before language acquisition. The main theoretical difference, therefore with the traditional socio-cultural paradigm was the inclusion of other cultural non-verbal semiotic tools, such as gestures, communicative uses of objects, and

vocalisations that can also be used with self-regulatory purposes. We videotaped 13 toddlers in their classrooms three times at 14, 16 and 18-months during typical activities. Our research questions were: 1) Which kinds of classroom activities engaged toddlers and could give the opportunity to display and develop self-regulation? and 2) Which kinds of behaviours can serve as indicators of preverbal children's engagement in self-regulatory processes in this context? We selected video clips from the classroom recordings and analysed qualitative aspects of children's engagement in goal directed actions and participation in familiar routines (e.g., using objects, making constructions, having lunch and during pretend play). These video recordings were analysed using a coding scheme adapted from the C.Ind.Le coding framework developed by Whitebread et al. (2009) and enhanced by the coding of pre-linguistic utterances and gestures developed by Basilio & Rodriguez (2011). Preliminary findings indicate that even at these young ages we can observe behaviours that evidence goal directedness, persistence and complex self-regulatory processes like monitoring and control. We discuss implications for educational practice specifically focusing on the role of practitioners in the recognition and encouragement of young children's early self-regulatory skills in the classroom and during educative adult-child interactions.

## *Metacognitive monitoring and controlling in primary school children: Evidence for the emergence of a reciprocal relationship in a test taking situation*

Roebers, Claudia

Developmental progression in metacognitive monitoring and control skills over the primary school years has been documented in many studies, also revealing that monitoring skills seem to develop earlier than the adequate and corresponding control processes. For example, although 7/8 year old children can correctly metacognitively distinguish between easy and hard-to-remember item pairs, their allocation of subsequent study time remains undifferentiated; it is only in 9/10-year-olds that this important interplay of monitoring learning and remembering, and controlling and adjusting control behavior functions efficiently. Thus, for long, metacognitive monitoring was assumed to predominantly influence subsequent controlling, in adults and also in children. Interestingly, recent work with adults indicates that monitoring may be based on previous control processes, arguing for a reciprocal relationship between metacognitive monitoring and control. The evidence that this may also be true for children, however, is still very limited as it has only been documented in terms of study time allocation. In the to-be-presented study an effort was made to test this assumption for primary school children in an achievement test-taking situation. In a multi-phase experiment including 3$^{rd}$ and 5$^{th}$ graders, children gave confidence judgements about the correctness of their answers in a science test, and were then allowed to revise both, their originally given answers but also their initial monitoring judgments. Results revealed that

monitoring-based controlling as well as controlling-based monitoring can co-occur among 9 and 11-year-old children: in both age groups, items that were given lower confidence judgments had a higher probability of being withdrawn than items with higher confidence judgments (= monitoring-based controlling). And, when confidence judgments were changed in the revision phase, they were adapted towards higher confidence for items that had been answered correctly (= controlling-based monitoring). As for uncertainty monitoring, however, only the older age group adequately decreased the level of confidence for items they believed to be incorrect and the majority of the children, independent of age failed to decrease the level of confidence for items that previously had been regulated inadequately. Results are discussed in terms of developmental progression and with respect to current theoretical frameworks of metacognition.

## *Development of metacognitive knowledge and skills in primary education*

Molenaar, Inge

Our knowledge with respect to the development of metacognitive knowledge and skills of young students in elementary education is restricted. There is abundant evidence that students' this age apply metacognitive activities during learning. Yet, we know very little about the developmental trajectory of metacognitive knowledge and skills. Moreover, there seems to be a discrepancy between the metacognitive knowledge students have and the metacognitive skill they apply during learning. This study focuses on whether there are developmental differences in the usage of metacognitive activities between 9, 10, and 11 year-olds. The discourses of 6 triads that collaboratively learned in an electronic learning environment over 6 hours were analyzed. Frequency analysis was used to understand the difference in usage of metacognitive activities and different sub-activities (orientation, planning, monitoring and evaluation) among students of different ages. Moreover, a sequential analysis was used to explore potential shifts in the integration of metacognitive activities in the group's overall learning activities and among the different sub-activities. Older students were engaged in more orientation and evaluation activities compared to younger students, whereas younger students performed more monitoring activities compared to older students. Moreover, the relation between the metacognitive activities becomes increasingly more cyclical as proposed by different theoretical models (Nelson, 1996; Veenman, 2011). For example, older students are more likely to follow monitoring activities with evaluation activities than younger students. In the sequential analysis we found that the position metacognitive activities in relation to other learning activities changes with age. For example, triads with older students show a strong link between social relational activities that monitor their collaboration and metacognitive activities. This seems to indicate a stronger integration of social and cognitive regulative activities. Thus, there are some indications of

developmental changes over age visible in the data that could help us to understand the development trajectory of metacognitive knowledge and skills.

### *Metacognitive skills and intellectual ability of young adolescents: A longitudinal study from a developmental perspective*

van der Stel, Manita; Veenman, Marcel

This study shows the final results of a longitudinal project where participants were followed for three consecutive years as they enter secondary school (aged 12 to 15 years). The first objective of this study was to investigate the development of both quantity and quality of metacognitive skills. The second objective was to establish whether the development of metacognitive skillfulness is intelligence-related or relatively intelligence-independent. Finally, the generality vs. domain-specificity of developing metacognitive skills was investigated. In the first year, 32 first-year secondary-school students participated in this study. In the second and third year, respectively 28 and 25 students remained. While thinking aloud, participants performed two different tasks representing two different domains: A text-studying task for history and a problem-solving task for mathematics. Each year, participants were given new tasks, suitable for their age. Participants' intellectual ability was assessed, as well as their metacognitive skillfulness and learning performance for both domains separately. Results of the first two years show a significant growth in both quantity and quality of metacognitive skillfulness. In the third year, however, growth did not continue. Furthermore, results show that metacognitve skillfulness contributed to learning performance, partly independent of intellectual ability. Results also show that metacognitive skills appear to be predominantly general by nature over the years. Although a smaller domain-specific component was found as well in the first two years, this component disintegrated in the third year. Interestingly, the age around 15 yrs. appears to be a crucial point in time during the developmental trajectory of metacognitive skills. At this age, the growth of metacognitive skills is temporarily put on hold, while the nature of these skills becomes fully general.

## S18 CAN WE TEACH EMOTIONS? METACOGNITIVE TRAININGS ON EMOTIONAL EXPERIENCE IN TYPICAL AND ATYPICAL DEVELOPMENT

Organiser: *Molina, Paola*
Discussant: *Albanese, Ottavia*

Metacognition is the awareness of one's own cognitive competences and could help the child's learning processes. Moreover, meta-cognition implies being aware of one's own emotional competence, as well; thus it is important to understand if specific

trainings in meta-cognition could help the child managing his/her social relationships. This symposium presents trainings on meta-emotional competences, both in educational (Cavioni et al., Ornaghi et al.) and clinical contexts (Bulgarelli et al., Farina et al.). The common objective of these interventions is to improve children's awareness about their own emotional experience, through several methods and tools, according to the context of intervention and to the children's age. The trainings for younger children are focused on body experience and verbalization of emotions (Bulgarelli et al., Cavioni et al.); the training for older typical children is centered on the reflection about the emotional experience (Ornaghi et al.), whereas the training for high functioning autistic children in focused on pragmatics (Farina et al.). The effectiveness of these meta-cognitive interventions is demonstrated in each study. Specific trainings could improve awareness about emotional experience, both in typical and atypical development. Such trainings could be useful to improve children's social competence: this is particularly important in school contexts, where the management of social relationships is often difficult for teachers.

## *The effectiveness of a training program in socio-emotional competence in preschool children*

Cavioni, Valeria; Zanetti, Maria Assunta; Renati, Roberta

The current educational context focuses largely on cognitive development of children from preschool age, promoting early academic literacy and numeracy. The increasing emphasis on socio-emotional aspects of learning, however, has led researchers to start focusing not only on academic achievement, but also on the emotional and social competencies underlying processes of learning (Denham, 2006; Peth-Pierce, 2000). The effectiveness of social emotional competence interventions in school has been demonstrated by several studies showing an improvement in academic achievement, increase in school attendance and motivation, decrease in anti-social behaviors and social inclusion within the class group (Zins et al., 2004). Several studies have shown that interventions aimed at enhancing emotional and social competencies can be most effective in preschool age (Appleton & Reddy, 1996; Clements, Rustin & McCallum, 2000). In this paper we present the findings of a study on the effectiveness of an intervention program to promote social-emotional competences in a sample of preschool children. We hypothesized that children in the experimental group would show significant improvement in social-emotional skills at post-test when compared to those in a control group. Furthermore, this study explored the relationship between emotional competence and behavioural problems. Pre-test/post-test research design with control and experiemental group and quantitative data analyis were used in the study. Questionnaries (parents and teachers versions) and direct measures were used to assess the emotional competencies and behavioral problems of the participants at pre and post

test periods in both groups. We recruited 74 preschoolers (M = 35; F = 39) from a kindergarten school in the north of Italy, divided into a control group with no training (N = 36), and an experimental group which received the intervention (N = 38). The following measures were used: TEC – Test of Emotion Comprehension (Pons & Harris, 2000; Children Behaviour Checklist 1 ½ – 5 C-TRF (Achenbach & Rescorla, 2001; Italian version: Frigerio, 2000); SDQ – Strengths and Difficulties Questionnaire (Goodman, 1997; Italian version 4-16 years). At pre-test the two groups showed significant differences, with the experimental groups scoring significantly lower in terms of relationship with peers, in prosocial behavior and attention skills. At post-test we found no differences. The experimental group registered, also, a significant increase in emotional competence ($t = -2{,}78$; $df = 37$; $p = .008$). The findings showed that the main effects of the training were related to emotional skills, suggesting that the program was particularly effective in strengthening the emotional competence of preschoolers. This paper will discuss the results and their implications for practice in early childhood education.

## *How to improve social cognition by training children in emotion understanding: a primary school study*

Ornaghi, Veronica; Piralli, Francesca; Cherubin, Elisa; Grazzani Gavazzi, Ilaria

The present training-study focuses on the development of emotional understanding (EU) in childhood (Harris, 2008). It examines to what extent improving children's EU has an impact on their social understanding (Hughes, 2011). We investigated whether training school-aged children in metacognitive conversational activities (Siegal, 1999) about the nature, the causes and the regulation of emotions played a significant role in improving their EU and their socio-emotional abilities. It was expected that the training group would outperform the control group on the post-test tasks. A total of 110 primary school children (mean age at the pre-test: 7 years and 3 months; SD = 3,4 months) took part in the study. They were attending the second class and didn't present any linguistic or psychological deficits. They were evenly divided by gender and randomly assigned to two groups: training group (N = 55) and control group (N = 55). Children were pre- and post-tested with the following measures: the Test of Emotion Comprehension (Albanese & Molina, 2008) to assess their comprehension of different aspects of emotions; a false-belief understanding battery, containing two second order tasks (Liverta Sempio et al., 2005), and an adapted version of the Explanation Task (Pesking & Astington, 2004); the Emotional Lexicon Test (ELT; Grazzani et al., 2009), to assess their understanding of emotional language; and the "How I Feel in different situations" Test (HIF; Feshbach et al., 1991, in the Italian version of Bonino et al., 1998) to evaluate the affective and cognitive dimensions of empathy. Children belonging to the training group took part in a 2-month intervention. They participated, in small groups, in twice-

weekly intervention sessions lasting around 40 minutes each. During these sessions, they were involved in metacognitive conversations about the nature, the external and internal causes, and the regulation strategies of fear, anger, sadness, happiness, and guilt. A multivariate analysis of variance was conducted with the factors Time (pre- vs. post-test) and group condition (training vs. control) as independent variables. Time was a within-subject variable, while Group Condition and Gender were between-subject variables. Scores for EU, false belief comprehension, emotional language comprehension and empathy were the dependent variables. The analysis revealed a significant effect of Time ($p < .001$), and a significant Time × Group interaction ($F = 2{,}63$; $p = .02$), as at the post test the training group outperformed significantly the control group. The univariate tests showed a significant interaction effect EU ($p < .05$), false belief comprehension ($p < .05$) and the cognitive dimension of empathy ($p < .05$). The findings suggest that promoting EU through metacognitive conversational activities has positive effects on children's social cognition during school years.

## *The SAS (Sviluppo Abilità Sociali) training: Validation of a new training for social abilities development in children with autism*

Bulgarelli, Daniela; Molina, Paola; Rossini, Emmanuelle; Thommen, Evelyne

The SAS (Sviluppo Abilità Sociali – Development of Social Competences) is an innovative training developed in Switzerland by Emmanuelle Rossini. Based on the theory of the embodied simulation (Gallese, 2006) and on recent theory on social competence (Albanese & Molina, 2008), it is meant to support the autistic child in the development of basic emotion comprehension (recognition and labeling, comprehension of external causes) and emotional regulation, Theory of Mind competences (perception knowledge, thinking/telling) and mentalization. The SAS sessions could be individual or in small group; three marionettes are used to simulate typical social situations. We will present the first data about the validation of the efficacy of the SAS, financed by the Swiss National Found, in collaboration with the ARES Foundation (Giubiasco), the Department of Psychology of Turin (Italy), and other Swiss and Italian partners. The sample is made of 21 children with PDD (16 boys), from 4 up to 10 years (average age = 76 months, SD = 16 months). Today, the control group is made of 11 children (all boys), from 5 up to 8 years (average age = 81 months, SD = 12 months). All children were diagnosed as autistic through the ADOS. All children are Italian speaker; 4 children of the experimental group live in Ticino (Switzerland); the others are all Northern Italian children (Piedmont). In the pre-test all children were administered the Leiter-R (Roid & Miller, 1997) to determine their cognitive level; to evaluate their socio-cognitive competence, the TEC (Test of Emotion Comprehension; Pons & Harris, 2005; Albanese & Molina, 2008), the ToM Storybooks (Blijd-Hoogewys et al., 2008; Molina & Bulgarelli, in press) and the APL (Linguistic-Pragmatic Abilities; Lorusso,

2009) were used. The experimental group attended 20 sessions of the SAS (one per week); then, after 8 months, the children were administered the post-test (TEC, ToM Storybooks and APL) soon after the end of the training, and were successively followed up three months later. The control group was administered the post-test eight months after the pre-test. From previous pilot studies, we know that the children attending the SAS improved their social competences and were able to attend "normal" schools in Switzerland. We expect the SAS children to show improvements in the socio-cognitive tests as well, and to perform better than the control group in the post test. We expect the SAS children to maintain these improvements three months after the end of the training.

## *Pragmatics and emotion understanding: A training for autistic children*

Farina, Eleonora; Brambilla, Paola; Albanese, Ottavia

Linguistic abilities and emotion comprehension are strictly linked in children with typical development. In particular, lexical, syntactic and semantic skills promote emotion understanding (Harris, de Rosnay & Pons, 2005), but the comprehension of complex emotional features is mainly predicted by the ability of making inferences, which deals with pragmatic competence (Farina, Albanese & Pons, 2007). Children with High Functioning Autism (HFA) and Asperger Syndrome (AS) present similar diagnostic frames, characterized by adequate cognitive development, good phonological, syntactic and semantic competences, but scarce pragmatic skills and low socio-emotional competences (Wing, 1981). Children with HFA and AS can therefore be important to the study deepening the links between emotion comprehension and language which can be found in literature. We hypothesized to identify the same link between pragmatic competences and emotion understanding, which emerged in children with typical development, in subjects with atypical development, too. Furthermore, we decided implement a training on pragmatic competences in order to promote an improvement in pragmatic skills and to detect any possible improvement in emotion comprehension too. Participants were 8 children with HFA and AS (mean age: 6.67), who were administered the Test of Emotion Comprehension – TEC (Albanese & Molina, 2008); Linguistic Pragmatic Abilities – APL Medea (Lorusso, 2009); ad hoc training from "Parliamone" program (Santoro et al., 2009). Children were divided in two groups according to their diagnosis (HFA or AS) and each group attended five sessions of training (2 hours for each session). Each group worked on five main pragmatic issues: understanding metaphors, making inferences, using the dialogical structure, comprehending idiomatic expressions and adapting the communicative messages to the listener. First results: the non parametric correlation analysis showed a positive link between TEC and APL (.821): this confirms our first hypothesis. Descriptive analyses evidenced, in the whole group, a deficit in emotion comprehension, but high levels of pragmatic competences.

Significant differences emerged between HFA and AS, the latter obtaining better performances in both tests. Those results seem to be in contrast with the literature and call for further investigation. Pre-post results show an improvement of the performances both in pragmatic competences and in emotion comprehension after the training. Furthermore the differences we found in pre-test phase between HFA and AS remain significant only for pragmatics, but not for emotion comprehension (HFA improved their performances more than AS). In spite of these peculiarities, and considering also the preliminary nature of this study, the efficacy of the training – identified in both groups – suggests its real applicability and usefulness in clinical and educational fields.

## S19 THE ORIGIN OF CHILDREN'S METACOGNITION: THE ROLE OF THEORY OF MIND

Organiser: *Lecce, Serena*
Discussant: *Pons, Francisco*

Recent theoretical frameworks (Kuhn, 2000) and empirical data (Lecce et al., 2010; Lockl & Schneider, 2007) suggest the existence of a significant link between children's development of theory of mind and metacognition. This symposium brings together multiple perspectives on the relationship between children's theory of mind and metacognitive knowledge at different stages of development. The first paper examines the role of theory of mind in the development of metamemory of 4-5-year-olds using a training methodology. The second paper uses two longitudinal studies to investigate the role of theory of mind in the acquisition of metacognitive knowledge during the pre- and primary-school period. Finally, the third study investigates the relationship between theory of mind and attribution.

### *The role of Theory of Mind in children's development of metamemory: A training study*

Lecce, Serena; Demicheli, Patrizia; Bianco, Federica; Nola, Marta; Pagnin, Adriano

Recent theoretical models (Khun, 2000) and empirical data (Lecce et al., 2010) have highlighted the existence of relationships between children's theory of mind (ToM) and metacognition. In a pioneering study, Lockl & Schneider (2007) showed that early ToM predict metamemory during preschool. In a recent research, Demicheli (2011) was able to measure both ToM and metamemory at two time points and showed that early ToM predict later metamemory, but not the reverse. Despite interesting, these studies are correlational and do not inform on the causal nature of the relationship between ToM and metamemory. To answer this question we used a training methodology. We designed a false-belief (FB) and a control-physical (CP) training and tested whether the FB training facilitate children's metamemory more than the CP one. In total, we

recruited 68 children that were randomly assigned to one of the training condition: FB training (17 boys and 19 girls; mean age = 56.28 months; SD = 3.9) and CP training (21 boys and 11 girls; mean age = 57.38 months; SD = 3.9). Children were administered standardized tests of vocabulary (pretest), memory performance (pretest) and a battery of ToM (pre and postest) and metamemory tasks (pre and postest). ToM was measured using 1st and 2nd order FB questions (Lecce et al., 2011) and the Theory of Mind Test (Pons & Harris, 2002). Metamemory was measured using the Metamemory Task by Wellman (1977) and the metamemory-strategies-story by Cornoldi and Orlando (1988). Children were pre-tested, trained and post-tested individually in their preschool. After the pre-test, children took part to the training that consisted of three training sessions. In the FB-training condition children were given three 1st order FB tasks per session. In the CP-training condition children were given three physical short stories (White et al., 2009) per session. In both condition the experimenter gave appropriate feedbacks to children's performances. Post test took place the week after the end of the training. The FB and the CP groups did not differ at pre test in any of the study-variables: vocabulary, $t = .50$, memory performance, 1st order FB, $t = .74$, 2nd order FB, $t = .64$, TMT, $t = .04$, Wellman task, $t = 1.8$, and the metamemory story, $t = 1.1$ (all ns). In terms of training effect, a series of ANOVA for repeated measured showed a significant interaction between training condition and: 1st order FB, $F(1,66) = 9.07$, $p < .01$; 2nd order FB, $F(1,66) = 4.38$, $p < .01$, TMT, $F(1,66) = 7.01$, $p < .01$, and metamemory, $F(1,66) = 5.27$, $p < .05$. Overall, results demonstrated the efficacy of the FB training on children's ToM abilities. They also showed that the FB training had a significant effect on children's metamemory. The present study, thus, supports the existence of a close link between ToM and metamemory and suggests that this relationship may have a causal nature.

## *Theory of Mind and metamemory: Longitudinal analyses on the reciprocal relationship between the ages of 3 and 7*

Lockl, Kathrin; Ebert, Susanne; Weinert, Sabine; Schneider, Wolfgang

Whereas developmental trends in children's declarative metamemory, that is, their knowledge about person, task, and strategy variables have been well documented, little is known about the origins of this knowledge in early childhood. Among the few studies, a longitudinal study demonstrated that theory of mind abilities at the ages 3 and 4 made significant contributions to the prediction of metamemory scores at the age of 5 controlling for language (Lockl & Schneider, 2007). However, in this study, metamemory was assessed only at the age of 5 and, accordingly, it could not be tested whether the sequence of theory of mind and metamemory may also be reversed, i.e., whether metamemory predicts theory of mind. Furthermore, it is unclear whether these predictive relations consist over a longer period of time. Therefore the aim of the present

study is to examine the bidirectional interrelationships between theory of mind and metamemory from the age of 3 until the age of 7. The data presented here come from two longitudinal projects following children from preschool to primary school. The first study represents an extension of the Würzburg Longitudinal Study (Lockl & Schneider, 2007) with about 180 children and includes measures of theory of mind and language at the ages of 3, 4 and 5 and metamemory at the ages of 5 and 7. The second study is part of the comprehensive longitudinal study BiKS-3-10 (Educational Processes, Competence Development and Selection Decision in Preschool and School Age). Beside various measures of verbal and nonverbal competencies a subgroup of about 130 children (Ebert, 2011) received also measure to assess theory of mind understanding and metamemory at the ages of 3;8, 4;2, 4;8 and 5;2 as well as metamemory measures again at the age of about 7. Overall, both studies yielded very similar results concerning the relationship between theory of mind and metamemory. During the preschool period significant correlations around r = .50 between both areas were found and these correlations remained significant controlling for verbal and nonverbal abilities. Concerning the predictive relations, study 2 adds new information in showing that earlier theory of mind measures made significant contributions to the growth of later metamemory but not the reverse. Looking at the predictive value of early theory of mind measures for metamemory, when children had entered school, low but partly significant correlations between early theory of mind measures and metamemory in school emerged. However, for both studies, these relationships turned out to be nonsignificant controlling for language and nonverbal competencies. To sum up, our analyses strengthen the assumption that theory of mind is an important factor which facilitates the acquisition of metacognitive knowledge during the preschool period. However, the impact of early theory of mind competencies does not seem to hold up until grade 1, after having accounted for nonverbal and verbal abilities.

### *Metacognition and Theory of Mind: A training program of mentalist skills*

Sáiz-Manzanares, María Consuelo; Carbonero Martín, Miguel-Ángel; Román-Sánchez, José-María

Recent investigations in Theory of Mind (ToM) relate its development to the development of the metacognitive skills "planning," "regulation", and acquisition of "predictive and causal reasoning." These studies reveal the importance of metacognitive training in the development of mentalist skills. In the present work, the effects of training were compared in 20 children, aged between 4 and 5 years. Significant within-group differences in the skills of belief attribution and memory attribution were found and a tendency towards significance in the skills of behavior prediction. Significant between-group differences were found in belief attribution, prediction, and memory. Significant correlations were found between the development of the skills of

comprehension and reasoning and mentalist skills of belief attribution and behavior prediction.

## INDIVIDUAL PAPERS

### I1 METACOGNITION AND READING

### *The relationship between metacognition, reading comprehension and individual differences in reading skills*

FURNES, BJARTE; NORMAN, ELISABETH

As pointed out by Williams and Atkins (2009), the ability to read with understanding is the most important achievement in a young student's life. Nevertheless, even students who can decode texts fluently often have difficulties with text comprehension. Research has consistently shown that successful readers in comparison to poor readers exhibit higher levels of metacognitive knowledge about reading, and are better able to evaluate and regulate their cognitive processes during reading. We summarize findings from existing literature on the relationship between metacognition, reading comprehension and individual differences in reading skills. Metacognition can be defined as cognition about one's own cognition, and plays a role in the monitoring and control of cognition (Koriat, 2007; Metcalfe, 2000). Metacognition includes knowledge, skills, and experiences (Efklides, 2001, 2008). Metacognitive knowledge refers to the individuals' knowledge and understanding of their own cognition (Flavell, 1976). Metacognitive skills refer to the individual's deliberate use of cognitive strategies to control cognition (Efklides, 2008). Metacognitive experiences are feelings, judgements/estimates and online task-specific knowledge that reflect what the person is aware of and feels during task performance (Efklides, 2008). Research has mainly focused on how reading comprehension skills are related to metacognitive knowledge and metacognitive skills. It has been shown that better readers demonstrate more metacognitive knowledge than poor readers (Baker & Beall, 2009), and that reading comprehension improves through strategy instruction (e.g., McKeown & Beck, 2009). The question of how reading comprehension is related to metacognitive experiences has received less attention. There is a need for research that systematically combines measures of the three forms of metacognition in one study. We present a study (N = 100) that demonstrates how metacognitive knowledge, skills and experiences can be measured within the same setting. Individual differences in reading comprehension was assessed at the start of the study, by the use of a standarized test (Strømsø et al., 1997). Each participant then read a sequence of short factual texts, each consisting of 1000

words. Learning outcome was measured as performance on recall and recognition questions that required both memory for details and higher-order comprehension. Metacognitive experiences in the form of metacognitive feelings was measured as (a) Feelings of Knowing (FoK) rated in conjunction with every recall response, (b) Confidence Ratings (CR) rated after every recognition response, and (c) Predictions of Performance (PoP) rated after completing a certain proportion of text. Metacognitive knowledge and skills were assessed by a self-report questionnaire. Results will be reported at the conference, and will be discussed in relationship to earlier findings.

## *Metacognitive skills and reading performance: Empirical findings from PISA 2*

Lee, Jihyun

The Programme for International Student Assessment (PISA) is an OECD project that assesses the national samples of the 15-year olds on their knowledge and skills in reading, mathematics, and science. This project started in 2000 with a three-year assessment cycle. In 2009, students in 65 countries and 10 economies participated in this assessment. The total student sample size in PISA 2009 was N = 475,460 with each country contributing to about 1% of the total PISA sample. The PISA also collects, based on the responses on the questionnaire format, the information about the factors that may be related to students' learning outcomes. Metacognition is one of the major constructs that has been assessed in the PISA project. It asks about students' metacognitive skills and habits in relation to their academic learning activities. In this presentation, I will demonstrate the similarities and differences in students' use of metacognitive skill and its effects on the PISA 2009 reading performance in about 30 OECD countries. The countries will be classified into one of the GLOBE society clusters (House, Hanges, Javidan, Dorfman & Gupta, 2004). In particular, five sub-domains of metacognitive skills will be analysed and compared across countries: Deep-reading habits (i.e., being aware of importance of understanding, remembering, and summarizing), Wide-reading habits (i.e., regular reading of a variety of materials), Control strategies (being aware of one's level of understanding and making sure learning is achieved), Elaboration strategies (being able to transfer new knowledge into out-of-school contexts), and Memorization (being aware of the usefulness of memorizing the materials). Results indicated that students/countries which tend to know the importance of understanding and remembering the materials also use more often the summarizing strategies. The correlations among then were as high as 0.69 across OECD countries. Similarly, the correlations between control strategies, elaboration strategies, and memorization also tend to be moderately high (around 0.41 to 0.55) across all OECD countries. This phenomenon was present in both East and West although the associations were slightly stronger for Confucian Asian countries. The associations between students' metacognitive skills and their reading performance vary across

countries, but they tend to be strong in general across all OECD countries. For instance, the differences of students or countries between the top and bottom quarters on the awareness of understanding and remembering was 90 score-points at the between-country levels and 70 score-points at the within-country level (on the reading scale of 600 and a standard deviation of 100). Confucian Asian countries tend to show stronger associations between metacognitive skills and reading performance. In fact, the factors that contributed to Asian students' higher performance were their metacognitive skills, rather than motivational factors.

## *When rereading is not enough: the importance of self-regulation in the use of rereading procedures*

Minguela, Marta

Reading comprehension is a complex activity implying not only automatic processes, but also real strategic thinking; skilled readers, faced with different reading requirements, know which cognitive processes need to be activated and how to do it; i.e., they can self-regulate comprehension. The ability to self-regulate one's own comprehension may not only be reflected in the product of comprehension, but also in the metacognitive procedures in which a reader engages, including both monitoring and control (Nelson, 1996). The aim of this study is to identify differences in self-regulated reading between skilled and less-skilled readers, when they reread a text to solve different types of comprehension questions. To address this issue, the rereading behaviour of 39 last-year secondary students (19 skilled readers and 20 less-skilled readers) was examined. Participants first read an expository text, answered to questions measuring different comprehension levels without looking back to the text, and made metacognitive judgements about their confidence in the answers. Then, they were enabled to reread the text to complete their answers if necessary. Metacognitive judgements were considered as a measure of monitoring, and the use of rereading procedures as a measure of control. Data were collected using a software that allowed keeping track of the reading and rereading processes followed. These data were analysed to describe the different rereading procedures used by participants. On the basis of the relevance of the reread information to answer to a given question, the sequence of reading, and reading speed, 3 different procedures were identified, in line with prior research on search behaviours (Cataldo & Oakhill, 2000). Self-regulation was analysed considering the coherence between the confidence in the answer and the presence or the absence of rereading, the improvement in comprehension after rereading, the rereading procedure used, and the adaptability of this procedures to the different kind of comprehension questions. Our preliminary results point out that skilled readers tend to better self-regulate their comprehension, judging accurately their answers and using this information enrol in an adequate rereading procedure to improve comprehension when needed. On the

contrary, less-skilled readers show difficulties to monitor and control their own comprehension, being more likely to overestimate their comprehension and to use rereading aimlessly. These results emphasize the importance of highlighting self-regulation in the teaching of reading comprehension.

### *The contribution of the left dorsolateral prefrontal cortex (DLPFC) as metacognitive control mechanism in attentional performance. An rTMS application*

Segurini, Alessandro; Balconi, Michela

The cortical contribution in response to sustained attention was explored in the present research by using brain stimulation. Thus, repetitive transcranial magnetic stimulation (rTMS) is a tool that can be used to modify activity of targeted cortical areas. The effect of this stimulation technique on attentional processes was explored in the present research, which focalized on the sustained attentional task (Stroop task). High-frequency (10 HZ) rTMS stimulation was induced on the left dorsolateral prefrontal cortex (DLPFC) when subjects (N = 10) performed the Stroop task. The 10 Hz stimulation was able to induce a temporary potentiation of the cortical responsiveness by improving the neuron polarization activity. Based on this evidence we supposed the rTMs stimulation may increase the subjects' performance in terms of both accuracy (number of correct responses) and efficiency (reduced RTs) when DLPFC was stimulated. One control condition was provided, in addition to the DLPFC stimulation, that is sham stimulation. The statistical results showed a consistent increased ability to focalize and sustain the attentional behavior, with significant shorter RTs, but a decreased of the correct responses. These partially unattended results pointed out that a possible "automaticity effect" induced by a significant increased activity by DLPFC that suggests a sort of impulsive behavior (more rapid but less accurate response). The effect of the left DLPFC was compared with previous studies that used low-frequency stimulation (inhibition paradigm) or that applied the stimulation on the controlateral (right) hemisphere. Specifically, the control functions of a frontal network, which includes the DLPFC, were largely discussed.

## I2 METACOGNITION AND SCIENCE LEARNING

### *Metacognition in and for appropriating physics knowledge: An empirical study on thermodynamics*

Fantini, Paola; Levrini, Olivia

The paper focuses on the role played by metacognition in enabling students to appropriate physics. Appropriation is chosen, in this research, as the core idea for recognising whether a teaching/learning experience in a real classroom is successful.

Appropriation includes more than deep understanding of content knowledge: it implies that each student situates her/his understanding within a wide personal project of intellectual and emotional growth, according to her/his cognitive style and cultural interests. The paper considers the data (answers to open questionnaires, audio- and video-recording of classroom discussions and individual interviews) collected during the implementation of a teaching proposal on thermodynamics in classes of scientifically-oriented secondary schools in Italy (grade 12). In a previous study framed within the Design Studies (Cobb et al., 2003), a qualitative data analysis allowed us to work out an operational definition of appropriation: that personal process of content knowledge transformation that leads disciplinary knowledge itself to be a consistent and personal reconstruction of physics "signed" by the students, where "signed" means that: i) the voice of the teacher is not present; ii) physics content knowledge is assumed within a personal broad path to knowledge that goes far beyond the mere aim of learning a specific domain of physics. The definition, bootstrapped from the data, is operational in two senses: i) it includes the indication of what observable features must be searched in students' discourses for recognizing appropriation; ii) it is effective for recognizing appropriation also in cases where it is not evident (Levrini et al., 2011; 2012). The presentation will aim at answering the following research question: what metacognitive skills and competences trigger and support appropriation? On the basis of a qualitative data analysis, it will be showed that the individual attitudes and abilities, recognisable as particularly evident in those students who appropriated thermodynamics, are:

- the ability of recognizing, in the conceptual scenario, a space for multiple possible paths for understanding;
- the ability of moving back-and-forth from local details to global views;
- the emotional disposition to taking care of and accountability for their learning and to venturing their guess for anticipating where the various paths for understanding can lead.

## *Unprompted student-driven metacognitive data from two distinctly different sources*

Sayre, Eleanor C.; Irving, Paul W.

Metacognition is a difficult concept to record as it is not always heard or seen during task performance (Veenman, 2006). An essential component of metacognition is employing study strategies to reach a goal, self-assessing one's effectiveness in reaching that goal, and then self-regulating in response to the self-assessment (Rivers, 2001). The ability to self-assess is considered essential to one's future metacognitive development. We record video data of students solving a harmonic problem in undergraduate physics instruction in two very different contexts (oral examination and informal recitation) to study students' use of coordinate systems. Case study students display two distinctly different levels of metacognitive development in the two contexts. In recitation, "Bill"

assesses his effectiveness at reaching his goal and identifies his own lack of understanding, but he still needs the TA to regulate his end point of satisfaction with the problem. In a high-stakes oral examination, "Zeke" employs a problem solving strategy, reassesses it at various points during his solution, and regulates his own end point of satisfaction with the problem. Bill works on the algebraic signs of forces in damped harmonic motion. The six minute episode starts when Bill asks, "Can we go over why these forces are negative?", displaying metacognitive awareness of his lack of understanding. In discussion, Bill attempts several times to come to an understanding and satisfying conclusion to the problem. He often confuses himself with his reasoning and the TA has to make several interventions when Bill trips himself up with his explanations. At the end of the discussion Bill asks the TA if his reasoning is ok, indicating a need an external end point regulator. In contrast, Zeke solves a one dimensional harmonic motion similar to Bill's. It takes Zeke three minutes to work through the problem and he confuses himself and starts over several times during that time. Unlike Bill, Zeke recovers from confusion on his own without any interaction with the examiner. Zeke ends the oral examination with the statement "Ok. I'm happy now" which he pronounces in a summative tone of voice. In an exam situation Zeke's attempts to satisfy his intrinsic need to understand the concepts and satisfy his own goals reveals an advanced level of metacognition. This paper gives evidence that metacognitive data can be observed in disparate classroom-based interactions. Metacognitive skills can be observed in the pressure situation of an oral examination; additionally, those skills are student-driven, revealing several possibilities for future research.

## *Failure to understand stock-flow thinking: Is metacognition possible explanation to this phenomenon?*

Asik, Gursu; Doganca, Zerrin

System thinking involves identifying parts of a system, seeing their interrelations, representing, and assessing dynamic structures of a system (Sweeney & Sterman, 2000). Effective decision making in dynamic systems requires a clear understanding of the relationship between stocks and flows. However, the literature points out that even highly educated people are often unable to understand the behavior of simple stock–flow structures (Sweeney & Sterman, 2000). Cronin et al. (2009) demonstrated that poor understanding of accumulation, that is stock–flow failure, is not due to an inability to interpret graphs, lack of contextual knowledge, motivation, or cognitive capacity. They rather concluded that the failure is related to using inappropriate heuristics, which is closely related to metacognitive functioning. The focus of the study is to examine deeply the role of metacognitive skills in solving stock-flow tasks. The first question of the study is whether students who give correct response exhibit a higher level of metacognitive skills. Sixty pre-service mathematics teachers were selected as subjects. All had taken

calculus course including stock-flow context, and had strong mathematics background. The subjects performed two common stock-flow tasks in an individual session of about 15 minutes. Metacognitive problem-solving processes during the stock-flow tasks were assessed through online systematic observations by the experimenters and scored on the occurrence of 14 activities (Veenman, 2006). At the end of the process, subjects received feedback to find out whether their answers were correct or not. The feedback was confined only as "correct" or "incorrect", and no other information was provided. In case of incorrect response, subjects were allowed to think on the tasks. Subjects' ongoing metacognitive behaviors in correction processes were re-assessed. Hence, the second question of the study is how metacognition leads participants to identify and correct mistakes after "incorrect" response is given to them. Observations are recorded and being evaluated by both researchers to ensure inter-rater reliability. The results of the study are significant in two aspects. Firstly, it demonstrates to what extent metacognitive skill development is essential in systems thinking. Secondly, the present study reveals the role of subjects' metacognitive behavior in correction processes. Data collection process has been almost completed and the results will be shared in the symposium.

## *Enhancing the trainee teachers' learning and teaching physics through metacognitive strategies*

Gaciu, Nicoleta

Over 35 years ago Ann Brown and John Flavell (Brown, 1975; Flavell, 1976) have investigated the relationship between metacognitive strategies and problem solving and their studies have shown that young people improve their own performances when they are engaged in metacognitive activities. The majority of teaching strategies used in science lessons for young learners, such as critical thinking, collaborative work, and self or peer assessment are correlated with metacognitive strategies of teaching (Bransford, 2000). The purpose of this study is to investigate whether the uses of metacognitive strategies influence trainee teachers' prior learning experiences and help them to overcome the anxiety related with teaching Physics. The subjects involved in this research are adult trainee teachers with a science degree in a subject other than Physics. They perceive Physics as a difficult subject and their approach towards learning Physics is a surface approach as a result of the fact that Physics was taught using mostly the cognitive approach (Woolnough, 1994) and due to the strong interaction between their particular habits, beliefs, and their initial experiences and attitudes about physical phenomena from extensive personal experience (Halloun & Hestens, 1985). My approach was to create a series of learning situations that require students to make successive refinements to the learning activities in order to accommodate increasingly complex phenomena, and to relate new concepts to their own life, to their experiences, knowledge, beliefs and feelings. This approach was supported by weekly reflective

journals and end of topic summaries which contained an analysis and self-reflection on metacognitive strategies and skills used for learning and teaching Physics. In addition, students were encouraged to work collaboratively with their peers to complete their learning tasks, build confidence, and give and receive feedback. An important outcome of the metacognitive approach was students' willingness to apply the metacognitive learning and strategies not only to their own learning and development, but also to collaborative learning and interactions with their peers. This strategy also helped them to discover the anxiety related with their learning and teaching Physics and to learn how to overcome it.

## I3 METACOGNITION: THEORETICAL ISSUES AND MODELS

### *Metacognition – The very idea. Conceptual issues of metacognition and their practical and empirical significance*

Klausen, Søren Harnow

Though it has been applied successfully to a variety of domains and subjected to thorough empirical scrutiny, the very notion of metacognition is still in need of further clarification. The precise understanding of the notion (as well as its component notions and more specialized notions of particular kinds of metacognition) has consequences for the various views on the importance of metacognition, for experimental design and for the interpretation of empirical findings The paper discusses some key conceptual issues and their possible consequences for the significance of metacognition and for psychological research in the field. The methodological approach is an application of philosophical psychology and epistemology to the notion(s) of metacognition currently in use (viz. analytical philosophy of a contemporary, empirically informed sort; it is not assumed that conceptual analysis can or should be an exclusively a priori, "armchair" business. Instead, the analysis is must involve an interplay between empirical findings, medium-range psychological theories and more abstract philosophical analysis). The main conceptual issue concerns the structure and epistemic standing of metacognition. Is metacognition a form higher-order thinking, or does it include other forms of self-regulation and/or other higher-order mental acts? This is pertinent to pressing issues concerning e.g., educational practice, as critics of the current emphasis on metacognition claim that metacognition tends to be too abstract, too intellectual and detached from subject-matter-based practice and concrete stills. This criticism is arguably based on a misunderstanding, that is, a neglect of the existence and importance of metacognition of a less intellectualist sort. But in order to mount a convincing reply, one need to develop an appropriately broadened, yet still precise and operational, notion of metacognition. A closely related question is in how far metacognition should be understood as higher-order knowledge. Ever since Flavell introduced the notion, it has been treated as more or less knowledge-like, sometimes distinguishing metacognitive knowledge from

metacognitive experience, sometimes assimilating the latter to knowledge as well, leaving its precise epistemic standing unclear. By applying some subtle and precise distinctions between different forms of knowledge taken from contemporary epistemology, the notion of metacognition can be clarified and refined, and common misunderstandings (like the charge of "intellectualism") can be overcome.

## *The notion of metacognition: A Trojan horse for cognitivism?*

Lo Dico, Giuseppe

Although in cognitivistic literature we can find many different definitions of metacognition, all of them seem to appeal to the capacity of a person to have knowledge of her/his own thoughts and of those cognitive processes that underlie her thinking (Reber & Reber, 2001). Two features seem to be implied in this definition: 1) in order to thinking about her/his cognitive processes (and possibly intervene over them) the person must be conscious and aware of them; 2) being conscious of her/his cognitive processes means to adopt a 'first-person point of view', that is, the only authority about the processes under consideration is the subject herself. Although the acceptance of these two features appears quite uncontroversial, they are a puzzle for cognitivism. In fact, according to this paradigm, almost all the mental processes must be considered unconscious (Sternberg, 1996, p. 20; Johnson-Laird 2006, p. 57) and cannot be consciously controlled, monitored and assessed in any way (Nisbett & Wilson, 1977, p. 252; Wegner, 2005, pp. 32-3). In this view, metacognition (and all the other mentalistic concepts with the prefix 'meta-') indicates a mental process without a real causal efficacy and thus a genuine explanatory value. In this paper, I'll try to show a picture of this controversy. On the one hand, I'll argue that cognitivists assume that (almost) all the mental is unconscious for characterizing it in a 'third-person point of view' as the natural sciences do with their objects of study. On the other, I'll point out that the notion of metacognition can be fully appreciated only if assumed in a 'first-person point of view'. I'll conclude by arguing that, if cognitivism accepted the notion of metacognition, it should renounce (at least partially) to characterize itself as a natural science (tout court).

## *The impact of metacognitive knowledge, strategy use and motivation on the achievement at Baccalaureate Schools in Switzerland*

Karlen, Yves; Maag Merki, Katharina; Ramseier, Erich

The successful self-regulation of the learning process requires different abilities, which are basically considered to be important for learning. With their model of the "good information processor", Pressley et al. (1989) postulate that effective (self-regulated) learning implies an alliance of adequate strategy use, high metacognitive

knowledge and successful motivational learning regulation. Especially metacognitive knowledge is considered highly relevant for reflective and strategic learning since it is a basic prerequisite for appropriate strategy use (Artelt & Neuenhaus, 2010). Moreover, the use of both metacognitive knowledge and strategy is connected to the motivational disposition of the learners. According to this, it is expected that there is a reciprocal relation between the three dimensions. The aims of this paper are (A) to examine the relationship of each of the three dimensions metacognitive knowledge, strategy use and motivation with the students' achievement and (B) to explore the interaction between metacognitive knowledge, strategy use and motivation with reference to the students' achievement. The analyses are based on data from a longitudinal study conducted in 116 tenth- and eleventh-grade classes at baccalaureate schools in Switzerland (Ntotal = 2518 students). The motivational aspects of learning as well as the frequency of strategy use were assessed by a standardized questionnaire. Additionally, a test capable of measuring metacognitive knowledge for tackling complex and difficult assignments at school was developed using a test structure previously described by Schlagmüller and Schneider (2007). The results of the t-test and regression analyses reveal that metacognitive knowledge is a stronger predictor for achievement than self-reported strategy use. Taking the motivational disposition into account, motivation seems to be more relevant than metacognitive knowledge and strategy use for successful learning processes. As expected, learners with a high score at all three self-regulation dimensions showed high performances. In conclusion, implications of these findings for future studies will be discussed.

## *Working on two levels: The power of metacognition in leadership learning*

Robertson, Jan

This paper will synthesise the findings from the author's different studies of leadership development, where meta-cognition has been a powerful part of the process in leaders' professional learning. The author theorises about the use of meta-cognition and how leaders can not only develop theory, but can also be assisted to make links between theory and practice. Metacognitive processes assist in the translation of research and the applied nature of leaders' learning. Studies of leaders' learning over a ten year period saw the development of the "Boundary Breaking Model of Leadership Development" (Robertson & Webber, 2008). This model included opportunities for the co-construction of meaning, provision of a forum for discussion, validation of personal knowledge, a generative approach to learning, formal and informal leadership, creation of a sense of community, growth of a counter culture, and international perspectives. Educational leaders need to become learners of their own practice through inquiry-focused, reflective practice with double- or triple- feedback loops for flexible, anytime learning. Broad understandings of "learning" are essential: learning for knowing, learning

for doing, and learning for being and becoming – which is about the examination of values, beliefs, biases, assumptions, and increasing self-awareness. Outside perspectives are essential in this learning process, through coaching (Robertson, 2011), to raise the learning to the metacognitive level rather than at the professional practice level. Both are essential in leadership learning. Validation of personal knowledge and formal and informal leadership characterized by partnership and reciprocity are key to this process. Learning experiences should be transformational, and move leaders out of their current ways of knowing and being – out of their comfort zones – so that reflection on this new learning can occur. If we want leaders to design C21st learning environments – underpinned by equity, social justice, moral purpose, and cultural responsiveness – then they need to be given these new learning experiences, with the metacognitive processes around their learning to understand and translate these new experiences to their own practice.

## I4 METACOGNITION AND MULTIMEDIA LEARNING

### *The misleading effect of illustrations on monitoring (mis)understanding of problem solutions*

Ackerman, Rakefet; Leiser, David; Shpigelman, Maya

Well-selected illustrations included in explanations of how to solve problems have been found to promote understanding. A question arises regarding the effects of ill-constructed illustrations. Ackerman and Leiser (2012) have shown that including uninformative illustrations in expository texts may nevertheless spuriously enhance the Sense of Understanding (SOU). Moreover, among relatively weak students the uninformative illustrations misled study-time management. Monitoring the understanding of solution explanations has not been studied before. Unlike learning expository texts, understanding solution explanations requires holistic understanding: People typically experience either understanding or misunderstanding. If the inclusion of uninformative illustrations produces an illusion of understanding in struggling students, it is highly problematic as they will cease learning too early, and this will harm their eventual performance. In the present study we examined whether uninformative illustrations affect SOU regarding solution explanations and whether the effect is limited to weak students or associated with hard tasks regardless of students' level. In Experiment 1 college students were presented with four hard logic problems (initial success rate < 25%). They attempted to solve each problem, read the solution explanation, rated their SOU regarding that explanation, and then tried to solve a transfer problem. Half the explanations were presented in plain versions and half were accompanied by uninformative illustrations. The effects were similar to those found with expository texts: SOU was higher for the illustrated explanations and the success rate in the transfer problems was somewhat lower than for the plain versions. However,

unlike with text learning, no differences were found between the lower and higher achievers. Experiment 2 examined whether students with even higher cognitive ability are less prone to the illusion of understanding generated by the uninformative illustrations. Engineering students with significantly higher SAT scores and more problem solving oriented backgrounds were presented with eight problems chosen to be hard for this population by the same criteria. They went through the same procedure as in Experiment 1. The effects in this group were even larger: SOU was higher and performance was significantly lower for the illustrated explanations than for the plain ones, across the board. Thus, even very high cognitive ability students are not immune to the misleading effects of ill-constructed illustrations included in explanations of problem solutions. This study will hopefully encourage designers of study material to use well-constructed illustrations only and take into account that uninformative illustrations not only have no benefit, but may actually impede learning.

## *Delegating metacognitive control of cognitive strategy use: The effect of implementation intentions in multimedia learning*

Stalbovs, Kim; Scheiter, Katharina; Gerjets, Peter

Presenting text and pictures has been shown to result in better learning than presenting text alone (Mayer, 2001). This multimedia effect is usually attributed to learners constructing two mental representations that can then be integrated into a more sophisticated mental model. To successfully integrate text and pictures, learners must process them in an active fashion by applying cognitive strategies (Weinstein & Mayer, 1986). However, even if learners know useful strategies and want to apply them, they will not necessarily do so. One technique that supports the translation of intended into actual behavior, even in cases of high cognitive load, is the use of implementation intentions (Gollwitzer, 1999). These "if-then" plans link opportune situations for achieving a goal with goal-relevant behavior (e.g., "If I have read a paragraph, then I will search the picture for the contents described therein"). They thus delegate action control to situational cues, circumventing the debilitating effects of cognitive overload. Hence, implementation intentions should be more effective than more (meta-) cognitively demanding instructional aids such as strategy prompts. The effect of implementation intentions on strategy use and learning was investigated in three studies. Study 1 was a 2×3+2 between-subject design (N = 160), which varied the type of strategies evoked by implementation intentions (text comprehension vs. picture comprehension vs. integration strategies) as well as the number of concurrently used implementation intentions (1 vs. 3). In addition, there was a control group without strategy information and a mixed group that learned with one implementation intention of each strategy type. As expected, the control group learned the least, whereas the mixed group performed best. Contrary to our expectations, there were no further differences. Study 2 compared

the mixed implementation intentions condition with a more conservative control condition (intention to use strategies) and replicated the effect. Study 3 (in progress) uses a 2×3 between-subjects design (N = 120) that varies instructional support (strategy information only vs. strategy prompt vs. implementation intentions) as well as cognitive load during learning (low vs. high; preload dual task paradigm). Under low cognitive load, learners in the "strategy prompt" and "implementation intentions" groups should outperform learners in the "strategy information only" condition; under high cognitive load, the "implementation intention" group should outperform all other groups. Results will be reported at the conference.

## *Metacognition in multimedia: A micro-analysis of process and judgment data*

Feyzi-Behnagh, Reza; Trevors, Gregory; Azevedo, Roger

We investigated the effect of three types of discrepancies (Within Text [WT], Between Text & Graph [BTG], and No Discrepancy [ND]) on undergraduate students' cognitive and metacognitive monitoring processes (coordinating informational sources [COIS] and metacognitive judgments [JOL]), and reading time in a multimedia environment. A subsample of twenty (N = 20) participants from a larger sample was used for this study. Twelve multimedia pages of science content with text and graph were presented to students who were asked to respond to inference questions on each page and make metacognitive judgments at different times during the experiment. The judgments included Ease of Learning (EOL; while viewing the question before inspecting the multimedia content), Judgments of Learning (JOL) for text and graph (after inspecting the content), delayed JOL for text and graph (30 seconds after JOL), and Retrospective Cognitive Judgments (RCJs; after answering the question). Trace data for this study were obtained from log-files and eye-tracking. The results of 3 x 6 repeated-measures ANOVA indicated significant main effects of discrepancy type ($F(2, 38) = 16.51$, $p < .01$, $\eta^2 = .465$), judgement type ($F(5, 95) = 7.00$, $p < .01$, $\eta^2 = .269$), as well as an interaction effect ($F(10, 190) = 13.07$, $p < .01$, $\eta^2 = .408$). JOL ratings on BTG discrepancy pages were significantly lower than WT and ND pages. Similarly, participants' immediate and delayed JOL ratings were significantly lower for graphs on pages with BTG discrepancy than for WT and ND pages. The analysis of time spent inspecting content on pages indicated no significant difference between reading time on pages with different discrepancy types, $F(2, 18) = .52$, $p > .05$. Eye-tracking data analyses revealed that participants spent significantly more time fixating on graph than text on pages with BTG discrepancy, $F(2, 38) = 3.57$, $p < .05$, $\eta^2 = .158$. This suggests that when participants noticed a discrepancy between text and graph, they spent more time inspecting the graph to resolve the discrepancy. No significant difference was found for fixation time on text for pages with different discrepancy types. In order to study how participants integrated information presented in graph and text form we investigated the

number of COIS they had on pages with different discrepancy types. An instance of COIS was operationalized in this study as a transition of eye-fixations from text to graph area and back to the text area, or vice versa. Our analyses further revealed that participants made a significantly higher number of COIS on pages with WT discrepancy than on BTG and ND pages, $F(2, 38) = 12.95$, $p < .01$, $\eta^2 = .405$. This suggests that when there is a WT discrepancy, participants inspect and compare the text and the graph hoping to resolve the discrepancy, while we expected a higher number of COIS on pages with BTG discrepancy. Overall, this study emphasizes the importance of fine-grained trace data for studying metacognition and learning from multimedia.

## *Fostering metacognition and reflectivity in early childhood professional caregivers through video and text cues*

Bove, Chiara; Braga, Piera; Mantovani, Susanna; Moran, Mary Jane

Research on metacognition mainly regards children and pupils and more rarely addresses teachers and caregivers in their professional activity, although themes such as memory, awareness of cognitive and emotional status, and the possible effect of metacognitive practice on self-control and intentional behavior, are undoubtedly relevant for the development of the educational professions, and especially in early childhood education and care where the caregiver-child relationships is salient and less mediated by contents as in teaching practices with older children. In the presentation we will discuss the impact and possible use in developing reflective and metacognitive behaviors for the professional development of caregivers of young children of video cues and micro-analytical and recursive interviews (Stern, 2004; Mantovani, Saitta & Bove, 2000; Bove, 2009). The examples will be drawn from an ongoing cross cultural qualitative study involving researchers and infant-toddler caregivers in two university lab infant day care centers (Mi-Bicocca/Tennessee) aimed to develop, illustrate and test reflective practices (Moran, 2007; Braga, 2009). In both sites teachers were videotaped and involved in processes of individual and group's review and analysis of video-clips. After a brief discussion of the concept of situated reflectivity Schön, 1983, 1987) and its links with metacognition's theories (Cornoldi, 1995; Albanese, 2003) we will use the words and voices of the Italian teachers involved in the study to illustrate and discuss the impact of mediational tools – artifacts such as videotapes, audiotapes, texts – that "freeze frame" thoughts and action to allow for deep, iterative, micro-analysis of the educating/caring process (Moran, 2009; Goldman et al., 2007). In our perspective, the participatory processes of becoming aware of what one does with children and why, as the process of making explicit the choices of each caregiver, is the outcomes of a situated/participatory process of observing, learning and changing through the interactions with other people thinking and practices (Rogoff, 2003). This process is embedded in the social and cultural context and in its typical educational practices

(Wenger, 1998). In the examples we will show how video can help implementing these processes acting as a powerful tool enabling many implicit assumptions to surface and provoking unexpected thoughts and questions (Tobin, Mantovani & Bove, 2010). Our hypothesis is that video reviewing and feedback (Tochon, 2007), and recursive semi-structured individual interviews provide opportunities to de-automatize (Holzman, 1969) ones thinking by shifting the role/position of the teachers from individual thinkers/actors to viewers of the self and of their practices. It can also help to de-automatize inattention taken for granted behaviors and possibly foster awareness, self-control and intentional practices in daily routines and structured activities.

I5 EPISTEMOLOGICAL BELIEFS

## *Students regulate their learning processes as a function of task complexity and epistemic beliefs: Analyses of trace data*

Trevors, Gregory; Feyzi-Behnagh, Reza; Azevedo, Roger

This study reports on differences in cognitive and metacognitive trace data sources (i.e., log-files and eye-tracking) relating to students' epistemic beliefs as they progress through a multimedia environment containing discrepancies between text and graphs. We test the hypothesis forwarded by Greene, Muis & Pieschl (2010) that aspects of the task can activate epistemic beliefs, which in turn influence the micro-level processes of self-regulated learning (Azevedo, Moos, Johnson & Chauncey, 2010). In these models, epistemic beliefs shape the learning standards that are used during metacognitive monitoring (comparing standards with cognitive products), which mediates strategy-use. A mixed-design was used to examine the effects of three levels of discrepancies [No Discrepancy (ND), Within Text (WT), and Between Text and Graph (BTG)] and epistemic beliefs on study-time allocation and eye movements. Preliminary analyses of trace data are reported for a subsample (N = 20) of undergraduate students. Study-time allocation was operationalized as time in seconds that students spent viewing one page of text and graph. Students' strategy-use for coordinating informational sources (COIS) was examined. COIS was operationalized as a sequence of two transitions between eye fixations on text and graph areas (e.g., text-graph-text), the frequencies of which were tallied for analysis. Epistemic beliefs were measured by the Connotative Aspects of Epistemological Beliefs questionnaire (CAEB; Stahl & Bromme, 2007). Scores for 17 items were used to calculate two factors, Variability and Texture, which had acceptable ($\alpha$ = .62) and poor ($\alpha$ = .50) reliability, respectively, although data from the larger sample (N = 34) show acceptable reliability for Texture ($\alpha$ = .67). CAEB scores were dichotomized into a medium split for both factors. Results showed no significant differences between study-times across the three discrepancy levels and between epistemic groups on ND pages, but students with beliefs in static science knowledge spent more time on WT pages, $F(1, 14) = 5.16$, $p = .039$, $\eta^2 = .269$, and an interaction

between beliefs in unstructured and static science knowledge related to increased time studying BTG pages, $F(1, 14) = 5.27$, $p = .038$, $\eta^2 = .273$, indicating that students regulated time allocation according to task complexity and epistemic beliefs. A similar pattern was observed for eye movement analysis, wherein beliefs in unstructured and static science knowledge related to more COIS behavior across all pages ($M = 22.4$, $SE = 2.5$) than beliefs in unstructured and unstable science knowledge ($M = 7.3$, $SE = 2.4$), $F(1, 14) = 6.38$, $p = .024$, $\eta^2 = .313$. This indicates that beliefs in ambiguous but stable science knowledge are related to increased effort to integrate information. The temporally fine-grained trace data reported here are among the first to empirically substantiate links between task complexity, epistemic beliefs, and self-regulated learning.

## *Epistemic stances of academic staff*

Bartimote-Aufflick, Kathryn; Brew, Angela

The study is focused on academic staff members' epistemic stances. The term, epistemic stances, is used here to describe the paradigms that encapsulate the underlying system of beliefs individuals hold – in regards to knowledge and knowing. The aims of the study are: to understand how an academics' current stance may have formed by examining the possibility of linkages to the cultural layers (Hofstede & Hofstede, 2005) of gender, age, discipline, institutions of study and work, ethnicity, religion, and parents' social class; and to explore the clustering of academics on the basis of epistemic stance and a range of cultural attributes, as a way of better characterising the current academic community than relying on discipline affiliation alone. The study is informed by critical realist methodology. In order to construct a model or models that may provisionally explain mechanisms that influence the formation of academics' epistemic stances, three central methods are being employed to complement one another – 1) a questionnaire that draws on Cunningham & Fitzgerald's (2002) framework for its epistemic stance items and also includes items on cultural layers; 2) an interview that explores (more deeply) the same issues as the questionnaire; and 3) recursive model development using these data sources along with theory and case comparisons to enhance and test possible models. The full study will involve the investigation of the epistemic stances of approximately 640 academic staff from four large research-intensive universities in Australia. Data from a preliminary pilot ($N = 10$) of the questionnaire indicates that although cognitively challenging for participants (in that most are considering their philosophical beliefs explicitly for the first time) the tool has utility both from a participant perspective and from a researcher perspective, but can also be improved. There are some indications of patterns in the data, e.g., all 3 academics coded in structuralism/contextualism studied mathematics at an advanced level at high school; all 3 in structuralism/contextualism studied language, communication and culture at an advanced level at high school; all 3 in realism/essentialism studied biological sciences at a

senior level in their undergraduate degree; and all 3 in structuralism/contextualism identify with Christianity. No respondents were coded in positivism/radical empiricism, and 1 was coded in poststructuralism/postmodernism. At the time of the conference, further questionnaire results, interview results and initial models based on a larger scale pilot will be reported. The study fills several gaps in the personal epistemology research area by use of a philosophically-oriented model, use of expert participants rather than university students, and by expanding the scope of the socio-cultural context examined.

## *Adolescents' epistemological beliefs and academic cheating behavior: The moderating role of intellectual potential*

Aus, Kati; Jõgi, Anna-Liisa; Peets, Kätlin

Students' epistemological beliefs have been conceptualized as beliefs about knowledge and the acquisition of knowledge, i.e., learning (Schommer, 1990). Beliefs about learning that tap students' perceptions about the malleability of the ability to learn as well as the speed of learninghave been shown to play an important role instudents' effort regulation and academic achievement (Chen & Pajares, 2010). In this study we examined students' beliefs about learning (entity beliefs), their level of cognitive ability, and academic cheating behavior as a form of maladaptive effort regulation. We hypothesized that students with lower intellectual potential as well as students, who view learning ability to be innate and expect learning to occur quickly, would be more inclined to cheat in evaluative academic settings. Also, we expected the relationship to be dependent on the level of a student's intellectual potential. Participants were 763 seventh-grade students (353 boys; *M* age = 13.02, *SD* age = 0.40) who were asked about their views on knowledge acquisition and theircheating behavior. Cognitive ability was measured by Raven's Progressive Matrices (sets D and E). We found that students who did not believe in concentrated effort (i.e., who believed that their ability was fixed) were more likely to engage in cheating behavior ($\alpha$ = .198, $p < .001$). However, this effect was further qualified by the moderating effect of students'intellectual ability ($R^2$ = .01, $F = 7.33$, $p$ = .007). Simple slopes analyses showed that among students with low intellectual potential (1 SD below the mean), the belief that their ability cannot be changed was related to higher levels of cheating behavior ($\alpha$ = .389, $p < .001$). In contrast, among students with high intellectual ability (1 SD above the mean), their epistemological beliefs did not relate to their cheating behavior ($\alpha$ = .122, $p$ = .104). Thus, our findings suggest that by promoting the view that intellectual ability is changeable we might be able to prevent low-ability students from engaging in cheating behavior and increase their interest and persistence in learning.

I6 METACOGNITON AND WRITING

## *How to use the right preposition in English, with metacognitive and cognitive point of view*

Song, Xin

English prepositions, as enclosed type in language system, take a small proportion of the language but have a big function. In secondary school, English prepositions emerge a lot in English textbooks. A major problem is that students often show low achievement in this area. The strategy commonly employed by teachers is teaching the multiple senses of prepositions by rote. Concerning the field of cognitive linguistics, new findings have a great impact on the methodologies of foreign language teaching and learning. In addition, Arlin (1983) indicated that metacognition, which requires secondary reflection upon one's knowledge, appears to place similar cognitive demands upon the child. And he also pointed that children' metacognitive performance about temporal prepositions should be related to their cognitive developmental abilities for both metacognition (Flavell, 1976, 1979) and metamemory (Flavell, Friedrichs & Hoyt, 1970; Flavell & Wellman, 1977). Thereby, the present study based on cognitive linguistic approaches was carried out, which followed the principle of meaningful teaching, methods inspired by cognitive linguistic and the theory of domain, in order to find out how German children taught by cognitive methods and how they reflect their metacognitive ability as well as cognition development. The whole experiments involved pre-test, three lessons for teaching three prepositions in three domains, post-test and 8-week delayed test. 89 7th grade students as subjects came from Otto-Hahn-Gymnasium Landau. The results indicate that German learners of English produce systematical errors in their use of prepositions, which are rooted in inadequate image schemata. Students performed spatial domain the best, and then temporal domain, and the worst in abstract domain. In all these three tests, the tendency of domains is the same, and post-test has significant improvement. Particularly, one student who wrote the image schema of three prepositions in 8-week delayed test, obviously showed that using metacognitive strategy could improve the achievement of English preposition significantly and has higher mean scores than other students. The present study analyzed the origin of errors under the view of cognitive linguistic and metacognition and attempted to provide a well-structured cognitive approach for meaningful teaching English prepositions.

## *The relationship between the performances of Quebec students in French spelling and grammar, their metagraphical comments and their teachers' pedagogical practices*

Ouellet, Chantal; Wagner, Anne; Boily, Élisabeth

For many Quebec students, French spelling and grammar is a *bête noir* (MELS, 2006), due to the teaching methods employed by teachers, the complexity of the subject (Catach, 1978) and the relationship between an insufficient mastery of written French and academic failure (Allal et al., 2001). While Quebec's official curriculum presumes that students will have mastered these skills by the end of primary school, many are still struggling with them by the end of high school (MELS, 2008; Simard et al., 1984). Cognitive learning psychology posits that correct spelling and grammar is related to the ability to review and self-correct one's writing (Fayol & Jaffré, 2008) – yet the existing research does not take metacognitive skills into account when studying the writing abilities of 6th graders and 1st year high school students. Thus this project focuses upon the writing and metagraphical abilities of students in those grades, as well as of students in high school special education classes. It does so by: 1) establishing the orthographical and metagraphical profiles of male and female students from the 6th grade, the 1st year of high school and from high school special education classes in 4 regions of Quebec; 2) documenting their teachers' pedagogical practices; and 3) elaborating the links between the teachers' pedagogical practices and the students' spelling and metagraphical profiles. Dictations were administered to 209 students at the beginning and the end of the 2010-2011 school year. Seventy-two students who were assessed as "average" participated in the 2nd dictation and were interviewed to solicit their metagraphical comments on 12 words requiring grammatical agreement on number and gender. The analysis focused on knowledge of each word's class, the strategies employed by the student that caused them to write the words in a particular way, as well as the use of metacognitive vocabulary and self-correction. Their teachers' pedagogical practices were recorded by means of a log over the course of the same school year. Statistically significant results from the survey sample indicate: very little difference in spelling and grammar performance between 6th grade students and those in the 1st year of high school; relatively greater progress between the 1st and the 2nd dictation for students in the 6th grade; and, no difference between boys and girls. Results from the metagraphical interviews indicate that 6th graders and 1st year high school students use mainly syntactic strategies, whereas special education students show no apparent pattern in the strategies used. In addition to elucidating these results, the presentation will outline the relationships between the results and the teachers' pedagogical practices. Taken together, the research will make a significant contribution to our understanding of why spelling and grammar errors are so widespread in French, and will provide a basis for developing plans to improve the quality of French.

## *Metacognition in student academic writing: A longitudinal study of metacognitive awareness and its relation to task perception, self-regulation and evaluation of performance*

Negretti, Raffaella

This article focuses on the metacognitive dynamics entailed in learning to write for academic purposes. Metacognition plays a key role in writing, yet little research has been carried out in naturalistic contexts and on a longitudinal scale to understand how metacognitive and self-regulatory developments guide students in the long process of writing academic papers. This study applies theories of metacognition and self-regulated learning to understand how beginning academic writers develop the ability to participate in the communicative practices of academic written communication and develop rhetorical awareness. The study focuses on the nature of metacognition in learning to write, how it changes over time, and how it relates to students' perceptions of the writing task, metacognitive awareness of strategic choices, and evaluation of writing quality. Through a constructivist grounded theory approach, qualitative data collected throughout a semester from students of beginning academic composition were analysed to determine qualitative changes in the categories under study. The data suggest a strong link between the nature of students' task perceptions, conditional metacognitive awareness – their understanding of how and why to adapt writing strategies to specific rhetorical requirements of the task-and performance evaluation. Metacognitive awareness also seems to have a reciprocal relationship with self-regulation and students' development of individual writing approaches. The results are connected to previous and current research on metacognition in writing and discussed in terms of implications for further research on calibration, self-regulation, and instruction of academic writing.

### I7 TOOLS AND ACTIVITIES PROMOTING METACOGNITION

## *Metacognition involved in the application of rubrics to the assessment of teacher portfolios*

Torres, Pablo; García, María Rosa; Leyton, Carolina

Cognitive activity is thought to be a large source of variance in portfolio rating (van der Shaff et al., 2005). Nevertheless, there has been little research about it and even less about the metacognitive processes involved in the assessment of portfolios. The present research is an exploratory study that attempts to contribute more information about this topic. It does so by analyzing the metacognitive strategies applied by six novice portfolio raters when applying rubrics to assess teacher performance shown through written portfolio entries required by the Chilean Teacher Evaluation System in 2011 to assess state school teacher quality. The portfolios included teachers' reflections, descriptions of learning units implemented by them, copies of assessments and the marking criteria

applied, and samples of feedback given to students. Each rater rated six different portfolio entries applying different rubrics of varied difficulty. Think aloud methodology was used to register the thoughts involved in the 36 rating episodes included in the study. Accuracy of the assessment done by raters is judged by the level of agreement between raters' judgment and those of the rubric developers. All the think aloud protocols were individually analyzed by two coders and assigned final codes by consensus by the two. Metacognitive capacity is supposed to be highly present in reasoning (Lee, 2004) and facilitate the effective representation of a problem in order to effectively solve it (Gourgey, 1998). It has also been said that metacognition is used more when dealing with tasks that are less structured (Hong, Jonassen & McGree, 2003). The present research tried to explore which metacognitive strategies are applied in the complex task ("problem") of assessing teacher portfolios, and how the number and/or type of metacognitive strategies applied by raters relates to the accuracy of judgments involved in the rubric application and the level of clarity ("structure") of the portfolio entries analyzed. The role of metacognition in lowering assessment bias (Schwarz et al., 2007) is also explored. A considerable range of metacognitive strategies were found to be used by the raters studied. These were mainly used by the raters to orient, plan and monitor their own thoughts while assessing portfolios. The largest variety of metacognitive strategies were found to be applied for monitoring cognitive processes and representations, whereas the largest number of metacognitive strategies had an orientation use. Accurate judgment was found to be more associated with more use of monitoring strategies and less of planning strategies. Less clear portfolio entries required a higher use of metacognition for orientation and less for planning purposes. A specific monitor metacognitive strategy that might lead to lower assessment bias, coded as "consideration of alternative scenarios", was found to be absent in the rater with the worse performance of the six participants.

## *Is it possible to promote metacognitive instruction through "metacognitive" textbooks?*

Papasolomontos, Christina; Hadjitheodoulou-Loizidou, Pavlina

The Framework of the Educational Reform announced in 2004 by the Cyprus Government (Educational Reform Committee, 2004) highlighted the need for the revision and modernization of the school curricula in order to be in line with the demands and challenges of the 21st century. In 2010, the New Curriculum (NC) was presented (Ministry of Education and Culture, 2010) and one of the key attributes is the development of students' metacognitive skills. Based on the NC, new school books were prepared giving special emphasis on the development and enhancement of metacognition in students. The aim of the present study is to examine whether the new Maths, Language and Biology books used in Lower Secondary School (Gymnasium)

promote metacognitive instruction since it appears to enhance metacognitive learning (Veenman et al., 2006). An instrument was developed to assess if and which kind of strategies promote metacognitive learning in these books. At the same time, teachers' opinion was investigated regarding the new books and to what degree they think that the new books promote metacognitive instruction.

## *Enhancing geometrical knowledge, metacognitive reasoning and visual spatial skills through a playing chess laboratory*

D'Amico, Antonella; Di Paola, Benedetto; Ferro, Mario; D'Eredità, Giuliano

Several theoretical and experimental studies in Mathematics education deal with the learning of Geometry, highlighting the way in which the students approach the perception and recognition of geometrical figures. Indeed, they frequently consider geometrical figures as whole objects, recognizing and memorizing them as global shapes instead of analyzing the relations among their parts. As a consequence, the students engaged in geometrical problem solving activity are not always aware of the object's properties but, rather, they focus only the visual perceptual global features of the figure. With the aim to enhance a more flexible and metacognitive knowledge about Geometry in lower secondary school students (11 years old), a 32 hours laboratory has been programmed, based on the learning of rules and strategies in playing chess, accordingly to the hypothesis that a chess laboratory could help students at improving their perception, memory and metacognition in dealing with geometrical concepts (Fischbein, 1993; Van Hiele, 1986). The laboratory is also intended to promote deductive reasoning, as well as attention and memory, particularly in the visual spatial domain, since it is well known that playing chess has an important role in enhancing these abilities. In order to study the effectiveness of the laboratorial intervention, a test/treatment/retest study has been designed, involving two experimental groups and a control group. The experimental group is composed of two classes participating in chess laboratory; the control group is composed of one class of the same scholastic level and it is involved only in test and retest phases. The following tests are used in the test-retest sessions: MT Reading Comprehension tasks (Cornoldi & Colpo, 1995); SPM Arithmetical problem solving tasks (Lucangeli et al., 2003) followed by an original problem solving task about Geometry; PML working memory tasks (D'Amico & Lipari, in press); SAVIO deductive and syllogistic reasoning tasks (D'Amico et al., 2001). Moreover, teachers have been requested to rate the scholastic achievement of children as well as different aspects of their behavior during lessons (perseverance, attention, organization, anxiety) using a purposed questionnaire. All the laboratorial activities are videotaped with the aim to analyze in a semiotic perspective the student's objectification processes in geometrical domain (Radford, 2003, 2006). Final result of the study will be discussed. The study, included in the Project "Edutainment: education and entertainment in experiential

learning labs" (http://edutainment.pa.itd.cnr.it), has been funded by Assessorato Regionale Istruzione e Formazione Professionale, Sicilia and promoted by MIUR, Agenzia Nazionale per lo Sviluppo dell'Autonomia Scolastica, Sicilia (ANSAS). Other partners are: Dipartimento di Psicologia, Palermo; Istituto per le Tecnologie Didattiche, CNR, Palermo; Istituto Comprensivo Buonarroti, Palermo; Children's museum BIMPA, Palermo.

## I8 METACOGNITION IN GIFTED LEARNERS

### *Development of metacognitive skillfulness in moderately gifted students*

Veenman, Marcel V.J.; van Haaren, Marieke

Metacognitive skills concern monitoring and controlling of one's cognitive activities. Metacognitive skillfulness is a profound predictor of learning outcomes. Earlier research has shown that metacognitive skills show a steep linear growth in children and adolescents from 9 years up to 22 years (Veenman, Wilhelm & Beishuizen, 2004). Existing methods for assessing metacognitive skillfulness (thinking aloud and observation) are labor intensive. Recently, an alternative method of assessment was developed in a research project on giftedness. While students perform a computerized task, metacognitive activities are registered in logfiles. The present study investigated whether this computerized assessment method was capable of detecting developmental differences in gifted students. Older students were expected to exhibit higher levels of metacognitive skillfulness and learning outcome, relative to younger students. Participants were 52 students (13 yrs.) and 112 students (17 yrs.) from pre-university secondary schools in a cross-sectional design. Participants performed a computerized Otter task, which required them to discover (combined) effects of five independent variables on the otter population growth. Variables were habitat, environmental pollution, public entrance, setting out new otters, and feeding fish in wintertime. By performing experiments, participants could identify main and interaction effects of the variables on the population growth. Activities of participants were recorded in a logfile, which was automatically analyzed on five indicators of metacognitive skillfulness (total number of experiments, number of unique experiments, thinking time in between experiments, scrolling back to earlier results, and systematically varying variables), which were validated before with thinking-aloud measures. Afterwards, participants completed a posttest with 20 MC and 11 open-ended questions about effects of variables on the population growth ($\alpha = .90$). Results show that17-year old participants outperformed 13-year olds on the five indicators of metacognitive skillfulness, and on learning outcomes (all $p < .001$). A collapsed measure of metacognitive skillfulness correlated .69 with learning outcomes (accounting for 47.9% of variance). These results show that such a computerized assessment instrument is well suited for detecting developmental differences in students of different age. This instrument may also be an adequate

diagnostic tool for increasing metacognitive skills over the years as a marker of giftedness, next to intelligence (Veenman, 2008).

## *Metacognition, achievement orientation and academic success in high school gifted students*

Beretta, Angela; Zanetti, Maria Assunta; Renati, Roberta

The purpose of this research is to examine the relationship between mastery goals, performance goals, metacognition and academic success in high school gifted high and low achievers and typical students, to improve learning tactics and encourage effective teaching practices (Coutinho, 2007; Snyder, Nietfeld & Linnenbrink-Garcia, 2011; Vrugt & Oort, 2008). Achievement goals are widely recognized as important constructs in understanding behavior in educational settings (Church, Elliot & Gable, 2001; Dweck, 1986; Nicholls, 1984) and their central role as predictors of educationally relevant outcomes has been documented in a host of studies (for review see Ames, 1992; Church, Elliot & Gable, 2001; Dweck, 1990; Harackiewicz & Elliot, 2002; Pintrich, 1999; Urdan, 1997). Mastery goals are hypothesized to lead to persistence in facing difficulty, challenge seeking and intrinsic motivation (Ames, 1992; Church, Elliot & Gable, 2001; Dweck, 1990; Nicholls, 1984). They orient students to a focus on learning and mastery content and they also have been linked to adaptive outcomes such as strong self-efficacy, good metacognition, and good performance (Coutinho, 2007; Elliot & Dweck, 1988). Some researchers in gifted education have hypothesized that gifted individuals are distinct of their typical peers because they think like experts (Carr & Taasoobshirazi, 2008; Jaušovec, 1998), and acquire expertise at a more rapid rate than typical students (Sternberg, 2001). Starting from the hypothesis that the relationship between goals and academic success is fully mediated by metacognition, as a strong predictor of academic success (Dunning, Johnson, Ehrlinger & Kruger, 2003; Kruger & Dunning, 1999), the aim of the present study is to verify if it's especially true for gifted students. A group of 466 high school students (mean age = 17,1; SD = 1) will complete the APM – Set II (Raven, 1962) as a measure of general ability (Nietfeld et al., 2006; Nietfeld & Schraw, 2002) and the Metacognitive Awarness Inventory (Schraw & Dennison, 1994 – Italian standardization by Colombo e Balzarotti, in press). They also will complete the 3x2 Achievement Goal Questionnaire (Elliot, Murayama & Pekrun, 2011. Their marks in school will be collected and, through the intersection of all data, will be selected a final sample of about 60 students, divided in three groups of 20 students each: gifted high achievers, gifted low achievers and typical students. An analysis of variance will be performed to highlight differences between the three groups. Our research will make possible to explore in depth some specific cognitive processes that are characteristics of gifted high achievers, who are expected to perform better than

low achievers and typical students because they are characterized by the ability to think using metacognitive process.

## *Critical creativity in PhD education: Acknowledging the scholarly frame*

Brodin, Eva

There is no doubt that critical and creative thinking are both considered as imperative learning outcomes in PhD education across the world, since these skills are frequently mentioned in educational policy documents at doctoral level. However, the actual meanings of critical and creative thinking and their relationship to one another in doctoral practice are not clear as this is a rather unexplored field of research. Therefore, the aim of this paper is to provide understanding in this regard through the lens of PhD students' own experience. The study is based upon semi-structured interviews with 14 PhD students in Sweden who were asked to reflect upon how they used their critical and creative thinking in their thesis work. The students had completed at least 60 % of their PhD studies and came from four different disciplines and faculties: Education (Faculty of Social science), Musical performance (Faculty of Art), Philosophy (Humanistic faculty), and Psychiatry (Faculty of Medicine). Through thematic hermeneutic-phenomenological analyses of the PhD students' narratives an interesting picture emerged. One might expect that critical and creative thinking in PhD education would be a matter of training students to challenge the status quo of the discipline and hence to move beyond the frames. This was not the case. Instead, the PhD students described their development of critical and creative thinking as a process in which they learned to identify, accept and appropriately use the current disciplinary and scholarly frames in their thesis work. Going beyond these frames was considered as non-critical and non-creative thinking. As regards the concrete meanings of critical and creative thinking and their relationships to one another in PhD educational practice, four overall horizons could be outlined in which the dialectics between the two phenomena appeared: "Scholarly traditions", "New knowledge development", "Academic authorship", and "Pragmatic action". Each of these horizons contained certain thematic meanings of either critical or creative thinking. Whereas critical thinking was emphasized within the horizon of "Scholarly traditions", creative thinking was emphasized within the horizon of "New knowledge development". The PhD students experienced the integration of both these horizons as a true challenge in their thesis work. On the one hand, they were supposed to contribute to new knowledge. On the other hand, they were supposed to keep themselves within the traditions of their discipline. In the horizons of "Academic authorship" and "Pragmatic action", the PhD students experienced both critical and creative thinking although with different meanings dependent on which phenomenon they reflected upon. During doctoral education critical and creative thinking became

conflated into critical creativity, where both faculties were integrated in the PhD students' cognition, action and speech.

I9 METACOGNITION AND MATHEMATICS

## *Elementary students' spontaneous metacognitive functions in different types of mathematical problems*

Mokos, Evagelos

The concept of metacognition has gained a lot of interest in mathematical education research and practice (cf., Schoenfeld, 1985; Mevarech & Kramarski, 1997; NCTM, 2000; Ku & Ho, 2010). In general the usefulness of the research of student's metacognitive strategies during mathematical activities is connected to the efforts made by students to acquire consciousness on their actions while they are learning mathematics. More recently, Nelson and Narens (1990) managed to organize and compose almost the whole existing research on metacognition (Schraw & Moshman, 1995). This model focuses on the interaction between two metacognitive functions: monitoring and control. Nelson & Narens proposed a theoretical mechanism, which is necessary so as to have a metacognitive system, and is composed of two structures: the meta-level and the object-level, and also the flow of information relationship between the two levels. In this model, information flows with the meta-level acquiring information from the object-level (monitoring) and the meta-level sending information to and thereby changing the object-level (control) (Dunlosky & Bjork, 2008). In mathematics education, firstly Schoenfeld (1985) presented a theory of the interaction between the cognitive and metacognitive procedures that take place while students solve mathematical problems and denoted four aspects of knowledge and behavior: sources (mathematical knowledge), heuristics (ways of solving a mathematical problem), control (metacognition) and beliefs (attitudes). While teaching tends to focus on the two first aspects, the failure of the students to solve problems seems to appear due to the malfunction of the two latter ones. This means that, students have the required mathematical knowledge, but they fail to use it, because they cannot control and monitor it (Schoenfeld, 1990). The present study, which is a qualitative research of a case study orientates its research questions as follows: The central question of our study is whether students spontaneously emerge different metacognitive control and monitoring functions when they solve different kinds of mathematical problems, without a previous metacognitive instruction. In our study we chose three different kinds of mathematical problems: open-ended, authentic and complex problems, as these problems are mostly presented in elementary school textbooks in our country. The trace of the metacognitive functions of control and monitoring was made by the "thinking aloud" method, during which the students solved different kind of mathematical problems. "Thinking aloud" is a verbal method which can be used either by the teacher

or two students working together or one student working individually (Goos & Galbraith, 1996; Hartman, 2001). For the analysis of the data we used an analysis protocol for the "thinking aloud" method, which was based on the Metacognitive Awareness Index (MAI) from Schraw & Dennison (1994). The subject's verbal reports were attributed to the suitable metacognitive area that is controlled by MAI. In this paper we present the results by each type of problem the students solved. In the Object level:

- Information Management Strategies seem to be stronger in the authentic problem.
- The Debugging strategies seem to be stronger in the open-ended problem.
- Planning strategies are almost equal for the three types of mathematical problems.
- Comprehension Monitoring strategies and Evaluation strategies seem to be stronger in the authentic problem.

In the Meta level:

- The strategies used by the Procedural Knowledge of the students seem to be stronger in the complex problem.
- The strategies used by the Declarative Knowledge of the students seem to be stronger in the authentic problem.

This study set out to examine spontaneous metacognitive functions which students emerge when they are engaged in different types of mathematical problems. A first issue of our study is the appearance of control actions spontaneously in both levels of our cognitive system, in each type of mathematical problems. The students developed strategies that helped them solve the problems. We observed that in each type of problem, metacognitive strategies were spontaneously emerged, and these strategies were traced by the verbal reports of the students. A second issue of our study is the appearance of monitoring actions spontaneously in both levels of our cognitive system, in each type of mathematical problems. The students developed monitoring strategies in order to monitor their thought, so as to reach suitable control actions and consequently solve the problem. A third issue of our study is that we can denote in each type of problem how each metacognitive function appears. A fourth issue of our study is that the verbal reports that were made by the students when they were solving different types of mathematical problems were not in accordance with the number of the students that participated in the research. Students do have strong metacognitive behaviors in Meta-level, while in Object level and in specific metacognitive behaviors maybe a reinforcement, through a metacognitive didactical intervention or a metacognitive program could help. A didactical intervention would be suitable depending of the type of problem that seems to be poor in specific metacognitive strategies.

## *Mathematics classroom with Italian and Chinese students: Metacognitive experiences in an intercultural perspective*

Di Paola, Benedetto

One of the more interesting problems that is being proposed today is certainly that of confronting oneself with the 'divers-ability' in multicultural situations, a reality which is now present in our society, in continuous socio-cultural mutation, and therefore a central point for the Education Research. If, in fact, the teaching/learning phenomena of the discipline already have complex investigative systems, the multicultural 'divers-ability' considerably increases its complexity. The problems that may arise from the contemporary presence in class of students whose cultural background is very different from the Italian one, who speak foreign languages, have different needs from the ones discussed by the Research in the Didactics for monocultural classes and different cognitive styles, often far from the "typical" class epistemology, are just some of the situations most "feared" by teacher and significance aspects studied by researchers, to develop a didactic work effective for all. How can we interpret the "different behaviours" coming in classes from different students cultures? Which disciplinary planning should we follow in a intercultural didactical program?... Today, what School often lacks in this sense is, in fact, knowledge and action tools appropriate for the change of the school reality in which the majority of students live. What School lacks is so the metacognition about the multiculturalism/interculturalism and its implication on the teaching/learning aspects of a discipline. The article, examining the increasing presence of students of Chinese culture in Italian classes, discusses some metacognitive mathematics experience with students and teachers from different educational schools stages (Primary, Middle and Secondary), oriented to underlie possible analogies and differences between the cognitive styles and the behaviours highlighted amongst the Chinese and Italian pupils in mathematics problem solving (in particular arithmetic and pre-algebraic problem solving). To be able to interpret the comparative study of Chinese thought and Italian one, from particular aspects held to be central to the didactics of Mathematics in teaching/learning situations in a multicultural perspective, reference is made to the studies of D'Ambrosio (2002), Gheverghese (1991), Needham (1959, 1985), and Nisbett (2001). A further suggestion for metacognition, as a deep 'comparison' of the two civilizations considered, is proposed in the paper from the historical-epistemological point of view, also by means of a critical analysis of that which can be considered one of the representative texts of Chinese culture and its mathematics education at school: the 'Jiuzhang Suanshu', 'Nine Chapters on the Mathematical Art'. The presentation of some specific characteristics of Chinese writing, tries also to define it as a possible 'tool' of acquisition of algebraic competences and metacognition in their believes and reasoning in mathematics problem solving.

## *Judgment-of-Learning and confidence in mathematics problem solving: A metacognitive benefit for the explainer*

Mevarech, Zemira; Shabtay, Galit

One form of metacognitive monitoring is Judgment of Learning (JOL). It refers to how people make judgments of whether they have successfully learned the assigned material. Research has suggested that people take into account their monitoring output when deciding whether to allocate more study time or whether to look for external resources in executing a given task. Studies in the context of text learning have repeatedly shown that in-depth processing not only promotes knowledge per se, but also enhances the accuracy of metacognitive monitoring. More accurate monitoring allows individuals to differentiate between the better known and lesser known items, as reflected in the higher correlations between confidence and accuracy of answers. Moreover, people tend to be overconfident in general. Reducing the gap between knowledge and confidence might promote monitoring accuracy which in turn facilitates learning. This is particularly important for teachers, because such gaps might lead to inaccurate teaching. The research on the role of in-depth processing in facilitating JOL and confidence accuracy is only at its beginning. Based on the contribution of in-depth processing to metacognitive monitoring accuracy, we hypothesized that articulation of one's reasoning would facilitate confidence accuracy when taking exams. Moreover, we hypothesized that explaining mathematical principles to a colleague would have a larger benefit than listening to the explained material, because articulation requires deeper processing than listening. Participants were 36 experienced elementary school teachers who participated in a professional development course that focused on teaching mathematics. The teachers were randomly assigned into dyads, in which one member (the explainer) articulated his/her math reasoning by explaining the topic to the other peer (the listener). All participants were pre and post-tested by relevant mathematics achievement test. In the test, after providing an answer for each problem, participants rated their confidence that their solution is correct. Self-report judgments and personal information were collected at the conclusion of the procedure for controlling of potential intervening variables. No significant differences were found between the explainers and the listeners prior to the beginning of the study on any variable. After the experimental procedure, the explainers showed a higher level of mathematical reasoning, achievement and confidence in their ability to teach that topic than the listeners. Importantly, the explainers showed also better monitoring accuracy than the listeners. The study's theoretical and practical implications will be discussed at the conference.

## *Objectivization vs. objectification subtle difference: The 'a' parameter properties case*

SANTOS MELGOZA, DAVID MARTÍN

Two year-ten English students interacted during a task regarding to geometrical representations of parameters. I will describe this interactions as a general learning episode but taken into account the academic features of math information' to show how meaningfulness of specific elements come up and are associate to math terms within a set of interrelated terms of specific process interpretations and give way to an academic mode of knowing. We refer to 'academic features of math information' as the rigour involve in math as a discipline. Freudental (1973) said '...no other science can be imposed so strong a deductive structure as on mathematics.' In mathematics it could be said with no doubt that something is right or wrong, and as the discipline that it is, the means are as important as the results. So, for the math student the learning process is not just about getting the right answer but the deductive system that underline it, nevertheless, as Freudental said, 'rigour can be acted out without knowing what it is'. In this sense, here we analyse the way mathematical thinking brings about during the learning episode. The students interact within a micro-world that includes a compendium of functions such as $f(x) = aö(x-b)^n + c$, and it is designed to present graphical representations of specific randomised functions. Students could manipulate a graph through sliders, dragging points or typing directly the values of a, b, c and n parameters. This time, I will focus on the associated graphical elements of the 'a' parameter. I will discus how math terms in conjunction with the students 'intention of find out' may function as quotations that represent the guidance to make sense of what I will term 'abstract objects' in an interactive task which involve mathematical thinking. Geometric representation is taken itself as the means to enact the cognitive academic outcomes in a learning episode, we believe that the academic features of math information rise from the social context regarding the validity of their responds during the task and not only by the manipulation that take place during the perceptually guided action they experience during the task. Learning outcomes in this episode show how the academic features of math information were brought about from the previous experience of students and the constraining and promoting capabilities of the task (which represent the math deductive system) they were committing in. Self-regulated process has at least two levels regarding the intentional behaviour when this learning episode took place: The first one regarding to the problem solving commitment – matching the graph –, and the second one related to the academic learning process – making up the math ideas that underlie the process – (Santos, 2010).

I10 METACOGNITIVE KNOWLEDGE

## *The role of metacognitive knowledge in school achievement and its development from grade five to seven*

Neuenhaus, Nora

The concept of metacognition is usually divided into at least two subcomponents – a process component and a knowledge component. The process component of metacognition encompasses activities such as regulation and control of cognitive processes, sometimes also referred to as metacognitive skills. While this subcomponent of metacognition has been receiving much attention in studies on self-regulated learning and research activities concerning this subcomponent have been increasing, research on the knowledge component of metacognition remains to be rare. Only a few studies were designed and conducted to investigate the relevance of metacognitive knowledge for learning and achievement and its development beyond primary school. Particularly findings based on longitudinal data are scarce. In order to close this research gap and to obtain longitudinal data on the impact of metacognitive knowledge and prior domain-specific knowledge for secondary school students within particular subject domains, we developed domain-specific metacognitive knowledge tests. After successfully piloting these instruments, they were repeatedly applied in a longitudinal study with about 920 students altogether. The first wave of assessment took place at the beginning of grade five. Metacognitive knowledge as well as achievement was assessed in the domains of English as a foreign language, reading and mathematics. Furthermore, cognitive variables such as working memory and cognitive ability as well as a variety of non-cognitive variables (e.g., goal orientation, self-efficacy, interests, self concept) were measured. Cross-lagged analyses of the developmental relation between metacognitive knowledge and domain-specific knowledge based on the first two waves of assessment indicate a reciprocal relation between metacognition and achievement within each domain. Repeated measure analyses of the metacognitive knowledge reveal a significant increase in this knowledge across the domains. Results from path analyses show that goal orientation and cognitive ability are significant predictors of later metacognitive knowledge even if controlling for the autoregressive effect of prior metacognitive knowledge. Latent-growth curve models shall be computed with data from further waves of assessment and will be presented. Thereby we will gain more insight into the developmental trajectory of metacognitive knowledge, its relation to achievement and the impact of cognitive ability or goal orientation on its development.

## *Examining change in metacognitive knowledge and metacognitive control during motor learning: What can be learned using a qualitative focus?*

Sangster Jokic, Claire

To date, research examining the role of metacognition in motor learning has almost exclusively applied quantitative methods in controlled situations. Recently, there has been growing recognition of the contribution of qualitative approaches in understanding the manner in which metacognitive behaviour occurs and evolves in meaningful and everyday learning situations. Consistent with growing use of a dynamic assessment approach for examining metacognition in socially-mediated learning contexts, the present study aimed to examine children's metacognitive performance as it was exhibited during participation in an intervention program aimed at addressing motor performance difficulties. Participants in the study were ten 7-9 year old children with developmental coordination disorder (DCD), a condition characterized by a marked impairment in motor coordination that impacts on children's ability to learn and perform motor tasks. All participants were engaged in a 10-session program in which children were taught to use a problem-solving strategy for addressing performance difficulties on self-selected motor tasks. In order to examine children's metacognitive performance in the context of mediated motor task practice, sessions were video-taped and subsequently analysed using a quantitative observational coding method, a cross-case analysis technique and an in-depth qualitative review of therapist-child interactions. By combining these methods, the study was able to carry out a very fine-grained analysis of the manner in which children exhibited evidence for metacognitive knowledge and control, how they applied metacognitive skills during motor-based learning and how this behaviour changed over the course of the program. Of particular interest was the manner in which individual children exhibited different elements of metacognitive competence and how such competence evolved over the course of the program. Specifically, children were often able to express task-specific knowledge but failed to apply this knowledge during practice, suggesting the children with DCD possess a limited awareness of the association between their own knowledge and self-regulated task practice. Secondly, children were often able to demonstrate performance-based evidence for metacognitive control but were not able to make conscious reports of such skill following practice. This finding is consistent with models of metacognitive development which suggest that the emergence of performance-based metacognitive skills such as self-monitoring and self-evaluation precede the ability for the conscious expression of metacognitive awareness and knowledge. In addition to contributing to current understanding of the role of metacognition in motor learning and in the motor performance difficulties of children with DCD, the findings in this study provide support for the combination of methodological approaches for examining these phenomena in the context of socially-mediated learning situations.

## *Declarative metacognition in primary school children: Evaluation of a new test procedure and IRT-analyses of its construct validity*

Haberkorn, Kerstin; Lockl, Kathrin; Pohl, Steffi; Ebert, Susanne

A new test to measure declarative metamemory in primary school children has been developed and evaluated within the longitudinal study "Educational Processes, Competence Development and Selection Decisions in Pre- and Primary School Age" (BIKS 3-10). Up to now, there are group testing procedures which can be administered at the end of primary school. However, these tests put high requirements on children's reading abilities and their capacity of working memory and therefore cannot be applied to younger children. In the newly constructed group test, children's metacognitive knowledge is assessed by a series of verbally and pictorially presented tasks. The test consists of 15 multiple choice items which refer to knowledge about everyday mental activities and knowledge about task and strategy variables, especially concerning reading strategies. The goal of the present study was to analyze the psychometric properties of the test and to adapt an appropriate measurement model to the declarative metacognition data. The sample consisted of 850 children who completed the set of metacognition tasks in first grade and one year later in second grade. Rasch analyses for dichotomous items were used to assess model-data fit and to evaluate construct validity of the test. 14 of 15 items exhibited adequate measurement properties for scalability in the first grade as well as in the second grade. To detect lacks of structural invariance, differential item functioning analyses were conducted. Furthermore, we examined measurement invariance over time so that the results of both measurement points can be linked, and investigated the relations of the metacognitive knowledge domains in the test using latent modelling procedures. Overall, the finalized instrument has shown good metric properties with appropriate item-fit, item-total correlations and subpopulation invariance. Analyses of the new test's psychometric properties will have implications for the National Educational Panel Study (NEPS) in which an adapted form of the test will be administered.

## *What teachers think about self-regulated learning (SRL). An investigation of teachers' knowledge and attitude towards SRL and their effects on teachers' instruction of SRL in the classroom*

Dignath-van Ewijk, Charlotte

Research on the promotion of self-regulated learning (SRL) has revealed that students can learn how to self-regulate their learning, but investigation of training them to do so has pointed out teachers producing weaker effects of training than researchers do (Dignath & Büttner, 2008). Observational studies of teachers fostering students' SRL

have shown that teachers do give students the freedom of self-regulation, but do not prepare them to handle the new responsibilities (Bolhuis & Voeten, 2001; Dignath, 2009). Although most teachers use more learner-activating teaching methods, they often do not account for teaching their students how to learn (De Kock, Slegers & Voeten, 2005). Only little is known about the relationship between teachers' beliefs on SRL and their instruction of SRL in class (Lombaerts, Engels & van Braak, 2009). More research can be found on the relationship between teacher beliefs and their teaching practice in general, delivering an inconsistent picture (Maggioni & Parkinson, 2008). In order to find answers to the question why teachers do not instruct self-regulation strategies more often, this study seeks to investigate primary school teachers' knowledge on promoting SRL and their beliefs towards students' self-regulation, as well as their effects on teachers' promotion of SRL in the classroom. Scales were adapted from existing questionnaires on teachers' knowledge and attitude towards concepts of learning and teaching with regard to the instruction of learning strategies and to constructivist characteristics of learning, as well as towards the implementation of self-regulated learning. In addition, teachers had to answer open questions on their understanding of self-regulated learning, as well as their implementation of SRL in their classroom. With regard to teachers' beliefs about SRL as well as about constructivist learning environments, the questionnaire data revealed positive attitudes towards both concepts ($M = 3.65$, $SD = .41$ for constructivist learning, and $M = 4.04$, $SD = .36$ for SRL on a 5-point scale). Teachers' knowledge on the instruction was mainly focussed on the aspect of providing students with autonomy and freedom (77.5%), but only few teachers acknowledged the aspect of instructing students learning strategies that help dealing with autonomous learning situations (22.5%). Ordered logistic regressions revealed significant effects of teacher beliefs on SRL on teachers' implementation of SRL in their classrooms ($B^2 = 2.58$, $SE = 1.21$). No significant effects were found neither for general teacher beliefs on learning, nor for teacher knowledge on SRL. Results can indicate why teachers do not instruct SRL yet, and where researchers and teacher educators would have to start in order to enable teachers to promote SRL effectively.

I11 SELF-REGULATION

## *Self-regulatory skills in Greek elementary students: Relations with school achievement*

Metallidou, Panayiota; Konstantinopoulou, Eleni

The aim of the present study was to examine young elementary students' actual self-regulatory skills and their predictive value for school achievement. In the research tradition of self-regulation most of the empirical data have been based on self-reported regulatory skills, which do not necessarily reflect the actual level of students' self-regulatory efficiency. Measuring actual self-regulation as an ongoing activity has both

theoretical advantages for the identification of the mechanism of self-regulation at a micro-level as well as practical advantages for designing intervention programs. In the present study a total of 120 young elementary school children from various Greek state primary schools completed the Self-Regulation and Concentration Test for Children (SRTC, Kuhl & Kraska, 1992, 1993), a behavioral computerized test. The SRTC examines children's ability to concentrate on a task and resist temptation (attractive distracters) as well as their compensation behavior and possible rigidity in intention changing, when maintenance of an intention becomes by the situation dysfunctional. The main advantage of the SRTC is that it reveals both the strengths and weaknesses of each child by measuring different components of self-regulation. Specifically, the test differentiates between: (a) deficits in attention and resistance to temptation, (b) fatigue and learning, and (c) conscious use of control strategies. In the present study children were examined individually in a private room in their schools, after obtaining the necessary consent of both the school principals and the parents. The examination lasted about 20 minutes. Also, teachers were asked to evaluate children's school achievement in language and mathematics. The results of both exploratory and confirmatory factor analyses provide empirical support for the SRT's factorial validity in the Greek sample, according to the theoretical assumptions. Namely, the SRTC seems to be a promising behavioral measure for discriminating motivational (first half of the test) and strategic components of self-regulation (second half of the test, where the main task becomes less interesting and children tend to get tired). Further, the SRTC seems to be a valid instrument for distinguishing children's ability to pay attention to a task from their self-regulation efficiency. Performance on SRTC was a significant predictor of teachers' achievement evaluations. The analyses of the data are still in progress. The usefulness of SRTC as a diagnostic tool for educational interventions in self-regulation will be discussed.

## *How do feedback and generation instruction influence metacognitive accuracy and self-regulation in cognitive skill acquisition?*

De Bruin, Anique; Rikers, Remy; Schmidt, Henk

The positive learning effect of metacognitive strategy instructions based on the cue-utilization framework (Koriat, 1997) has been shown in memorizing word pairs and studying expository text. However, little is known about how the cue-utilization framework might improve metacomprehension accuracy and self-regulation in other educationally relevant domains, such as problem solving and skill acquisition (De Bruin, Rikers & Schmidt, 2007). The present study explored the effect of these types of instructions in one such domain, that is, cognitive skill acquisition. In two experiments, the effect of having learners generate cues that are predictive of future performance prior to judging themselves was investigated as a potentially effective instruction to improve

metacognitive accuracy and self-regulation. Moreover, the effect of performance feedback on these metacognitive skills was examined. In both experiments, novices learning to play chess were asked to predict chess moves and judge how well they would correctly predict a similar move in the future (i.e., provide JOLs). Metacognitive accuracy was measured by computing an intra-individual gamma correlation between JOLs and move prediction performance. Afterwards, they self-regulated their learning by deciding whether they wanted to study a similar move again. Self-regulation was computed by correlating JOLs and restudy decisions intra-individually. In the final test phase, learners played five chess endgames against the computer. In the first experiment, half of the learners had to generate another move prediction prior to providing JOLs. The results indicated that this generation instruction positively affected meta-comprehension accuracy and test performance, but not self-regulation. In the second experiment, half of the learners were given performance feedback after providing JOLs, with the goal to make learners aware of the discrepancy between JOL and performance. However, providing learners with performance feedback had no influence on metacognitive accuracy, but did improve self-regulation and test performance. These studies provide support for the positive effect of a generation task on metacognitive accuracy in cognitive skill acquisition. The effect of performance feedback on metacognitive accuracy, however, is not as straightforward. Learners had difficulty adjusting their JOLs based on feedback, but were able to translate the feedback to better self-regulation decisions. The complexity of selection of restudy activities in cognitive skill acquisition, and the need for transfer tasks that assess understanding at the long term are further discussed.

## *Real life or virtual world? How self-regulated learning of science contents can be supported*

Schiffhauer, Silke; Opfermann, Maria; Wirth, Joachim; Goessling, Jill; Leutner, Detlev

When thinking about fostering experimental skills, two methods have attracted research interest. While some studies focused on hands-on experiments (HO), others used computer-based environments (CB). Both focus on important aspects of experimental methods and skills, but also disregard aspects of these. For example, in HO, operating errors can be made that occur due to wrong usage of appliances. This is not possible in CB as for instance, measures with specific appliances are presented automatically and contents are structured. Research, however, indicates no differences between groups that learned in HO vs. CB (Triona & Klahr, 2003). Therefore, instead of comparing both, Zacharia and Anderson (2003) suggest to combine them to foster learning. This might imply advantages especially with regard to the acquisition of self-regulatory abilities such as strategy knowledge and strategy usage. The question that arises in this regard is, how such a combination could look like and whether there is an

optimal order. These questions were in the focus of our study. 272 eighth graders with an average age of 13.3 years were randomly assigned to one of four experimental conditions. In all conditions, two learning phases on the domain of physics (buoyancy in fluids) took place consecutively. The first group learned with a computer-based environment both times (CB-CB), the second with hands-on environments both times (HO-HO), and in the other two groups, the environments varied (CB-HO, HO-CB). Dependent variables were cognitive load during learning, motivation, science content knowledge and strategy knowledge regarding scientific experimenting and methods. Results show that motivation, science content knowledge and strategy knowledge gains were higher for the two conditions with varying learning environments compared to the two conditions where students learned with the same method both times (also when considering CL during learning). The order of presentation did not make a difference. It can thus be stated that in line with Zacharia & Anderson (2003), a combination of hands-on and computer-based environments seems to make use of both methods' advantages. That is, students are better able to find solutions to physics problems when they experience different ways to approach such problems, which in turn might foster their metacognitive and self-regulatory skills.

## *Self-regulation learning in the physics laboratory: A proposal to the methodological change in the higher education*

Sáiz-Manzanares, María Consuelo; Bol-Arreba, Alfredo; Carbonero Martín, Miguel-Ángel; Román-Sánchez, José-María

Theory and practice are very important in Higher Education Reform. This is especially significative in physics laboratory. The aims were: a) to check if it is significative differences between experimental (metacognitive-regulation training) and control group in solving metal expansion practice (inter-group analysis). b) To check if the metacognitive-regulation training produces improvement in the development of practice in experimental group (inter-analysis). c) To analyze the procedure in the metal expansion practice. d) To identify the habitual mistakes in the metal expansion practice. The sample was composed by engineering civil students in first year. First Study (quasi-experimental): 44 students divide in both groups (experimental and control). Second study: (qualitative: Think aloud protocol): 12 students. The results show intergroup significative differences in acquisition of concepts: physics magnitude uncertainty ($p = .02$), increase of the temperature ($p = .05$) and the skills of search of information in the solving problem ($p = .01$). Also there are intragroup significative differences in the acquisition of concepts (the metal thermal expansion ($p = .05$); the physics magnitude uncertainty ($p = .03$); and the expansion coefficient interpretation ($p = .02$). In the qualitative analysis we also found differences in the skills of: team group, self-instruction, and the mistake analysis as well as in the mathematical and physics prior knowledge.

There were essential to constructive resolutions of laboratory practice. Consequence: The metacognitive-regulation training is the efficient methodology in learning physics laboratory.

I12 METACOGNITION AND TEXT COMPREHENSION

## *Self-regulated learning with expository texts: An analysis of the required competencies*

Schuette, Melanie; Wirth, Joachim; Leutner, Detlev

The aim of the study was to analyze the structure of self-regulation competence when learning with expository texts, which is represented by several competencies and their intercorrelations. Based on the research on self-regulated learning ten competencies could be identified which are necessary to meet the phase-specific demands within the different phases of the self-regulated learning process when learning with expository texts (see Schütte, Wirth & Leutner, 2010). In the model competencies are defined as cognitive dispositions. Thus, they represent only the potential and not the actual activity in a specific situation. The model only describes the different competencies needed, but there is no information about the structure of self-regulation competence, e.g., interdependences between the competencies. Therefore, a correlative study was conducted to investigate the structure of self-regulation competence. 559 German ninth-grade high school students participated in the study. The mean age of the sample was 14.92 years (SD = .52) and 52.1% were female. The design of the study was twofold. On day one, an expository text was administered (topics from either chemistry or physics). Within 15 minutes, students were asked to learn as much as possible while reading the challenging text. Before and after reading the text, content-valid achievement tests were used to assess students' knowledge gain. On day two, the competencies were assessed using newly developed tests. If students had worked on a chemistry text the first day, the test to assess the competencies on the second day dealt with topics from physics and vice versa. Overall, the intercorrelations between the competencies were found to be rather low (mainly r = .2). However, using an explorative factor analysis (principal component analysis with varimax-rotation), two factors could be identified which explained 23.9% of the overall variance. The first factor represented the ability to judge one's own knowledge-base (before and after learning). The second factor comprised all competencies for judging the given learning conditions (e.g., textual features, conditional strategy knowledge). Furthermore, the predictability of both factors for the independent learning outcome at day one was analyzed. Both factors were equally predictive for learning outcome (factor 1: ß = .22; $p < .01$; factor 2: ß = .25; $p < .01$) and could explain 14.1% of the variance of learning outcome (medium effect size: f2 = .16). Overall, the study presents a first insight in the structure of self-regulation competence. Thereby identified factors are in accordance with the theoretical assumption of independent

internal and external prerequisites for learning (see Winne & Hadwin, 1998; Zimmerman, 2000). The focus on cognitive dispositions can help to better understand the construct of self-regulation and can serve as a basis for the development of efficient training material.

## *Metacognitive knowledge, summarization skill and text comprehension in early adolescence: A longitudinal study*

Kolic-Vehovec, Svjetlana; Roncevic Zubkovic, Barbara; Pahljina-Reinic, Rosanda

Although the importance of metacognitive knowledge and summarization skill for the text comprehension has been extensively explored, there are only few studies that longitudinally follow metacognitive development during early adolescence, which is a crucial period for the improvement of metacognition in reading. The aim of the current study was to examine whether groups of students with specific patterns of summarization skill, metacognitive knowledge of reading strategies and text comprehension, obtained by means of cluster analysis in the 4th grade, still differ in those skills in the 6th and 8th grade. We also wanted to explore the stability of the obtained cluster structure and the changes in the group memberships from the 4th to the 8th grade. Metacognitive knowledge was assessed by 14-multiple choice questions asking students to select appropriate reading strategy in given situation. In summarization task students were asked to summarize main ideas from expository passages. Text comprehension was assessed on one narrative and one expository text. By k-means cluster analysis the four groups were differentiated in the 4th grade, when students were 10 years old. The group of the good comprehenders had above average metacognitive knowledge and summarization skill. Poor comprehenders had below average metacognitive knowledge and summarization skill. Two groups of average comprehenders differed in the metacognitive tasks. One group had above average metacognitive knowledge but below average summarization skill, whereas the opposite pattern occurred in the second group. The results showed that the differences in metacognition and text comprehension obtained between the groups in the 4th grade were not as prominent in the 6th and 8th grade. There were no differences in any of assessed variables between good and average comprehenders in the second and third wave of measurement. However, initially poor comprehenders still had the lowest comprehension scores than the other groups, and they still differed in metacognition from the good comprehenders. All the groups improved their metacognitive knowledge from 4th to 6th but not from 6th to 8th grade. The analysis of the cluster membership showed that most of the initially good comprehenders maintained same positive metacognitive pattern in the 8th grade, while the two groups with average comprehension and the group with poor comprehension showed less stable patterns.

Most of the changes in group membership were toward the groups with more positive metacognitive performance.

## *Metacomprehension and cognitive vigilance. A multi-teachers experiment in last year of secondary school*

Leclercq, Dieudonné; Laguesse, Céline; Henrotay, Pierre

Teaching and testing for comprehension are challenges that can benefit from metacognition. Piaget has argued that in many occasions it is possible for a student to be successful without having understood the underlying concepts of the content. Smedslund (1997)'s definition of comprehension: "A person S (as Student) understands a message M formulated by a person T (as teacher) if they agree on what, for T, is equivalent to M, is the contrary of M, is implied by M, has nothing to deal with M." has many implications, namely that there should be a debate about COMMON understanding. Since understanding (comprehension) is linked to cognitive vigilance General Implicit Solutions (such as "Lack of data", "Absurdity", for Open Ended Questions and the same plus "None" and "All of them" for MCQs. Metacognitive Spectral Tests (MST) have been adopted where: (1) Students answer to about 20 questions, on a special sheet, adding to each response a confidence degree (0 20 40 60 80 100); (2) Students answer a second time, with a red pencil, having been reminded one of the possible traps described here over. This second instruction enables to distinguish lack of comprehension from lack of vigilance. (3) During the debriefing phase, for each question, (a) the teacher communicates what is (are) the expected correct answer(s) for him/her; (b) students are invited to debate about alternative correct answers they would propose (c) the students position their answer on a (pre-printed) quality spectrum ranking from –100 (incorrect with 100% confidence) to 100 (correct with 100%); (d) the students are invited to answer (if appropriate) to one of the two following metacognitive questions: "Why was I so sure whereas I was wrong?" or "Why was I so unsure whereas my answer was correct"; i.e., operate a self-diagnosis (or causal attribution), necessary for subsequent regulation. (4) These MST are repeated during the school year and, at the end, students are invited to elaborate a "Metacognitive Retrospective and Prospective Report". This kind of formative evaluation had been initiated at the university level ten years ago. From September 2011, it has been implemented in a secondary school for about 40 students (in 2 classes) and 4 teachers in various areas, with the help of 2 university researchers in (1) producing visualisations of individual progresses in terms of spectral quality in relation to self-diagnosis as well as item analysis based on classical indices such as the biserial correlations and on new indices based on Subjective mastery on realism in self-assessment, (2) organising reflexive workshops with teachers. Interesting results are already available in terms of insights in the students' minds and in teachers' ones as well as in terms of item analysis. The opinion

of both, on this one year process, will be collected in April 2012, as well as an overall cost-benefit analysis.

I13 JUDGMENTS-OF-LEARNING

## *Activation of inaccurate prior knowledge affects primary school students' metacognitive judgments and calibration*

van Loon, Mariëtte; De Bruin, Anique; van Gog, Tamara; van Merriënboer, Jeroen

Metacognitive monitoring and regulation play an important role in learning from text. It is important that learners are able to accurately monitor the extent to which they have understood studied information, and that they can accurately evaluate the quality of their performance, so they can use this information to regulate their learning. Unfortunately, research on judgments made during learning (i.e., Judgments of Learning – JOLs) and on monitoring test performance (i.e., Self-Score Judgments – SSJs) has shown that both tend to be inaccurate. Learners tend to overestimate their memory performance, by often expecting to receive partial or full credit for responses which are entirely incorrect, so-called commission errors. And when students erroneously believe that they correctly understood and recalled the meaning of a concept, regulation of study will be inefficient because they will prematurely drop this concept from further study. In the present study, we aimed to investigate whether activation of inaccurate prior knowledge before study contributes to primary school learners' commission errors and overconfidence for these errors when learning new concepts. Primary school learners ($N = 103$, M age = 8.6 years, $SD = 0.8$) participated. First, they were asked on a pre-test whether they had prior knowledge about 20 key concepts. Subsequently, they studied the meaning of these 20 key concepts, and after study of all concepts they provided JOLs. After providing JOLs, they selected items for restudy, performed the recall test for the studied concepts, and provided SSJs about the quality of their test responses. The results show that inaccurate prior knowledge affects children's learning and calibration of their monitoring judgments. First of all, inaccurate prior knowledge activation led to more commission errors at the recall test than when learners were not able to activate any prior knowledge ($p < .0001$). Second, the level of children's judgments of learning for recall responses for which they would not receive credit was inappropriately high after activation of inaccurate prior knowledge ($p < .0001$). Moreover, children more often prematurely discarded concepts from further study after activation of inaccurate prior knowledge, than after no activation of prior knowledge ($p < .0001$). Finally, results showed that activation of inaccurate prior knowledge was not only detrimental for monitoring judgments during learning, but also for calibration accuracy after test taking. When providing SSJs judging the quality of their recall responses on the posttest, children were more overconfident when they had activated inaccurate prior knowledge than when they were not able activate prior

knowledge ($p < .0001$). These findings indicate that when children study, detection of inaccuracies in their prior knowledge might be important to improve monitoring accuracy, self-regulated learning, and learning outcomes.

## *Calibrating discourse: The qualitative nature of metacognitive judgments and the rhetorical effectiveness of writing by L2 graduate students*

Negretti, Raffaella; Kuteeva, Maria

What is the nature of calibration in academic writing? Why are some students better judges than others of the quality of their texts? These two questions guide this study. Academic writing in English has become increasingly important in the current globalized multi-cultural university as a means of assessment and gate-keeping, especially at the graduate level. Although research has recognized the significance of metacognition in writers' mental rhetorical representations, how and why students' judgments guide their writing choices is still an open question. The issue of calibration is further complicated by the socio-cognitive nature of academic genres, posing the question of the relationship between genre competence and metacognitive monitoring. Building on two previous studies, this research adopts a novel approach to the study of calibration in writing. Using qualitative measures triangulated with what students actually do – their academic texts – as assessed by an ad-hoc measure of rhetorical effectiveness derived from genre analysis, this study investigates how the qualitative nature of students' judgments is reflected in their writing, and the relationship between the effectiveness of their evaluations and their metacognitive genre awareness or "metaknowledge of genre". The complexity of the findings suggests several interesting avenues for further research on calibration and the role of metacognition in the learning and instruction of academic writing.

## *Do delayed Judgments-of-Learning of older adults base only on retrieval processes?*

Volz-Sidiropoulou, Eftychia; Gauggel, Siegfried

A two-stage process underlying delayed JOLs have been recently suggested: familiarity and target retrievability (Metcalfe & Finn, 2008; Son & Metcalfe, 2005). The first-stage is to determine whether the cue is recognized. If it is recognised, then one moves on to second stage, in which one attempts to retrieve the target. This process would result in middle or high JOLs. If the cue is not recognised, any further processing will be stopped and low JOL ratings are expected. Relative to retrieval process, the recognition process would be fast. We tested this hypothesis in a sample of healthy older adults. As older adults increasingly experience limitations in episodic memory performance, we expected them to use additional cues (like familiarity) and not only

retrieval attempt in order to make delayed JOLs. 44 older adults (M age = 66.5 years, SD = 5.7) studied 30 pair associates and were randomly assigned to two groups: 22 older adults made JOLs without special instructions ("JOL only" condition) and 22 older adults retrieved the target and then made JOLs ("JOL with pre-JOL recall" condition). The response latencies of the JOL ratings have been recorded as an indicator of familiarity or retrieval processes. Both groups showed a high relative accuracy (M gamma "JOL only" = 71, M gamma "JOL with pre-JOL recall = .69). There was no significant effect of condition either on the relative accuracy [F(1,43) = .05, ns] or on the final performance [F(1,43) = .01, ns]. The functions of the response latencies of the JOL ratings were monotinic, showing an increase in response latencies with decreasing JOL and parallel between the two groups, as would be expected if only retrieval fluency entirely determined JOLs. The present data disconfirmed the hypothesis that JOLs are made on the basis of two stages, familiaritiy and target retrievability. They provide further support that people make JOLs by attempting to retrieve the target first, either when they are instructed to retrieve the target and then make a JOL or make JOL with no special instructions.

I14 METACOGNITION AND COMPUTER-SUPPORTED LEARNING

## *Metacognitive knowledge in relation to experimentation skills and knowledge acquisition within a computer-supported inquiry learning environment*

Ristic Dedic, Zrinka

The study examines two components of metacognitive knowledge – metatask and metastrategic knowledge, which are relevant in the context of inquiry learning and, more specifically, inductive causal reasoning. Existing work on the topic has shown that engagement with inquiry tasks improved metatask and metastrategic knowledge (Kuhn & Pearsall, 1998; Keselman, 2003). It has also been demonstrated that strategic mastery could not be achieved without learners' understanding that their task is to analyse the effect of each individual feature and that the appropriate strategy is to apply a control-of-variables strategy (CVS). The aim of the present study is to investigate the gains in metacognitive knowledge that occur as a result of learners' repeated engagement with an inquiry learning task, and to examine the relationship between metacognitive knowledge and performance on the task. The study employed a microgenetic approach. The participants were 34 8th grade pupils, who participated in a self-directed experimentation task in a computer-supported environment using the FILE programme (Hulshof et al., 2005). The task required pupils to design and conduct experiments and to make inferences regarding the causal structure of a multivariable causal system. In order to track changes in the processes of knowledge acquisition, pupils participated in four learning sessions over the course of one month. Metacognitive knowledge was assessed by metacognitive questionnaire on two occasions – before and after working in

FILE. There were two measures of metacognitive knowledge: a) a direct measure which included answering two questions about the goal of the task and about the appropriate strategy to meet the task goal, and b) a transfer measure that tested the application of metacognitive knowledge on the task that had the same structure as the main FILE task, but was different in content. The results indicate that learners demonstrated improvement in metacognitive knowledge after repeated engagement with the task. Their understanding of the task changed from one oriented towards achieving a positive outcome to one aimed at exploring the effects of independent variables. However, learners failed to apply newly achieved metacognitive knowledge to the transfer task, which suggest that metacognitive gains received through engaging with the task were fragile and restricted only to the immediate learning situation. In regards to the relations between metacognitive knowledge and performance on the task, the results indicate that learners who attained a higher level of metacognitive knowledge used valid experimentation strategies more, had more valid inferences and acquired a higher level of domain knowledge than learners who did not improve on metacognitive knowledge. Furthermore, the results suggest that a particular level of metacognitive understanding is a necessary, but not sufficient condition for successful performance on the task.

## *Learning in the digital age: Comparing metacognitive accuracy for text material presented on paper, computer screens or electronic reading devices*

Norman, Elisabeth; Furnes, Bjarte

When you read a report, document or article with the intention to learn its content, do you prefer to read it directly on screen or do you prefer to print it? Many people report that they feel it is easier to learn a text if it is printed. The main emphasis of the current study is on how study media influences metacognitive feelings, which is a form of metacognitive experience that reflects aspects of ongoing processing and play an important role in self-regulated learning (Efklides, 2006). We report the results from a survey and two experiments exploring the relationship between learning and metacognitive feelings for on-screen versus on-paper learning. Survey participants (N = 99) expressed a stronger preference to read a text on paper if the aim was to learn the text (87.8%) than if the aim was to get an overall impression of the text (21.2%). It has been suggested that such differences in preference reflect underlying differences in metacognitive regulation for different study media, and that on-screen learning is associated with less accurate metacognitive feelings than on-paper learning (Ackerman & Goldsmith, 2011). This question was explored in two experiments addressing the relationship between study media and metacognitive resolution, i.e., how well the person discriminates between correct and incorrect responses. In both experiments, each participant read a sequence of short texts (Experiment 1 = 600 words, Experiment 2 = 1000 words) in one of three study media – on paper, on a computer screen or on an

electronic reading device. Learning outcome was measured as performance on a recall task and a recognition task. Metacognitive feelings were measured as Feelings of Knowing (FoK) rated in conjunction with every recall response, Confidence Ratings (CR) rated after every recognition response, and Predictions of Performance (PoP) rated after completing a certain proportion of text. In Experiment 1 (N = 60) simple fictitious texts were used. In Experiment 2 (N = 60) factual texts with a higher level of complexity were used, and reading strategy was assessed. Results from Experiment 1 showed a relationship between metacognitive resolution and study media: The relationship between metacognitive feelings and memory accuracy was significantly higher for participants who read texts on paper than those who read texts on a computer screen. The electronic reading device group did not differ from either of the other groups. Results from Experiment 2 will be presented at the conference. The results are discussed in relationship to theoretical models of metacognition and in relationship to previous empirical findings, including those of Ackerman & Goldsmith (2011). Theoretical implications as well as implications for self-regulated learning in educational settings will be raised. Finally, we discuss the extent to which our results validate the claim that elecronic reading devices "bridge the gap" between paper books and computer screens (Lemken, 1999).

## *Graph methodology to assess learning process traces in virtual environments: A preliminary experience in higher education*

Cerezo, Rebeca; Nuñez, J. Carlos; Sanchez-Santillan, Miguel

According to different approaches, the metacognitive control and use of self-regulation strategies promotes the academic learning and raise its quality (Zimmerman, 2008). For that reason there is an increasing interest on the self-regulatory and metacognitive component of learning. At the same time, the quantity of learning contents that are provided through LMSs (Learning Management Systems) is increasingly important. It is precisely these virtual and hypermedia learning environments more demanding for students in terms of self-regulation (Cerezo, Núñez, Rosário et al., 2010). However, the assessment of the learning process that occurs in these conditions is in many cases insufficient or even nonexistent. Also, traditionally, the methodology used is more focused on results than on process. The main objective of this project is to show the preliminary approaches to an experimental assessment tool to evaluate the learning process in virtual environments online – while takes place – through the navigation data recorded by LMSs. Once processed the data we proceed to the graphical representation of them through graphs. A graph is a visual and intuitive representation of the traces that the student left after passing through the learning platform. Somehow, this tool resembles the classic Trace Methodology (Winne & Hadwin, 1998) but in a new context like virtual learning environments. Preliminary

results are discussed. The present work has been funded by the Spanish Ministry of Science and Innovation: "Promotion of competences of self-regulation of academic learning in higher education by means of the virtual campus (e-TRAL Project)" Ref. EDU2010-16231.

## *Can technology foster emotional regulation in medical students? An international case study approach*

Lajoie, Susanne; Cruz-Panesso, Ilian; Poitras, Eric; Kazemitabar, Maedeh; Wiseman, Jeffery; Chan, Lap Ki; Hmelo-Silver, Cindy

All students need to learn to monitor and manage their emotions in academic settings. However, medical students must manage their own emotions (intrinsic regulation) as well as their patients' emotions (extrinsic regulation – see Gross & Thompson, 2007) when communicating bad news. This paper defines and assesses emotional regulation in terms of what strategies medical students need to use to monitor and control emotions. Enhancing emotional regulation can lead to more effective forms of physician-patient communication, which ultimately leads to better patient care. We use a hybrid instructional approach that combines cognitive and affective models of instruction within a "communities of practice" method (Wenger, 2000) supported by a problem-based learning framework (Hmelo-Silver & Barrows, 2008). We explore how technology can support this framework connecting medical students and tutors in Canada and Hong Kong to explore these issues. Communicating bad news requires that students monitor and control cognitive and affective activities. The cognitive skills pertain to knowledge and understanding of the disease. The affective skills require monitoring their own, and their patients', emotions as they give bad news. A mixed-methods design was used with time (Pre- and Post-Test) and culture (Canada and Hong-Kong) as the independent variable. The dependent variables were students' self-efficacy, value, confidence, and use of emotional regulation strategies of delivering bad news. The relationship between the student and patient was analyzed in terms of attentiveness to patients' emotional responses when receiving bad news. A state-trait model was used to examine changes in discourse from pre-to-post in how well student's monitored and controlled their emotions when dealing with patients and how such monitoring led to better cognitive outcomes. This case study presents a model for defining emotional regulation in a medical setting along with operational definitions of how to assess changes in regulation. Pre-post changes in student performance revealed that the intervention helped student acquire better self-regulatory skills.

I15 CONFIDENCE

## *Confidence in primary school students: A measure for self-concept?*

Fritzsche, Eva Susanne

Confidence scores derived from item-level self-assessments in knowledge tests are assumed to represent a person's expectation of having solved items correctly. Thus, they are potential measures of metacognitive monitoring (e.g., Roebers, Schmid & Roderer, 2009). Furthermore, as confidence and self-concept are correlated in adults (Kröner & Biermann, 2007; Stankov & Crawford, 1997), confidence might also be applied as a measure for self-concept in primary school students. Thus, in a series of four empirical studies, the validity of mean confidence of primary school students in a spelling test as a measure of their verbal self-concept was investigated. In the first three studies, relations between confidence scores, domain-level self-concept and achievement were examined cross-sectionally and also longitudinally in the third study. Results consistently showed a correlation between confidence and self-concept and a correlation of both variables with achievement criteria. However, when the corresponding spelling scores were controlled, unique effects on achievement criteria were surprisingly missing for confidence scores. When investigating cross-lagged effects, known reciprocal effects between self-concept and achievement were replicated. However, regarding reciprocal relations of confidence and achievement, only effects of achievement on confidence were found. These results provide only weak evidence regarding a strong overlap of confidence scores and verbal self-concept. Nevertheless, results might be due to different levels of specificity of self-concept and confidence. Thus, in study 4, the relation of confidence scores and verbal self-concept was compared with the relation of confidence scores and task-specific self-concept in spelling. When controlling for spelling scores, unique effects on achievement criteria were only present for verbal self-concept, but not for task-specific self-concept and confidence scores. In addition, there was a stronger correlation between confidence scores and task-specific self-concept in comparison with confidence scores and domain-level self-concept. Taken together, this indicates that confidence scores might be an indicator of task-specific rather than domain-level self-concept in primary students. However, these first results need to be replicated before applying confidence scores in school and educational settings.

## *Behavioural differences following high- vs. low-confidence errors within a tutoring learning environment for fraction learning*

Schnaubert, Lenka; Andrès, Eric; Eichelmann, Anja; Narciss, Susanne; Goguadze, George; Sosnovsky, Sergey

We know from different lines of research, that errors committed with high confidence (HCE) are more likely to be corrected after feedback than those with low confidence (LCE) (e.g., Kulhavy & Stock, 1989; Fazio & Marsh, 2009; Butterfield & Metcalfe, 2001). Metcalfe & Finn (2011) recently found evidence that, besides the extra attention paid to surprising feedback, familiarity also contributes to this hypercorrection-effect. The aim of this study is to investigate, if this effect can also be found within an interactive tutoring learning scenario regarding fraction learning, which is a domain that holds severe difficulties for children. We further investigate if LCE are followed by an increase in skipping behaviour. We analyzed data of 101 6th / 7th graders, who worked on eight multi-trial fraction tasks each. After their initial trial to solve the task, the students indicated on a percentage-scale how confident they were, that their answer was correct. They were given three trials to solve the task, in between which they received outcome as well as tutoring feedback in the case of incorrect solutions. After the third trial as well as after correct solutions, they were given a worked out solution of the problem. We focused on those task-completions, where the initial solution was incorrect (N = 310). Those incorrect solutions with a confidence rating over 50% were labelled HCE (N = 145), all others LCE (N = 165). The post-error behaviour was coded differentiating between correct, incorrect and no input/skip. We conducted $Chi^2$-tests to test for differences in behaviour between tasks containing HCE versus LCE. We found that trials following LCE were solved significantly less often than those following HCE. Furthermore, even though students did not skip significantly more trials right after LCE than HCE, they skipped significantly more trials after failing to correct an LCE than after failing to correct an HCE. These findings show that the hypercorrection-effect also occurs within realistic learning scenarios, thus providing further proof that confidence has an important impact on learning behaviour. Our findings further suggest that micro-adaptive learning environments should pay more attention to LCE, since they are not only less likely to be corrected, but might also foster unfavourable behaviour (skipping).

## *Improved accuracy of confidence for recall of an episodic memory event*

Buratti, Sandra; Allwood, Carl Martin

Several studies have shown that people are overconfident in many contexts. For example, eyewitnesses tend to be overconfident in their memories, which is problematic

since jurors often judge the credibility of an eyewitness based on his or her confidence. In this study we investigated whether people can make their metacognitive judgments more accurate by adjusting them. The regulation of confidence accuracy can be seen as a form of meta-metacognition where the accuracy of the first-order confidence judgments is evaluated by second-order judgments. In this study we also analyzed the relation between which confidence judgments were adjusted and the answers' processing fluency and phenomenological memory quality. The study had a 2×3 design with the within-participant variable of Task (Confidence task vs. Adjustment task) and the between-participants variable of Condition (control vs. processing fluency vs. remember/know). In the Confidence task the participants (N = 200) rated their answers to 40 recall questions on a video clip just seen. The participants in the processing fluency condition also gave a rating concerning how easily they thought they recalled the item. In the remember/know condition the participants rated which memory quality they believed the recalled memory had (remember vs. guessing vs. know). In the Adjustment task all participants were asked to try to increase the accuracy of their confidence judgments by modifying the confidence judgments they believed to be the least accurate. The participants managed to increase the accuracy of their confidence judgments, although the effect was small. The confidence judgments associated with low processing fluency and the memory quality know tended to be modified more often. In brief, our results provide evidence that eyewitnesses can improve the accuracy of their confidence judgments of reported memories by making accurate second-order judgments.

## I16 METACOGNITION AND LEARNING STRATEGIES

### *University students' knowledge about and usage of learning strategies*

Haendel, Marion; Lockl, Kathrin; Tupac-Yupanqui, Ana

University learning (and testing) environments require knowledge about learning strategies and an adequate use of strategies. However, university students do not always have sufficient strategy knowledge and sometimes show ineffective study behavior (compare McCabe, 2011; Tuckman & Kennedy, 2011). Inter-individual differences in the repertoire and usage of strategies of adult learners might be due to prior knowledge, motivation, gender, study experience or subject of study. In our study we investigated metacognitive strategy knowledge and self-reported strategy use (see Veenman, van Hout-Wolters & Afflerbach, 2006 for methodological considerations) with regard to study experiences, the subject of study and the effects concerning an ecologically valid training. University students with different study experience in two different subjects of study (education/psychology versus others) participated in the study (N = 58). A subgroup of the education/psychology students actively engaged in a 15-week course on metacognition and self-regulated learning. At the end of the semester, all students filled in a questionnaire on self-reported strategy use and a metacognitive knowledge test. The

results show a moderately frequent self-reported strategy use and a moderate to high metacognitive knowledge. With higher study experience, students show higher metacognitive knowledge but no specific pattern of strategy use. No significant differences could be shown for different subjects of study. Finally, students who participated in a course about self-regulated learning showed higher metacognitive knowledge but no different strategy use than their counterparts. The results of our study supplement research by simultaneously investigating metacognitive knowledge and self-reported strategy use with university students. We showed that longer study experience is associated with more sophisticated metacognitive knowledge and that providing students with an ecologically valid setting on metacognition and self-regulated learning can improve their metacognitive knowledge. Certainly, more longitudinal research is needed to examine the underlying developmental processes in more detail. The reasons for the unexpected effects concerning the subject of study on the two investigated variables and the mostly lacking effect on self-reported strategy should be further investigated with larger sample sizes. Possible explanations for the heterogeneous findings will be discussed.

## *Using learning journals to support metacognition in vocational education*

Mauroux, Laetitia; Dehler Zufferey, Jessica; Jimenez, François;
Gurtner, Jean-Luc

While the impact of self-regulation and metacognition on learning has largely been documented (Efklides, 2009; Whitebread et al., 2007), bringing learners to use self-regulation and metacognitive strategies while performing a task is more difficult to achieve. Under certain conditions, Learning Journals (LJ) have the potential to stimulate self-regulated learning (Abrami et al., 2008) as well as the use of metacognitive strategies (McCrindle & Christensen, 1995). This research attempts to introduce an online LJ in vocational education to stimulate apprentices' reflection on their learning and mastery of professional skills. Apprentices in the bakery and confectionary domain (N = 16, age: 15 years) took pictures from their workplace experiences and incorporated them in a web-based LJ. Three prompts (following Kicken et al., 2009) were integrated in the LJ to guide apprentices' reflection and stimulate the use of metacognitive and self-regulated strategies as planning, evaluation, elaboration and appropriate help-seeking. The question addressed is whether the use of such a LJ leads to an increased level of self-reported learning strategies, assessed through questionnaires adapted to vocational education from the MSLQ and the MAI. Results show that, compared to a control class, apprentices using the online LJ reported a larger use of the targeted metacognitive strategies. Moreover, within the experimental group, apprentices who made the larger use of the specific prompts inserted in the LJ showed a larger use of the corresponding strategies in the questionnaire, namely organization, elaboration, planning and help

seeking. In June 2012, apprentices will pass their final exam. We will see if these increases in metacognitive strategies also lead to specific gains in their mastery of the professional skills tested during this final exam.

## *Exploring student reactions to online metacognitive scaffolding during inquiry-based learning*

Hsu, Ying-Shao; Zhang, Wen-Xin; Wang, Chia-Yu

The purpose of this study is to explore the effects of online metacognitive scaffolding on scientific inquiry. The specific researcher question is: "What patterns of student reactions to online metacognitive scaffolding were found in different stages of inquiry such as questioning, planning, analyzing, and interpreting?". Twenty-six ninth graders in Taiwan receiving inquiry-based online curriculum with metacognitive scaffolding. Multiple data were collected for us to analyze students' performances and developments on inquiry and metacognition. Besides students' pretest and posttest scores, we also collected students' performances from worksheets and their actions of online inquiry activities through a screen recording software called Camtasia Studio. This paper only focuses on student actions to scaffolding by selecting one case (called "Sam") with low metacognitive ability to show his actions. According to the types of prompts (i.e., cognitive or metacognitive scaffolding) he was engaged, we further coded Sam's reactions and inquiry ability development based on the rubrics developed from literature review and ground theory approach. Sam's performances collected from the log files were further coded into individual events, starting by an initiation of prompts and then the corresponding reactions to the prompts. Sam's performances in 22 events were coded and displayed by different units of the season lesson (training tasks, structured inquiry, guided inquiry, and peer evaluations) in a figure. Then, we synthesized assertions from the figure to indicate the patterns of reactions to metacognitive scaffolding. Three found assertions were: (1) The case student did not precede further inquiry task due to his inability in recognizing the goal of the task or his weak inquiry abilities to support him to engage in deep inquiry task even if he had recognize the learning goal; (2) The case student started his regulation learning after being aware of his weakness and difficulty; and (3) Being a self-regulated learner requires multiple practices of inquiry ability and metacognition. In general, we found that students demonstrated a better learning process of inquiry if they received some guidance by metacognitive scaffolding in an inquiry-based curriculum in this study. Guiding students to find that they had encountered certain problems or were doubting their original answers or plans was an important step, because students often cannot realize that they have encountered problems in learning process. Once students fail to discover that they face certain problems, they easily ignore the fact that they don't understand the learning task, or that they are using the wrong strategy. And once students' awareness has been promoted,

they will monitor and evaluate their own learning processes, answers, and strategies, and then change the answers they give or the strategies they use. It is a key to design metacognitive scaffolding for high quality of inquiry learning.

I17 METACOGNITION IN SOCIAL ENVIRONMENTS

## *Relationship among metacognition, motivation, social-emotional learning competencies and achievement of primary children*

Ee, Jessie; Ming, Zhou Ming

According to Zins et al. (2004), metacognition has been found to be a good mediator for enhancing social emotional learning (SEL). As metacognition is thinking about thinking, the more students are aware of their thinking processes as they learn, the more they can control such matters as goals, dispositions, and behaviour. If students are aware of how committed (or uncommitted) they are to reaching their goals, of how strong (or weak) is their disposition to persist, and of how focused (or distracted) is their attention to a task, they can regulate their commitment, dispositions, and behaviour and be self-regulated (Marzano et al., 1988). As SEL is still a relatively new initiative in Singapore, this study seeks to examine the role of metacognition and SEL in their predictive value on primary students' academic achievement. The findings with 523 primary school students (53% boys) showed that student's five SECs predicted their metacognition, which in turn predicted their academic achievement (as shown by their Math and Science scores). In other words, students who have higher social-emotional competencies are likely to be more metacognitive and this will also enhance their academic performance.

## *Development of metacognition in Chilean preschool children: The relationships among the type of feed-back given by teachers and the elicitation of metacognitive control behavior*

Santa Cruz, Josefina; Muñoz Arancibia, Liz Pilar

From the challenge faced by Chile to raise the quality of public education at all levels, the goal of this study is to highlight the role of teacher in cognitive development of preschool children who belong to district who has low economic status, of the city of Santiago de Chile. The authors presents findings from a quasi-experimental transversal study that explores the relationships among the type of feed-back that the teacher gives while the young children works in collaborative assignment and the elicitation of control metacognitive behavior. Teachers at the same school, but in alternate work days, were trained either in "self regulation feedback" or in "task and/or person feed back". The

experience was realized in educational naturalistic settings, and was recorded using audio and video sources. The number of metacognitive behaviors was measured, from children who received either one or the other kind of feedback from their educators. The data was analyzed using the Kruskal-Wallis, a non parametric test, which indicated that there is a significant difference ($p = 0.032$) between observed groups. Specifically, the group of children who received "self-regulation feedback" showed twice as metacognitive control behaviors that children belonging to the group of students who received "feedback task and/or person". The results showed differences in the planning and evaluation dimensions, predominantly in the last one. At the same time, the major number of metacognitive control behaviors ocurr when the children work without supervision. The authors discuss i)The role of the teacher in developing metacognitive skills in young children ii), the importance of the kind of feedback that is given to children when they work in collaborative assignment iii) the importance of developing self-regulation abilities in early ages and their relation to the promotion of development and learning skills in the later years.

## *Sense of community and self-regulation. Reciprocal interaction in a Knowledge Building Community*

Girani De Marco, Barbara; Albanese, Ottavia; Balboni, Giulia; Cacciamani, Stefano; Coscarelli, Alessandra; Farina, Eleonora; Perrucci, Vittore

The research on the efficacy of on-line knowledge building communities has brought to light the crucial role of two interconnected factors: the sense of community (SoC) and the self-regulation of learning (SRL). Sense of community is defined by McMillan and Chavis (1986) as the sense of belonging and hard interdependence of a person within a group and the perception of being part of a very reliable and stable group. The theoretical construct of self-regulation is described by Zimmerman (2008) as a group of pro-active self-directive processes and beliefs about self used by the student to acquire cognitive, metacognitive, motivational, behavioural and environmental competences to improve personal academic results (Pintrich, 2000; Boekaerts & Corno, 2005). The aim of our research is to identify the relationship between sense of community and self-regulation and to verify the existence of a directional relationship between them. We hypothesized that more self-regulated students are more able to develop sense of community in the first few days of activity and that the early development of the sense of community will allow students to enrich their SRL competencies and to develop the sense of community even more. Participants of our research are 90 university students, members of a Knowledge Buiding Community at Milano Bicocca University. Students are asked to fill in two questionnaires in the first two weeks and at the end of the course: the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1993; Italian version developed by Bordin et al., 2009) and the "Scala del Senso di Comunità

nei corsi online" (sense of community in online course scale, Perrucci et al., 2009). We correlate the early SoC general index with all MSLQ components at the beginning and at the end of the course. Structural equation models will be used in the next few months to analyze directional relations between the two constructs. Data show significant correlations between early SoC and all SRL competencies at the beginning and at the end of the course: pre-test strategies ($r = .32$, $p < .001$), pre-test motivation ($r = .24$, $p < .01$), post-test strategies ($r = .30$, $p < .01$), post-test motivation ($r = .29$, $p < .01$). Moreover, results show correlation between final SoC and all SRL outgoing scores: post-test strategies ($r = .28$, $p < .01$), post-test motivation ($r = .29$, $p < .01$). Our results suggest the existence of a relation between SoC and SRL competencies and show the need to develop students' personal self-regulation competencies and to foster the development of a sense of community from the beginning of the course. The results lead us to verify more in depth the existence of a directional relation between the two constructs (SRL and the sense of community) with the intent to develop specific models of the relations between them.

I18 METACOGNITION IN ATYPICAL LEARNERS

## *Metamemory and subjective memory experiences in students with learning difficulties*

Mirandola, Chiara; Ghetti, Simona; Cornoldi, Cesare

Metamemory refers to the ability to introspect on one own's memory processes and report on them. Introspection on internal memory states allows for the investigation of subjective remembering, which reveals essential in adding information on the qualitative aspects of memory, especially in populations of children with learning difficulties. Nonetheless, children with learning difficulties, in particular those with faulty comprehension of conceptual material such as a written text, may show a similar level of memory accuracy than their peers but different abilities at the subjective level; indeed, knowing the subjective experiences associated with memory of a narrative text enhances the relevance that the text itself has for the person and this could have implications for the particular case of those texts, offered at school, which need to be studied and elaborated by the students. If the text is well processed and thus not only well remembered at the objective level (i.e., accuracy) but also subjectively perceived as compelling, then it is more likely that it will be later remembered in more details. The present research was aimed at investigating recognition memory for sentences included in a narrative text and subjective memory experiences related to the text in adolescents with and without learning difficulties. Adolescents (age range: 15-19 years) with learning difficulties were selected based on their performance on a standardized test for text comprehension and on the teachers' evaluations of their school achievement. In a recognition memory paradigm for text (created ad hoc for the purposes of the present

experiment), students with learning difficulties ("poor learners") compared to a control group, showed a lower hit rate for sentences, thus they were less able to recognize whether target sentences appeared in a previously heard narrative. Further, "poor learners" were less likely to associate Remember judgments to the target sentences, whereas both groups associated a similar level of Familiar responses to the old items (Remember-Know paradigm; Tulving, 1985). These results show that students with learning difficulties have a less subjectively compelling memory experience related to a complex text, and thus are less competent at the metamemory level than students without learning difficulties. The results are discussed in terms of their implications in school contexts.

## *Teaching teachers to help hospitalized children to cope with emotions*

Kanizsa, Silvia

Most recent studies on metacognition show that children recognize emotions from their earliest youth and that to express feelings helps a healthy growth (Harris, 1989, 2000, 2004, 2006; Saarni, 1999; Pons, Harris & De Rosnay, 2004; Albanese, Lafortune, Doudin & Pons, 2006). Nevertheless, hospitalized children cannot express their emotions, such as fear, or unease, because adult are scared of children suffering (Freud, 1977; Freud & Bergmann, 1965; Raimbault, 1978; Kanizsa & Dosso, 1998; Benini, 2004; AIEOP, 1998; Capurso & Trappa, 2005). The school in hospital is the only place where children can express emotions without fear to be stopped and can be helped to cope with their inner difficulties and to live the hospitalization in a better way (Kanizsa & Luciano, 2006; Capurso, 2001; Caviezel-Hidber, 2000; Polizzi & Perricone, 2005; Ricci, 2003; Lanzetti, Ricci & Piscozzo, 2008). For this reason it is very important to train teachers working in hospital to help children recognizing and expressing their emotions. First of all during the training teachers have to learn to observe children's way to express, or to hide their feelings. Secondly they must learn what can be done to allow children to recognize their emotions and to be able to speak about them. Methods as reading or writing stories, painting, writing or acting for puppet theatre, dancing, making music, working with clay and so on, and sometimes even schools' lessons can be used in order to achieve the purpose. This paper presents the first findings of a theoretical and empirical study which falls in the sphere of meta-cognitive teaching which focus on training teachers to cope with the emotion of hospitalized children. 30 students, training as primary and pre-primary teachers at the university of Milano-Bicocca (Italy), worked in 8 hospital schools studying how to make a context useful to allow hill children to express themselves and to live the hospitalization not as a place where to suffer and to hide their emotions (halting, or drawing back in the growth), but as a place where the emotions of the illness can be told and used for a healthy growth. They observed the situations and proposed the activities which best suited the context and the children

situation. They took notes of all the happenings and then worked on the results. The first findings of the research show that if the teacher works on the emotions and is able to help children to tell how they really feel, children are more confident and more able to cope with pain and fear that illness and hospitalization imply.

## *Theory of Mind in deaf adolescents and young adults*

Petrocchi, Serena; Baruffaldi, Francesca; Lecciso, Flavia

Research on Theory of Mind (ToM) in deaf children found significant differences among native signers, late signers, oral deaf, and hearing children (Schick et al., 2007). Few studies examined ToM during adolescence and adulthood (Hao et al., 2010). The present research compared ToM ability in deaf and hearing participants and among deaf participants. Participants were 92 subjects from 15.9 years to 28 years (M = 21.9 years, SD = 3.25 months). 47 participants were severely deaf (N-native signers = 15; N-late signers = 15; N-oral deaf = 17) paired by gender, chronological and mental age with hearing peers. 5 WAIS-R verbal subscales (IQv; Orsini & Laicardi, 1997); Second-order false belief task (SFB; Liverta-Sempio et al., 2005); Strange Stories (SS; White et al., 2009); Reading the Mind in the Eyes-test (RME; Serafin & Surian, 2004). All tasks were translated in Italian Sign Language for native and late signers. Significant differences emerged between native signers and hearing peers ($t(26) = -6.75$, $p = .000$), and between late signers and hearing peers ($t(26) = -8.39$, $p = .000$) in IQv. Deaf participants showed lower IQv score than hearing peers (M-native signers = 74.93, SD = 10.36; M-hearing paired = 102.46, SD = 11.21. M-late signers = 66.67, SD = 12.08. M-hearing paired = 105.33, SD = 13.13). None difference emerged between oral deaf participants and hearing peers in IQv. GLMs with group (deaf vs hearing) as independent variable, IQv as covariate, and ToM scores as dependent variables were carried out. None differences emerged between native signers and hearing peers. Significant difference emerged on RME score between late signers and hearing peers, $F(1\ 26) = 9.53$, $p = .005$, and between oral deaf and hearing peers, $F(1\ 31) = 8.79$, $p = .006$. In both cases, deaf participants showed lower RME score than hearing peers (M-late signers = .50, SD = .05 and M-hearing paired = .67, SD = .08; M-oral deaf = .62, SD = .12 and M-hearing paired = .75, SD = .08). GLMs with group (native signers vs late signers vs oral deaf) as independent variable, IQv as covariate, and ToM scores as dependent variables were carried out. Significant differences emerged on SFB score, $F(2\ 42) = 4.30$, $p = .020$, and SS score, $F(2\ 43) = 4.94$, $p = .012$. Planned contrasts revealed that late signers got lower ToM scores than both native signers and oral deaf. With RME score, only the IQv was significant, $F(1\ 41) = 11.59$, $p = .001$. Deaf adolescents and young adults showed similar ToM performance as found in literature during childhood (Schick et al., 2007). Native signers, compared to hearing peers, didn't show any ToM delay; despite the age, late signers and oral deaf showed a ToM delay (cf. Russell et al.,

1998). ToM training programs should be developed in order to improve social abilities of deaf people.

I19 METACOGNITION AND CREATIVE PROCESSES

## *The nature of the insight: A study of general and school-related Aha-experiences*

Reber, Rolf; Haukenes, Silje B.

The Aha-experience is a fascinating but little understood with reference to metacognitive experience. Four features define the Aha-experience: (1) the solution comes suddenly and (2) easily to mind; this sudden insight elicits (3) positive affect and (4) confidence that one has found the true solution. Topolinski & Reber (2010) combined these four attributes into an integrative fluency account of the Aha-experience: Sudden ease of processing (fluency) elicits positive affect and increases subjective confidence that a solution is true. In addition to these four dimensions, control, motivation and coping may be relevant. We conducted a questionnaire study that examined Aha-experiences and its effects. We constructed an online questionnaire and invited undergraduate students from different disciplines to complete the survey for payment. One group was instructed to describe Aha-experiences in general (N = 21 who remembered such an experience) whereas a second group had to describe Aha-experiences from school (N = 22). Seven dimensions were created: suddenness, ease of processing, positive affect, confidence in the truth of the solution, control, motivation, and coping. Each dimension was assessed by four questions that had to be answered on a scale from 1 (completely disagree) to 7 (completely agree). Each question had to be answered in relation to three stages of an insight: Before the Aha-experience; during the Aha-experience: and after the Aha-experience. This resulted in 84 experience questions totally (7 dimensions * 4 questions * 3 points in time). Participants first described a specific Aha-experience before they completed the questionnaire that included the 84 experience questions. As there were no interactions, with the exception of suddenness, we report the findings for the two groups combined. We calculated simple contrasts which are the contrasts (1) between before and during the Aha-experience; (2) between before and after the Aha-experience. There were significant effects for one of the contrasts in all dimensions. As predicted by the fluency account, the scores for positive affect, ease of processing, and suddenness (only for the Aha-experiences-at-school group), and certainty increased. The increase in experienced coping can be seen in relation to the increase in certainty. Experienced control was lowest during the Aha-experience. Finally, we found an increase in motivation that lasted beyond the Aha-experience. In conclusion, beyond confirming the model by Topolinski and Reber, the study yielded new insights about motivational consequences of Aha-experiences. We discuss the results from the viewpoint of increasing motivation at school through the induction of metacognitive experiences.

## *Children's metacognitive awareness of the change of interpretation involved in creativity*

Pizzingrilli, Paola; Molteni, Stefania; Antonietti, Alessandro

Autobiographical accounts and experimental findings support the notion that the core phase of the inventive process is when persons change the interpretation of the given situation by restructuring it. Being aware of this process is critical to foster creativity since such awareness enables individuals to plan and control mental activity accordingly. A task has been devised to test whether children recognise that restructuring is the crucial mental process involved in creativity. Such task allows one to check if children know that original products are yielded thanks to a change in interpretation so that the common interpretation is substituted by a new, unusual interpretation. Children are told a story and a series of drawings are presented. The story tells about two schoolmates, Mark and Luke. Mark is drawing a flower but suddenly he has to go out, by leaving the initial drawing incomplete. Luke comes and, after having seen Mark's drawing, decides to modify it so that it appears a human character (intermediate drawing). When Mark comes back, he notices the changes that Luke made and he decides to complete it following the direction suggested by his friend, so that the final drawing depicts a sultan. In the control version of the story, Luke modifies the initial drawing without changing its starting meaning; consequently, when Mark comes back, he finds a drawing which matches his previous intention and so he completes the drawing by depicting a flower. Children are requested to judge the degree of beauty and originality of the drawings and to decide if Mark or Luke gave the greatest contribution to the realisation of the drawing. Children are also asked metacognitive questions designed to assess the awareness of other aspects of the mental processes underlying the realization of the drawing: they are asked if they would have predicted that the picture in the initial phase would have been completed so to appear differently in the final stage, if the way the final picture was drawn matches what children usually do, if the teacher would assess the contribution of the two characters of the story according to the same criteria used by children. The task was administered to a sample of 120 children, ranging in age from 5 to 12 years. Results showed that, starting from 7 years, beauty scores failed to change across the three phases and no difference between the non-creative and creative versions emerged; by contrast, originality did not change across phases in the control version, whereas it increased dramatically from the initial to the intermediate drawing in the creative version. Younger children, instead, were not able to distinguish clearly between beauty and originality and to distinguish between the original and common drawings; further, they tended to appreciate most the character of the story who begun the drawing, irrespective of the contribution – creative vs. non creative – of the second character.

## *Objects and materials to shape children's ideas*

Guerra, Monica; Zuccoli, Franca

The encounter with objects and materials is a constant in the life of children, starting from an early age in an exploratory and independent way, afterwards intentionally carried out in schools. These encounters have been deepened thanks to a long-standing pedagogical tradition (Froebel, 1826; Agazzi, 1929; Pizzigoni, 1931; Montessori, 1950; Freinet, 1959; Malaguzzi, 1990, 1993), which has gradually revealed how the exploration of materials is conducive to learning, making the processes of thought visible (Tarr, 2008; Gordon-Smith, 2010). In particular, the introduction of unusual materials inspires children to explore and create connections, transform and reinvent, thereby facilitating creative and divergent thinking (Eckhoff & Spearman, 2009), as well as expressing and sharing thoughts and feelings (Gandini, Hill, Cadwell & Schwall, 2005). This paper presents the first findings of a theoretical and empirical study which falls in the sphere of metacognitive teaching, based on the idea of exploring how materials not designed exclusively for educational use, drawn from everyday life (hence attributing finished objects with different meanings than their original functions) as well as recycled or waste materials (meaning recognizable or unrecognizible used or new unfinished materials), may raise questions in children (individually and in groups) and offer opportunities for "natural" problem solving because of the destructured characteristics of the materials. The analysis was carried out through experimentation and systematic observation in kindergartens and primary schools, aimed at documenting the design, construction and reflective strategies implemented by the children in their encounters with the above-mentioned objects and materials. Working with these objects and materials, both in their concrete aspects but also thanks to their flexibility, seemed to promote a spontaneous meta-cognitive attitude. This was evident in the ability to express accurate judgments regarding the characteristics of the materials on the part of the children who were able to identify the best strategies for use and explain their choices to other peers or adults.

I20 METACOGNITION AND EMOTION

## *Metacognition and reflexivity: Which role for emotions?*

Freda, Maria Francesca; Esposito, Giovanna; De Luca Picione, Raffaele; Manzo, Stefano

The paper discusses the relationship between metacognition and reflexivity that in some contexts are used as equivalent, in others as different. We refer to those theoretical strands that define reflexivity as a metacognitive competence consisting in having awareness of own thought processes in order to control them and to facilitate a functional adaptation to contexts (McAlpine et al., 1999; Moore, 2011). However, with

reflexivity and metacognition we can mean two different levels of development and complexity according to which reflectivity would be a first stage in the process of metacognitive elaboration (Semerari et al., 2003), or it is possible to recognize points of congruence, but not of coincidence, between reflexivity and metacognition, if they are intended as procedural and intersubjective devices able to restart non adaptive situations of stasis. With reference to this last point, and beginning from the premise that cognitive activity can not be divorced from the emotional and relational matrix, the paper will discuss how the construct of mentalizing or reflexive function (Bateman & Fonagy, 2011) can be used to articulate and mediate the relationship between metacognitive and emotional processes within a relational and intersubjective field. These questions are declined through the exemplification of an action-research project conducted within university settings with groups of underachievers students late in the acquisition of CFU and with a low average to the exams. This action-research, part of an international project funded under the measure ERASMUS Multilateral Project, aimed to promote reflexive competence for First Level Degree students of the University of Naples Federico II. The training methodology has adopted the narrative device that has an empowering function the reflective process (Freda, 2008; Salvatore & Freda, 2011) and involved the use of narrative tools relating to four discursive channels (metaphoric, iconographic, mediated by writing, bodily). We discuss the methodological steps that have allowed to explain the relationship between reflexivity and metacognition mediated by emotions.

## *DLPFC, meta-cognitive control and emotional expression. What role of the frontal network for emotion and cognition in memory mechanisms?*

Balconi, Michela; Ferrari, Chiara

A recent hypothesis proposed that the prefrontal cortex (PFC) may be identified as the site of emotion-memory integration, since it was shown to be particularly sensitive to the encoding and retrieval of emotional contents and it was observed to have a meta-cognitive control on emotional behaviour (Balconi & Ferrari, in press). Thus, PFC could be crucial in mechanisms underlying the regulation of emotion, such as inhibition. It was found PFC governs the executive control of information processing, including the ability to inhibit irrelevant stimuli and impulses, and evaluate and select the appropriate response. Specifically a top-down meta-control of PFC on the amygdala allows for a cognitive modulation of emotional processes by frontal brain structures. However, some evidence suggests that multiple regions of the PFC have the capacity to perform multiple types of executive control functions (i.e., evaluate, maintain, inhibit, or select). In particular, evidence indicates that PFC extending to the ventrolateral PFC, could facilitate successful goal-oriented behaviour by inhibiting the influence of emotional information in the context of physical sensation, selective attention, and emotion

regulation. In the present research we explored the role of the dorsolateral prefrontal cortex (DLPFC) in memory retrieval process of positive vs. negative emotional stimuli when old (target) and new (distractor, semantically related and unrelated to the target) stimuli were presented. This effect was analyzed by using a rTMS (repeated Transcranial Magnetic Stimulation) paradigm that induced an increased cortical activation of the left DLPFC. Subjects were required to perform a task consisting in two experimental phases: an encoding-phase, where some lists composed by positive and negative emotional words were presented to the subjects; a retrieval-phase, where the old stimuli and the new stimuli were presented for a recognition performance. The rTMS stimulation was provided during the retrieval-phase over the left DLPFC. We found that the rTMS stimulation over this area affects the memory retrieval of positive emotional material, with higher memory efficiency (shorter Response Times, RTs). Moreover, related and unrelated distractors were better discarded when they were positively valenced, and the more significant effect was produced in response to related distractors with an increased effectiveness (better accuracy) and efficiency (reduced RTs). This result suggested that left DLPFC activation favours the memory retrieval of positive emotional information and secondly that it is able to induce a more appropriate selective process to distinguish target from distractor stimuli. The valence model of emotional cue processing may explain the increased performance.

## *Meta-emotive intelligence, mindfulness and scholastic learning: A treatment study*

Terminello, Anna; D'Amico, Antonella; Chifari, Antonella; Merlo, Gianluca

This study, arising from the cooperation between different educational workers (researchers, educators, teachers, experts) is aimed at analysing the use of innovative methodologies for socio-emotive teaching/learning and its effects on student learning. To this aim, an original training named "Meta-emotive intelligence and mindfulness: monitoring by mobile devices" is being delivered to a group of 51 students at a junior secondary school in Palermo. The training uses methods coming from the Buddhist tradition, such as yoga and mindfulness, as well as methods taken from the REBT – Rational Emotive Behavioural Therapy – (Ellis, 1962) and from the literature about Emotional Intelligence (Mayer & Salovey, 1997). Thus, the training is performed using both traditional methods (relaxation exercises, focus groups) as well as using ICT such as educational software (D'Amico & De Caro, 2008) and applications running on mobile devices (Chifari & Merlo, 2011) to foster the self-monitoring of students' emotional states. The effectiveness of the training will be assessed through a quasi-experimental test/treatment/retest design, involving two experimental groups and a control group. The experimental group is composed of two classes at lower secondary school which participated in the mindfulness and meta-emotive intelligence training. The control group is composed of a class of the same scholastic level, that has been involved only in test and

retest phase. The tests used in the test-retest phases are: the IE-ACCME: Intelligenza Emotiva: Abilità, Credenze e Concetto di sé Meta-Emotivo (D'Amico, in press) to evaluate the emotional intelligence; the PML: Prove Memoria di Lavoro (D'Amico & Lipari, in press) to assess Working Memory; the MT (Cornoldi & Colpo, 1995) and the SPM: Soluzione Problemi Matematici (Lucangeli, Tressoldi & Cendron, 2003) tests, to assess reading comprehension and arithmetical problem solving abilities. Moreover, teachers' marks and data on students' behaviour during lessons (perseverance, attention, organization, and anxiety) are collected. We expect the experimental groups to show an improvement in their performance in the field of emotive intelligence, emotive self-regulation, attention, concentration and working memory. We also hypothesize that, in turn, these improvements will lead to an enhancement of school achievement. The final results of the study, currently under development, will be discussed. The study, included in the Project "Edutainment: education and entertainment in experiential learning labs" (http://edutainment.pa.itd.cnr.it), has been funded by Assessorato Regionale Istruzione e Formazione Professionale – Sicilia – and promoted by MIUR, Agenzia Nazionale per lo Sviluppo dell'Autonomia Scolastica – Sicilia (ANSAS). Other partners are: Dipartimento di Psicologia, Palermo; Istituto per le Tecnologie Didattiche, CNR, Palermo; Istituto Comprensivo M. Buonarroti, Palermo; Children's museum BIMPA, Palermo.

I21 METACOGNITION IN CHILHOOD

## *The contribution of solitary symbolic play to babies' self-regulation*

Orr, Edna; Geva, Ronny

Self-regulation is a mental tool that enables the mastery of behavior and emotions by using executive functions; an umbrella term for a wide range of cognitive abilities such as attention, planning, problem-solving and decision-making. Symbolic play is well-known as a tool that promotes children's self-regulation because of its internal mental planning. However, its contribution to infants' self-regulation has not yet been investigated. The aims of the current research are to examine whether self-regulation exists during solitary symbolic play and if so, to determine its characteristics. To investigate the research questions, 14 babies between the ages of 6-18 months were videotaped once a week. 320 imitation and transformation actions were identified as intentional symbolic actions. The identification of intentional actions was determined according to the criteria of Baldwin et al. (2001), in addition to one new criterion that was determined after a case study. Each action was coded for motor and behavioral variants. The motor variants refer to the level of the action. Four levels of action were recognized between the ages of 6-18 months, as follows:

- Simple symbolic action level 1 – babies hold one object and perform one simple action.

- Simple symbolic action level 2 – babies hold one object and perform an action sequence.
- Complex symbolic action level 1 – babies hold two objects, one in each hand, and perform one action.
- Complex symbolic action level 2 – babies hold two objects, one in each hand, and perform an action sequence.

The behavioral variants refer to the infants' responses during the action performance. The following variants were coded for each action: a. the type of object that was chosen by the infant – familiar or ambiguous, b. the infants' vocal response during the action: babbling, clear speech, avoidance response and rattling sound. The findings revealed from this longitudinal study were:

- Development occurred according to the following order: baby babbling, baby speech, avoidance response and rattling sound.
- The factors that predict performance of simple action level 1 were: babbling, speaking, no response, rattling sound and complex action level 2.
- The factors that predict complex action level 2 were: babbling and avoidance response.

In light of these findings, we conclude that:

- Communication factors appear before symbolic play factors. Furthermore, the communication factors such as babbling and baby speech were strong predictors of development of symbolic action, especially simple action level 1.
- Self-regulation ability exists from infancy and is manifested by avoidance of additional difficulties during action performance, such as using speech during complex action level 2.

Additional contributions of solitary symbolic play to infants' self-regulation and development will be discussed in light of the findings.

## *Narrative and self-regulation: An empirical study into mother-child reminiscing and children's metacognitive skill*

Neale, Dave

There is evidence that the content and structure of adult-child talk about cognitive activity relates to children's metacognitive skill (Pino-Pasternak & Whitebread, 2010). Narrative, as a particular way of structuring talk, has been explored in relation to social and emotional regulation, but not metacognition. A literature review identified three ways in which narrative talk could theoretically impact on metacognitive skill: through its emphasis on mental states; its evaluative functions; and its role in the construction of self-concept. To explore this, the present study drew together research into metacognitive development with research into mother-child reminiscing – the joint recall of events by mothers and their children. The aim was to assess whether a

correlation may exist between aspects of mother-child narrative talk and children's metacognitive skill. Ten mothers and their 4-year-old children were visited at home on two consecutive days. On the first visit the child completed the train track task – a puzzle task designed to assess metacognitive skill. On the second visit mother and child engaged in reminiscing: with prompts from the mother, they co-constructed a narrative about the visit and the child's task engagement the day before. Performance on the train track task was analysed in order to generate a metacognitive skill score for each child, and the reminiscing episodes were analysed to generate a mental state content and elaborative style score for mothers. Elaborative style reflects the narrative qualities of talk: mothers with a high elaborative style encourage elaborate descriptions, a sense of story and context, and use open-ended questions, whereas mothers with a low elaborative style focus on remembering events as a set of isolated incidents, ask for specific details and use more yes-no questions (Fivush, Haden & Reese, 2006). A significant correlation was found between mothers' elaborative style scores and children's metacognitive skill, particularly monitoring skill. Also, a marginally significant correlation was found between the mental state content of mothers' talk and children's metacognitive skill. Consequently, results support the view that narrative talk is related to metacognitive development, and suggest that theoretical perspectives that seek to relegate narrative to the socioemotional domains of human experience are misguided. The study's main limitations were the small sample size and its synchronous, correlational design, but despite these limitations the findings show that further investigation into narrative and metacognition would be worthwhile.

## *Metacognition in learning physics and astronomy for teaching in kindergarten and primary school*

Giordano, Enrica; Rossi, Sabrina; Onida, Monica

From 1998, we started forming future teachers of kindergarten and primary school on how to teach physics and astronomy at those school levels. We selected basic ideas and practices of both fields and we proposed them in the Didactic of Physics and Astronomy courses. Our didactic proposal was based on national and international research on teaching and learning science (Giordano, 2011; NRC, 2007), that suggests the importance and the possibility to involve children in science since the kindergarten level, providing that science is reconsidered and properly reformulated. We present some problems that university students showed in appropriating contents and ways of teaching proposed during our courses. We found that the main difficulties of future teachers are on the metacognitive plan. They often begin the university considering themselves as no successful learners of scientific knowledge and keeping in mind an image of physics as a set of definitions and formulas, without any connection with reality and everyday experience. In particular, their idea of physics seems to lack its fundamental

characteristics: the need for coherency between different pieces of knowledge and the connection between facts, descriptions and interpretations. We also found that they have problems to connect what "they know" with "what they see and live", especially in the astronomy field. For example, everyone says that the Earth rotates around itself and around the Sun but she is not able to reconcile the image of the spherical and rotating Earth with the experience of a flat and steady Earth under her feet. We concluded that physics and astronomy knowledge appears to be scientific but it is a meaningless knowledge and let students to not observe anymore and to look for definitions and calculations rather than for meanings and links with experience. In the paper we will present some more examples of students difficulties and discuss some success or failures in guiding future teachers in terms of metacognitive awareness of the mentioned dimensions. Finally, we will propose a comparison with middle school students that were involved for three years in a different image of science, through a teaching intervention looking for meaning and awareness in collaboration with the project Globo Local (www.globolocal.net).

## POSTER

POSTER SESSION 1

### *Monitoring and control in children aged 5 to 7*

Nesrin Destan, Emily Hembacher; Claudia, Roebers; Simona, Ghetti

Developmental progressions in procedural metacognition (monitoring and control) during childhood have been demonstrated by assessing monitoring components like judgments of learning (JOLs) and confidence judgments (CJs) and by looking at control variables like study time allocation (i.e., Lockl & Schneider, 2003; Lyons & Ghetti, 2010; Roebers, von der Linden & Howie, 2007). However, the early development of procedural metacognition, that is, the emergence of these skills, has been targeted in only very few studies. The goal of this study is to examine monitoring and control and their developmental changes in children aged 5 to 7. Participating children learn the meaning of 16 Japanese Kanji. In one experimental group, the monitoring component consists of immediate JOLs and CJs, while in the other group, these judgments are reported after a delay. Additionally, both groups are asked to make a performance prediction (aggregate JOL). To account for the control aspect of metacognition, two variable learning sessions (quantifying study time allocation) and a postdiction task are employed. For the postdiction, participants are asked to sort the learned Kanji into two containers (treasure box or trash can) according to their perceived performance during the recognition task.

Data collection is just being completed and some preliminary analyses have been performed. These seem to document developmental progressions in monitoring: the older children appear substantially less optimistic about their learning outcomes (JOLs) and about the accuracy of their responses (CJs) compared to the younger children. As to control, both age groups showed a differentiated pattern of study time allocation, but only in the older age group a small but systematic association to the previously given JOLs was found. When children had the option to sort the symbols based on how they monitored their performance in the recognition test, even the youngest participants were able to metacognitively distinguish between correct and incorrect recall. Further analyses comparing the two different types of judgments (immediate vs. delayed) and a comparison of individual – item JOLs with aggregate JOLs are planned.

## *Metacognition and feedback monitoring. rTMS (repeated transcranial magnetic stimulation) applied on dorsolateral prefrontal cortex affects feedback processing*

Balconi, Michela

External feedback from contextual cues allows humans to behave appropriately in their environments. Presentation of feedback provides an external indication that allows subjects to modify their behavioural responses upon perceiving a negative signal (feedback of an error) as a consequence of their performance (Balconi & Crivelli, 2010a, 2010b). However, subjects are also required to evaluate the reliability of the information furnished by the external environment. This monitoring mechanism is likely supported by meta-level functions that intervene to compare expected feedback to observed feedback. Indeed, a multi-stage model that governs this monitoring process was proposed; the process produces a coherent representation of the subject's performance and confronts this performance with external feedback. A particular cognitive system operates to compare the correctness of the observed performance (first-order representation) with the correctness of the feedback information, derived by the external device (second-order representation). How the brain modulates feedback monitoring functions remains unknown. In the present study, the explicit response to veridical vs. false feedback was explored. In addition, the contribution of the prefrontal cortex in this monitoring process was tested by administering an rTMS inhibitory paradigm. Seventeen subjects participated in the study and were required to detect correct vs. incorrect feedback. The experimental task included three main phases: the subject's performance (spatial decisional task); the system's response to the performance (external feedback); and the subject's judgment and response to this external feedback (feedback monitoring). A systematic mismatch was introduced between the expected feedback information and the observed feedback (incorrect feedback), which was linked to the subject's performance. In other words, a mismatch was prompted between the internal expectation and the unattended external information by manipulating the external

response of the computer device. rTMS was performed on the DLPFC. As showed by the behavioural measures, DLPFC deactivation induced worse performance (higher ER and RT) for both correct and incorrect feedback. Indeed, this prefrontal region seems to contribute to conscious monitoring functions. when an explicit response is required. This study revealed the presence of systematic behavioural response modulation based on DLPFC inhibition during external feedback processing, and a causal role of the DLPFC may be suggested for feedback monitoring.

## *Has the error detection automatically driven in the calculation?*

Okamoto, Masahiko; Amano, Shogo

Our previous study had examined an automatic metacognitive process with the implicit error-detection task (Okamoto, SIG16-2010). But this study could not show an automatic metacognitive process. The purpose of this study is to show an automatic error detection process in the calculation. Participants were 26 university students. They were asked to judge the answer is correct or incorrect for the addition problems. An addition problem was presented on a display as "1 + 4 = 5 6", and instructed to add two underlined numbers. So participants need to add 1 plus 5 in this case, and then they must judge whether the answer that was presented right end is correct or incorrect. The addition calculations included the correct calculation ("1 + 4 = 5 6") and incorrect calculation ("1 + 4 = 6 10"). In addition, half of the answers were correct and the other half were incorrect, e.g., "1 + 4 = 5 7". Total four types of problem: Correct Calculation/correct answer, Correct Calculation / Incorrect Answer, Incorrect Calculation / Correct Answer, and Incorrect Calculation / Incorrect Answer, were included in this task. All formula was consisted from a single digit number. In this task, participants were asked to compute a sum of two underlined numbers and judge it's answer is correct or incorrect. It is hypothesized that if participants automatically monitored the error in the addition calculation, the reaction time of the judgment of answer is longer for the incorrect calculation than for the correct calculation. RT was calculated for each easy problem whose answer is under ten or difficult problem whose answer is over ten. The RT for easy problem is CC/CA: 854ms, CC/IA: 941ms, IC/CA: 880ms, and 951ms. A 2 (formula: correct formula vs. incorrect formula) x 2 (answer: correct answer vs. incorrect answer) ANOVA for the easy problem showed that a main effect of formula is significant ($F(1, 25) = 8.80$, $p < .01$), and a main effect of answer is also significant ($F(1, 25) = 60.84$, $p < .01$). The RT for difficult problem is CC/CA: 915ms, CC/IA: 1032ms, IC/CA: 943ms, and 1028ms. The same ANOVA showed that a main effect of formula is significant ($F(1, 25) = 3.84$, $p < .07$), and a main effect of answer is also significant ($F(1, 25) = 71.35$, $p < .01$), and an interaction was significant ($F(1, 25) = 3.92$, $p < .06$). These results suggested that (1) the increase of RT for the Incorrect Calculation problems indicated that the error detection had

automatically driven for the calculation errors, and (2) those automatic error detection process depended on the working memory loads. Because that error detection aroused extra cognitive load, a cognitive process for the judgment of an answer was interfered. But these processes did not occurred for the difficult problems.

## *The effects of delayed-JOL, sentence generation and self-explanation instructions on metacognitive judgments*

van Loon, Mariëtte; De Bruin, Anique; van Gog, Tamara; van Merriënboer, Jeroen

When people study, their metacognitive judgments of how well materials have been learned are used as a basis for deciding whether to terminate or continue learning. Unfortunately, metacognitive judgments are often inaccurate: Learners are often overconfident, especially when providing completely incorrect responses (so-called commission errors). Therefore, they cannot efficiently decide which information needs further study, and as a result future test performance might be suboptimal. In the present between-subjects experimental study we aimed to acquire insight into effects of three instructions on metacognitive accuracy and regulation when secondary school learners (N = 72) studied 20 idiomatic phrases and their meaning. After learning, they predicted future performance by providing judgments of learning (JOLs), and thereafter they indicated which idioms they thought they needed to restudy before taking the test. The investigated instructions which might be promising to improve metacognitive skills were delayed-JOL, sentence generation, and self-explanation. When judging learning following the delayed-JOL instruction, learners are presumed to attempt to retrieve the meaning of the idiom. The sentence generation instruction asks learners to make a novel sentence with the studied idiom before providing a JOL, and presumably this instruction focuses them implicitly on the quality of their mental network in which studied information is integrated with already existing prior knowledge. In the self-explanation task, prompts were provided to focus learners explicitly on their quality of their mental network for the studied idiomatic phrases. We expected that the sentence generation instruction, which implicitly focused attention to the quality of the mental network for the idioms, would lead to more accurate monitoring and more efficient regulation for commission errors than the delayed-JOL and the self-explanation instructions. Regarding metacognitive accuracy, results show that the JOLs for commission errors showed significantly more overconfidence following the delayed-JOL ($p < .0001$) instruction than the sentence generation and self-explanation instructions. Moreover, regarding restudy selections for the commission errors, the sentence generation significantly led learners to more efficiently select items ($p < .0001$) than both the delayed-JOL and self-explanation instructions. In addition, reaction times were measured when learners provided judgments, and findings support the assumption that learners attempted retrieval after receiving the delayed-JOL instruction, whereas they

focused on the quality of a constructed mental network when providing JOLs after sentence generation and self-explanation. Importantly, the findings imply that an instruction which implicitly focuses young learners' attention on the availability and quality of a constructed mental network is promising to improve metacognitive accuracy and subsequent regulation of study.

## *Interaction of self-efficacy and abilities while predicting the use of metacognitive strategies*

Jõgi, Anna-Liisa; Aus, Kati; Kikas, Eve

Using metacognitive strategies, i.e., monitoring one's progress is needed for self-regulated learning, better understanding of material and performance (Winne & Nesbit, 2010). Students with higher self-efficacy engage more in learning and are more likely to persist on a task (Wigfield, Eccles & Rodriguez, 1998). The present study was carried out to answer following questions: Is higher self-efficacy of middle-school students leading to more frequent use of metacognitive strategies in learning situations? Do students with better abilities use metacognitive monitoringmore often and do abilities increase the effect of self-efficacy on metacognition? 763 seventh grade students (46.2% boys, *M* age = 13.02, *SD* age = .40) from different schools in Estonia participated in the study. Self-efficacy and metacognition were assessed by self-reported measures. Non-verbal abilities were evaluated by Raven Progressive Matrices. Results of regression analysis indicated that both self-efficacy and abilities are significant predictors of monitoring and planning one's learning. Higher self-efficacy lead to increased use of metacognition ($\alpha = .244$, $p < .001$) and higher abilities surprisingly lead to decreased metacognition ($\alpha = -.013$, $p < .01$). Further moderation analysis revealed a significant interaction between self-efficacy and abilities ($\alpha = -.017$, $p < .01$). Students with lower abilities and higher self-efficacy reported increased metacognitive strategy use. Results indicate that during middle school, students who might not be among the brightest, but who do believe in their capability to understand learning tasks and to do well at school, plan and analyse their learning processmore than their brighter self-confident peers. Students with lower self-efficacy use less metacognitive strategies irrespective of their abilities. Further research is needed as there might be different explanations for the findings. One might suggest that at middle school levelthe brightest students donot need to think about their learning as they will manage their tasks with ease. Also there is a possibility that teachers pay more attention to supportingthe metacognition of lower-ability students as they need it more at the time.In the long run though the low use of metacognitive strategies among self-efficacious high-ability students is alarming as by knowingly planning and monitoring their learning process, their studyresults would be even better. On the bright side, self-efficacy seems to give students with lower abilities the necessary courage to use adaptive learning strategies.

## *Effects of subliminal mere exposure on the study time allocation*

Amano, Shogo; Okamoto, Masahiko

It is an important question for the cognitive study whether implicit processes affect metacognitive control or not. Reder & Ritter (1992) showed that @FOK with a problem effected participant fs strategy for the calculation problems. On the view of Koriat (2000) that FOK is a product through implicit processes, the implicit process, as FOK, relates next metacognitive process. It was not cleared whether implicit processes actually influence metacognitive control, because Reder & Ritter (1992) used supraliminal primes. Our study investigates this question with subliminal mere exposure paradigm. Next important question is individual difference of metacognitive process. Song et al. (2011) studies showed individual differences in metacognitive monitoring. The purposes of this study are to examine whether (1) the implicit process relates metacognitive control, and (2) this relation depends on individual metacognitive monitoring ability. Forty-three university students participated in this study. The experiment consisted of three phases: subliminal mere exposure phase, study phase, and recognition phase. The stimuli used in this experiment were unfamiliar polygonal shapes. In subliminal mere exposure phase, the participants were presented five polygons subliminally 15 times for each stimulus. In study phase, the participants were asked to study 10 polygons, five new and five old, by their pace. In recognition phase, the participants were asked to recognition judgment for each 10 studied and 5 distractor items. And they were asked to predict a performance on the recognition task. We divided participants into high monitoring group and low monitoring group with the discrepancy between recognition performances and predictions of recognition. The standardized scores of the study time were exposed items: –0.168, unexposed items: 0.168 for high monitoring group (N = 10) and exposed items: 0.103, unexposed items: –0.103 for low monitoring group (N = 16). A mixed ANOVA showed the interaction of study items and monitoring accuracy. This result indicated that high monitoring group studied unexposed items for longer time than exposed items and low monitoring group studied same time for both items. Our results suggested that we could use the information from the implicit process to metacognitive control.

## *Metacognition as a resource for study method*

Ruggi, Simona; Gatti, Monica; Daffi, Gianluca

In order to improve one's own way of learning and to obtain good results at school, it is important to become aware of the efficacy of the strategies used during the study. The work illustrates the results of an action research that involved 517 students of different Secondary Schools (11-18 year olds) in North Italy. In a pre-test phase two questionnaires (QS1 and QS2) from AMOS 8-15 (Cornoldi, De Beni, Zamperlin &

Meneghetti, 2005) were administered to the students, in order to investigate their studying strategies and how they considered them useful. During the following two months, students were trained to experiment new studying strategies aimed at fostering their skills in the following fields: reading and understanding texts, elaborating materials, using extra-stimuli (graphics, photos, CDs, dictionaries, maps, etc.), how to memorize new information, how to organize an oral presentation. Results collected in post test phase showed that the training implemented the awareness about both what is useful and what thwarts one's own method of study. In particular, results proved that younger students are more oriented to stop the dysfunctional strategies rather than to implement functional strategies, which are probably too difficult for them to carry out.

## *An Empirical Study on Assessing Critical Success Factors of Knowledge management Implementation in Indian B-Schools*

Ranjan, Jayanthi; Sharma, Vandna; Ranjan, P.P.

The old structures of education system are required to undergo drastic changes due to environmental challenges of digitalisation, globalization, and industrialization. One of these innovative instruments is development of knowledge management (KM) infrastructure which can play an effective role in Indian b-schools. The major objective of the study is to identify, ascertain and measure the critical success factors of KM and propose a model to assess KM orientation. Research data is collected using a questionnaire on teacher perception of developing KM and its antecedents. The findings are explained in detail. The study indicates evidences of KM orientation and systems in b-schools.

## *Memory and metacognitive strategies in mathematical learning*

Costa, Hiwet Mariam; Passolunghi, Maria Chiara

In the last decades a large body of literature has examined the role of domain-general and domain-specific precursors of mathematical learning disability and some studies confirmed that some abilities of kindergartners can predict later mathematical achievement outcome (Mazzocco & Thompson, 2005; Passolunghi & Lanfranchi, in press; Krajewski & Schneider, 2009; De Smedt et al., 2009). With regard to domain-general precursors, several of authors investigated the role of working memory in the development of mathematical abilities. Some studies investigated whether this learning problems can be overcame by a training designed to enhance working memory abilities confirming that systematic working memory training can improve both working memory and learning abilities (Holmes, Gathercole & Dunning, 2009). The present study examines the possibility to enhance working memory abilities of kindergartners

using a specific working memory training and to verify if the memory gain leads to a enhancement of pre-mathematical knowledge. The treatment used focuses on activities designed to enhancement of working memory abilities with special attention to metacognitive and motivational aspects. Some authors considered metacognition to be close related to learning performance (Wang, Haertel & Walberg, 1990; Ugar-Tetxea, 2001; Versschaffel, 1999; Zimmerman, 2000). Other studies demonstrated that from the age of 5 years metamemory and metacognitive knowledge begins to develop (Alexander, Carr & Schwanenflugel, 1995) and so, also very young children may reveal elementary forms of orientation, planning and reflection if the task is appropriated to their interests and level of understanding (Whitebread, 1999; Marcel, Vennman, Van Hout-Wolters & Afflerbach, 2006; EARLI conference in Cyprus, 2005). Therefore we planned this training with the aim to give metacognitive instruction to preschool children in order to encourage the development and the automation of their metacognition abilities related to working memory. Indeed, during the training sessions, teaching of memory strategies was always preceded by a reflection on metacognitive knowledge related to memory and on the proposed task. These steps are fundamental to find, automate and generalize the right strategies to perform the tasks. 33 children (17 males and 16 females) in their last year of kindergarten participated in the study. 17 children were assigned to the experimental group and 16 children were assigned to the control group The experimental group formed by children in their last year of kindergarten, received ten session of working memory training. The results showed a significant treatment effect: the specific working memory training used, brought to improvements in outcome tasks measuring working memory and mathematical abilities. In particular, there was a significant treatment effect for all active working memory tasks that involve both storage and manipulation of information.

## *Metacognitive scaffolding in physical versus online inquiry activities*

Chen, Sufen; Tsai, Cheng-Yue; Chen, Mei-Rong Alice; Chang, Judy Wen-Hua

This study examined the influence of metacognitive strategies on high school students' performance in an inquiry activity and if the influence differed in physical and virtual laboratory settings. The importance of inquiry activities in science learning has been well-documented in science education reforms worldwide (Lunetta, Hofstein & Clough, 2007). An authentic inquiry allows learners a high degree of openness and learner control, and thus improves their conceptual learning and motivation (Dillon, 2008). Self-regulatory learning (SRL) models have been used to explain complex interactions among motivation, behavior, and context (e.g., Greene & Azevedo, 2007; Winters, Greene & Costich, 2008), and may account for learning in inquiry activities. Accordingly, an inquiry activity related to Boyle's Law was designed for high school students using metacognitive scaffolding. The scaffolding utilized metacognitive

strategiesto promote students' planning, monitoring and controlling of their learning. In this quasi-experimental design, two 11th grade classes (N = 63) at an urban public high school in Taipei conducted the inquiry in either a physical or web-based setting.Their learning sheets, pre- and post-achievement tests, and interviews were collected. The data revealed thatstudents of both settings performed equally well and had remarkable gains in their pre-test to post-test learning achievement. Inquiry activities with metacognitive scaffold improve concept learning. Moreover, students who performed better in the planning stage could interpret the experimental results better, and scored higher in the post-test, $t = 4.39, 2.25$, $p < .05$, respectively. Furthermore, students in both the physical and web-based settings performed similarly in reasoning about choosing the equipment. But for deciding the amount of experimental data to collect, students in the physical setting provided more reasonable answers and relevant reasons, $\div 32 = 17.85$, $p < .001$.In carrying out the experiment, all the students in the physical setting used their chosen equipment, whereas 22% of the students in the web-based settingdid not. The consistency between the planned and the taken data points was also higher for the physical setting. It seemed that the metacognitive scaffolding for planning was more effective in the physical setting. So were the scaffoldings for improving the experiment and interpreting results, $\div 42 = 11.34$ and 20.77, $p < .05$, respectively.The post-laboratory interviews found that the physicallaboratory setting granted students a deeper level of ownership and seemed to lead to more science passion. This study concludes that SRL can be used to design effective inquiry activities. Web-based inquiry activities are as effective as physical inquiry activities in learning physics concepts, but that metacognitive scaffolding works better in the latter.

## *Analysis of learning competences in Industrial Engineering students: A metacognitive intervention proposal*

Sáiz-Manzanares, María Consuelo; Montero-Garcia, Eduardo; Carbonero-Martín, Miguel-Ángel; Román-Sánchez, José-María

Now, the university student needs skills to relate transfer and generalization of learning to work environments. This study examines the correlation between variables: styles and learning strategies and different materials (Heat Engines, and Mechanical Technology, Circuit Theory) in engineering students. The results reveal significant differences in learning strategies in relation to different materials in: Acquisition, Coding, and Retrieval of Information strategies, but not in Metacognitive and Information processing support skills. These students will need to improve the following strategies: self-knowledge, planning, regulation, and self-instructions. Therefore, this suggests the need to implement metacognitive programs in higher education to facilitate the acquisition of such strategies.

## *A Brain Workout Routine for Thinking in a Second Language From Chinese to English – from topic to subject prominent: A descriptive study*

Chen, Leighanne Jamie

Speaking good English is a very big deal in Taiwan. Immeasurable resources have been poured into English learning. However, the result has been borderline scandalous. Not only is the failing rate high but also so wide-spread that almost everyone is part of the "problem" –educators, parents and students. Is it possible for a Mandarin speaking person to "think in English" and how? This study aims to identify the missing element(s) for success and to draw a model from the cognitive learning pattern shared in many success stories. Through retrospective analysis, interviews, teaching observation and follow-ups, I compared the learning environments (sociolinguistic factor), learner's characteristics (psycholinguistic factor), learning patterns (neurolinguistic factor), and language competencies (pure linguistics) between the period of 1971-1990 and that of 1991-2010 against the learning results. Similarity and dissimilarity between the high achievers from the two periods were also looked at. Assessment of the high achievers of different learning methods regardless of the periods was done as well. Gaps between the high and low achievers were listed along with the reasons. Nonchalant peeking and poking at the correlations between the learning pattern and cognitive functions took place, too. No measuring tool was applied as most English certification process does not reflect satisfactory results. Results: 1) An effective cognitive learning pattern was seen repeated and was documented 2) Starting the kids on English at a young age doesn't guarantee satisfying results and in fact may carry much disappointment and a difficult-to-reverse damage on mother tongue and learning attitude 3) The test-driven learning and heavy memorization reduce English from an animated specialty to a dead knowledge and also condition the brain in such a way that the cognitive function in second language acquisition is not maximized or cultivated 4) An unintended finding presented itself – the fall of the Mandarin Chinese in its priority learning position and the regression in people's Mandarin level. A cognitive learning model for Chinese speaking people to improve their English has been observed and tested. The gap between the topic and subject prominent languages and the absence of active thinking can be filled with 'brain workout routine'. This result paints the pathways from 'hearing a language with your eyes' to 'seeing a language with your ears', and from memorizing to analyzing. Language acquisition is more than a performance calculation; it is also a human calculation. The next thing to do would be to continue the 'study' to extend it to a true qualitative and quantitative study which will hopefully benefit many people. Also, the negative impact on the Chinese mother tongue demands attention YESTERDAY!

## *The undergraduate students' performance of critical thinking in the context of reading science related news*

Lin, Shu-Sheng

Critical thinking involves the use of metacognitive skills and strategies, especially in information and argument evaluation appeared in the process of reading. This study explored the undergraduate students' performance of critical thinking when they read the science related news. Respective fifty-two science and non-science major undergraduate students were asked to select a science related news article from internet sources and then to read and make comments on its contents. The comments were analyzed in terms of the argument elements presented. The results showed there is no statistically significant difference in generating arguments, counterarguments, qualifiers and rebuttals between science majors and non-science majors ($p > .01$). However, science majors outperformed in constructing evidence than non-science majors did ($p < .01$). Science majors tended to give numerical evidence to support or rebut the arguments shown in the science related news, but non-science majors were inclined to use qualitative data as evidence. It revealed two groups of undergraduate students to some extent adopted different metacognitive strategies in evaluating the contents of science related news reports they choose. Implications for science instruction in general education at university level are discussed.

## *Metacognitive instruction to improve reading comprehension: An experimental research study*

Feucht, Florian; Burke Lefever, Jennifer

Reading comprehension among adolescents is a persistent national education problem in the USA. Consistently over the past 35 years, close to six million secondary students have been barely reading and writing at the expected grade level (Miller, 2009). Low levels of reading proficiency among ninth and tenth grade students are a mounting concern because few reading programs target this age group, and even fewer have been proven effective (ES + 0.05 to + 0.22) (Slavin et al., 2008). The purpose of the research was to develop an intervention that will cause meaningful change in ninth and tenth grade English students' reading comprehension with a medium to large effect size. The instructional strategy of the two week intervention was to use meta-cognitive instructions targeting critical thinking, reading strategies, reading engagement, and news media knowledge to improve reading comprehension of informational text and graduation test outcomes. To evaluate the effect of the intervention, a Randomized Controlled Trial with pre-test and post-test assessment was conducted at a rural high school. Students were individually randomly assigned to be a part of the intervention or

control group. The sample consisted of 199 freshmen (N = 99) and sophomores (N = 100) from a rural high school. The majority of the students were white (95%) and 53% were female. Analysis of covariance (ANCOVA) was used to assess group differences on the measures at post-test, while controlling for pre-test functioning. There were significant group differences in news media knowledge ($F(1, 187) = 28.74$, $p < .001$) and use of reading strategies ($F(1, 188) = 23.90$, $p < .001$) with the intervention group scoring higher on average than the control group. Differences in reading comprehension, and critical thinking were not significant, but all differences were in the expected direction with students in the intervention out-performing those in the control including a near-significant trend for Need for News ($F(1, 188) = 3.19$, $p = .076$). ANCOVA was also used to assess group differences on the Ohio Graduation Test (external measure) while controlling for pre-test levels of reading comprehension. There were significant group differences on four of the 5 subtests: Reading (ES = .36, $p > .01$, writing (ES = + 0.50, $p > .01$), science (ES = + 0.39, $p > .05$), and mathematics (ES = +0.47, $p > .05$). The intervention outperformed other reading programs (Slavin et al., 2008) at the ninth grade level with a larger effect size, administered in a shorter timeframe, and with more students per group.

## *Metacognitive and cognitive factors underlying the understanding of the text*

Pepi, Annamaria; Maltese, Agata; Scifo, Lidia

Learning the written language, is characterized by an evolutionary continuity that develops from an early acquisition phase, traditionally defined as "emergent literacy" (Pinto, 1993; Whitehurst & Loningan, 1998; Pepi, 2004). Learning the written language has its origins in the earliest stages of a child's life, before the start of formal literacy and involves all those skills (cognitive, metacognitive, language, short-memory term, etc.), knowledges and attitudes presumed to be precursors of the development of conventional reading and writing forms (Lonigan et al., 2000). The current research shows the continuity of development between the first emergent literacy skills, starting from kindergarten, and early reading skills in primary school. An important issue is that you can identify individuals "at risk" for learning to reading, to calculate and therefore difficulties in the acquisition of academic skills from the start of kindergarten. Children who have difficulty in the early stages of learning to read is very likely continue to have for years more school failures in this area by triggering a process that will involve many negative and problematic fields of their life (Cornoldi & Tressoldi, 1991). Significant research, has verified through a longitudinal research project, the predictive significance of the various components involved in the construct of emergent literacy in preschool Wilson & Lonigan, 2010). It's necessary, to analyze this construct, through longitudinal analyzes in which the predictive data, are able to correlate positively or negatively with the performance of a given learning in the next step. This is to verify the significance of

the different components involved in the literacy process and the nature of their relations in the preschool period and verify the burden evidence, that every component has for the learning to read and write. Through the analysis of the individual components of the construct, then, we will determine its "predictive relationship" and elaborate a profile for the risk of difficulty and/or disability in reading and writing competences.

## *Fostering a metacognitive attitude in creativity training*

Antonietti, Alessandro; Scarantino, Claudia

Metacognitive skills are needed to identify the situations that must be addressed creatively, to identify what are the strategies to be applied and what are the most effective ways to implement them. This type of metacognitive skills has been little investigated, however. The purpose of this study was to test whether the effectiveness of a training aimed at enhancing creative thinking is modulated by systematic metacognitive reflections. The training included activities that can easily be conducted in the classroom by teachers. Each activity was accompanied by metacognitive hints that prompt reflection about the underlying mental processes. The hints concerned the evaluation of the performance, the reconstruction of the strategies adopted, the perception of the difficulties encountered and their causes, the beliefs about the types of help that might be useful. An abbreviated version of the training has been implemented, over the course of two months, with a sample of 160 students of the third, fourth and fifth grade of primary school. The application of the training was done in two conditions: with and without metacognitive questions. The metacognitive questions were standardized to be focused on the introspective assessment of the ability level expressed, the effort required and the pleasure experienced in carrying out the creative activities. Such an assessment was asked both before and after the activities. All students were evaluated before and after the training with the WCR test, that provides separate measures of the following creative skills: widening the frame of mind, connecting remote ideas and reorganizing situations conceptually. An increase in creativity scores from the pre-training to post-training phases emerged. The effectiveness of the training did not depend on gender and age. The inclusion of metacognitive questions produced, compared to the condition without questions, a higher increase in widening scores. The opposite was true for the reorganization scores. The two conditions affected connecting scores to the same extent. The analysis of the responses given to the metacognitive questions revealed that children improved their ability to predict the performance across the training, maintained unchanged their capacity to evaluate the effort, but worsened their prediction about pleasure. The overall picture that emerged supports the notion that the metacognitive approach is useful for developing specific aspects of creativity.

## *Children understanding art*

Gilli, Gabriella; Ruggi, Simona; Gatti, Monica; Savazzi, Federica

Art is a powerful communication tool. It fosters the interaction between representational systems. In fact, internal representations of other minds, being based on common patterns can also be shared with others through symbolic systems, such as art. Artworks can thus be seen as representational mediators for communication, requiring an audience that recognizes the artist's intentions (Bloom, 2004), as well as the comprehension of the interpretative role of the beholder (Freeman, 2010). Children progressively master a system of external notations, for example paintings, leading them to question the different elements involved in the art system. The research aimed at analyzing how children come to comprehend that intentionality is essential in the definition of art system. The hypothesis is that older children are more able to recognize intentionality criterion for defining the artist. 30 children: 10 5 year-olds (6 F and 4 M), 10 8 year-olds (4 F and 6 M) and10 10 year-olds (6 F and 4 M) were interviewed. Two studies were carried out. In the first study, subjects saw a video showing an artist who hid one of his paintings. Ss were then interviewed in order to investigate the concept of intentionality of the artist and the role of the public in recognition of an artwork. The second part of the interview sounded out the children' aesthetic conceptions, in relation to the notions of beauty, authorship, and the critics. In the third part of the interview, subjects were encouraged to judge the value of a fake artwork in comparison to the original one. The results confirmed the hypothesis: the recognition of the communicative intention of the artist, of the authorship, and of the role of the critics increases with the increasing of age. An interesting result is that 10 years-old children believe that false artworks can be appreciated because of the technical skill of the painter. The second study aimed to explore the role of aesthetic judgment (pleasantness) and of the knowledge about the artist in determining the evaluation of the artwork. Results confirmed that children are disposed to reason about artworks in terms of inferred intention.

## *What preschoolers think about the power of artists*

Freeman, Norman H.

Up to a point, pictures seem somehow to look like what they depict. Picture-perception research centres on how children manage to recognize what is depicted even when the picture is ambiguous. Other research asks how children use their picture-perception to infer what the artist was thinking about, that is, to make mind-centered inferences. Together, picture-centered and mind-centered inferences go into a child's representation of artists' power to make you see what they intend you to see. A popular research tool is to show children an artist first announcing what she intends to depict

(e.g., balloon) and then making an ambiguous picture (e.g., could just as plausibly be a lollipop), and to test whether the children regard the artist as the authority on what the ambiguous picture represents. In a series of experiments we studied the impact of an artist's statements of intent before making pairs of ambiguous drawings (e.g., balloon and lollipop). By age six or so children took the artist's opinion into account but did not regard it as entirely binding on them. Four-year-olds more rigidly conformed to the artist's opinion, as the literature suggests. However we have discovered one condition (involving perceptually contrasting shapes e.g., balloon and snake) which enabled most four-year-olds to break out of their rigid following of the artist's opinion; and we discuss this condition in relation to other work on the topic.

## *Metacognitive strategies for a Smart Museum*

Rozzi, Francesca

The aim of this study is to understand how museums can improve their offer to the public, creating exhibitions able to let the viewer feel active protagonist of his/her encounter with art. From the analysis of previous theories and scientific literature, the following hypothesis was formulated: an interactive strategy (Heeter, 1989, 2000; Rentezi, 2009) integrated with the Flow Theory (Csikszentmihalyi & Csikszentmihalyi, 1988) can transform a museum in a Smart Museum. The Smart Museum offers an experience that physically, intellectually, emotionally and socially activates the visitors (Rozzi & Gilli, in press). We have demonstrated that layout and arrangement evaluation ($F = 8{,}854$; $df = 1$; $p < .005$; $R^2 = .086$; adjusted $R^2 = .076$) and perceived utility of the communication tools ($F = 10{,}309$; $df = 1$; $p < .005$; $R^2 = .121$; adjusted $R^2 = .101$), like panels, labels, etc., can improves the visitor's activation perception, which affects his/her satisfaction ($F = 78{,}797$; $df = 1$; $p = .000$; $R^2 = .456$; adjusted $R^2 = .450$). From this findings we propose to combine metacognitive strategies with museum methods to increase the visitor's perceived utility of the communication tools. We hypothesize that panels, labels, didactic, brochures, guide tours and the other tools can be made more effective in sustaining public's appreciation and comprehension of the artworks through metacognitive didactic strategies.

## *Implementation and evaluation of a hypermedia tool applied to learning difficulties in mathematics*

González-Pienda, Julio; Núñez, J. Carlos; García, Trinidad; Cueli, Marisol; Cerezo, Rebeca

Academic performance is a growing concern within the educational community. At the center of the problem are academic failure and the corresponding early school

truancy. Last PISA report reveals the low performance in mathematics of our students. To solve this problem, we should determine what mechanisms are associated with students' failure, and what intervention should be done to modify the situation. Today we know that successful students are effective regulators of their learning, activating and modifying their cognitive, metacognitive and behavioral processes before, during and after learning. In this sense, the use of Computer-Based Learning Environments (CBLEs), can allow students to work in rich and interactive environments, granting them a more active role and promoting metacognitive processes, developing a self-regulated learning (SRL). An example is the use of hypermedia tools and IWBs (Interactive White Boards), which introduces new methodological and empirical issues. The present study focuses on the following question: how can the new technologies, mainly hypermedia applications used in IWBs," contribute to promote academic success in mathematics? We use a tool called Hypatia, oriented to the learning of mathematics in the last two years of Elementary school. Considering the positive implications of both, CBLEs and SRL, we expect students in the experimental groups (trained in self-regulated learning contexts), to show greater learning and achievement in mathematics and further development of their skills to auto-manage their learning processes than the students in control groups (which follow a common instructional method). The SRL process will be assessed through the method of the Triple Task, which has a long tradition in reading comprehension and written composition. In this methodology the student is asked to perform three tasks. The first one is the object of analysis, to solve a mathematical problem through whiteboards. The second one is a simple response time task, which consists on pressing a key as quickly as possible when an auditory stimulus appears. Finally, the third one is a direct retrospection task, where the student must indicate what he/she is doing when the acoustic signal appears, using a given category system. This study is being carried out in public and private schools of Asturias (Spain). After applying the tool, academic achievement, motivation and metacognitive processes of students who have completed the training will be assessed, comparing this result with those obtained by students who have followed the traditional learning method. [This work is funded by the I+D+i project with reference EDU2010-19798, the support of a grant from the Ministry of Science and Innovation (BES-2011-045582), and the program Severo Ochoa (BP 11-067)].

## *Training self-regulated learning through presential and virtual formats: Differential efficacy in higher education*

Cerezo, Rebeca; Suarez, Natalia; Nuñez, J. Carlos

Empowering metacognitive competence to learn is considered one of the great challenges of the education nowadays, especially in higher educational levels. Self-regulated learning (SRL) is one of the keys to reach this aim. In addition, it is largely

assumed that advanced learning technologies (ALT) are increasingly being used to enhance students learning. From this perspective, this work focuses on capacitating effectively students for an autonomous and metacognitive learning implementing two different versions of an intervention (using the learning management system Moodle as an ALT environment or not) and comparing its results. The total sample comprised 576 undergraduate students from different university levels and degrees: Control group (N = 206), non ALT Experimental Group (N = 203), and ALT Experimental Group (N = 167). The TRAL program – Training for an Autonomous Learning and eTRAL program – electronic TRAL version were implemented showing its efficacy to promote change in all the variables of interest. However, we are interested in test their differential efficacy and the study have found that there were no statistically significant differences between the two formats with regard to the level of knowledge of SRL strategies [$F(1, 367) = .493$, $p = .483$, $\eta^2 = .001$]. Nevertheless it was obtained statistically significant differences between the two intervention formats regarding both approaches to learning, superficial ($F(1, 367) = 44.096$, $p = .000$, $\eta^2 = .107$) and deep ($F(1, 367) = 11.207$, $p = .001$, $\eta^2 = .030$). The data indicate that, at post-test, the students who worked with the ALT format showed a less superficial approach to study, and a deeper approach to learning. The differential results are especially interesting due to the absence of studies that test interventions' effectiveness and particularly differential effectiveness between ALT and non ALT environments. The program implemented through the ALT grants students more autonomy to complete it, which could be translated into higher demands of engagement and depth of comprehension, to which the students respond satisfactorily. In contrast, with the non ALT format, the development of the intervention is more mediated by the applicator. It does not mean that favors a superficial approach, but it would not be essential to adopt a deep approach to learn through the non ALT format. Implications and motivational aspects would be discussed further. The present work has been funded by the Spanish Ministry of Science and Innovation: "Promotion of competences of self-regulation of academic learning in higher education by means of the virtual campus (e-TRAL Project)" Ref.EDU2010-16231.

## *«Videogames make me feel/improve...»: Metacognitive consciousness in the videogaming experience*

Cantoia, Manuela; Milani, Luca; Pennati, Alessandro

Videogames represent a worldwide phenomenon which involves both children and adults. Although video gaming typically fosters the develop of some skills (Gee, 2008; Gentile & Gentile, 2008; Green & Bavelier, 2003; Greenfield, Brannon & Lohr, 1994), it seldom represents a real metacognitive experience since the player lacks a clear awareness of the mental processes activated. On the contrary, when the mental processes are tracked and the player can reconstruct the retrospectively, the learner perceives the

improvements of his/her abilities (Romeo & Cantoia, 2011). Thus, guided metacognition can turn a simple video gaming session into an enriching learning experience. The cognitive and motivational learning potentials of videogames may thus represent a field of interest in the study of education and learning in a life-span perspective. Our study enrolled 800 students, from primary school to university, in order to analyze their video gaming experience from both a metacognitive and a motivational point of view. Participants were administered a questionnaire consisting of 20 items regarding different issues: gaming habits, motivation to play, emotional background during play, self-perceptions regarding one's abilities and psychological correlates of digital game playing. The main aim of the study was to focus on the subjective perception of (1) the activated mental processes, (2) the developed skills and (3) the transfer to real-life situations and (4) the motivational-emotional orientation during the videogame experiences. Results indicated that players feel that their skills improve thanks to the videogaming experience in all the domains proposed in the questionnaire (visuo-motor, cognitive, motivational, social skills). The perceived improvement of the skills was focused upon three main domains: reasoning skills, reacting to events and general skills. Players regarded videogaming as especially useful to improve concentration, reasoning and decision-making skills. Finally, participants resulted to be aware of the positive impact of digital gaming on their skills and were able to point out the specific domains which are improved.

## *Do socio-cognitive conflicts enhance metacognitive skills? A pilot study in educational robotics*

Castiglioni, Marco; Datteri, Edoardo; Zecca, Luisa; Businaro, Nicoletta; Laudisa, Federico

Within a social constructivist perspective, the development of knowledge is viewed as the outcome of two interdependent kinds of process: cognitive and social. In such a perspective, Piaget's construct of socio-cognitive conflict has been revisited, receiving empirical support from a number of studies conducted within the theoretical framework of European developmental social psychology (Doise, Mugny, Perret-Clermont, Carugati and others). The results obtained suggest that greater learning progress is achieved when children with different cognitive levels and strategies work together than during collaboration between children with similar cognitive levels and strategies. Furthermore not only the less advantaged children but also the more advanced students benefit from social interaction. Engagement in a collaborative problem-solving activity entails the capacity to decentre from one's own point of view and to reciprocally coordinate individual centration. This in turn implies involvement in a metacognitive activity, given that it requires both knowledge and regulation of individual cognitive processes. The aim of this study was to investigate the role of socio-cognitive conflict in

the development of metacognitive skills in primary school children (average age: 7 years), during a robot-supported science laboratory. The laboratory used a LEGO Mindstorms robot assembled as a small vehicle, equipped with ultrasonic sensors, and programmed by the supervisor to function as three different Braitenberg-like vehicles, reacting in various ways to the presence of obstacles. The children, divided in small groups, were asked to describe what the robot was doing, and to explain why the robot was doing that. The setting for each laboratory session was "ecologically" structured: the children were free to interact with each other as well as with the robot, given that their assignment was to engage in a collaborative, albeit supervised, process of explanation of the robot's behavior. The sessions were video- and audio-recorded; the recordings were subjected to an empirical, qualitative inter-judge analysis, following a grounded-theory-based ethnographic approach. Preliminary results suggest that in a non-competitive context, socio-cognitive conflicts enhance metacognitive skills, as an outcome of the coordination of both cognitive and social processes. The results are discussed in relation to some methodological limitations of the study and to the potential for the use of educational robots in developing cognitive and metacognitive skills.

## *Educational robotics and science education in primary schools*

Datteri, Edoardo; Zecca, Luisa; Laudisa, Federico; Castiglioni, Marco

In the spirit of Papert's LOGO language, educational robots (e.g., the LEGO Mindstorms kit) have proven to support learning of various curricular disciplines and to facilitate the development of problem solving and abstract thinking abilities in primary schools. In most educational robotics laboratories, children are required to assemble and program robots enabling them to carry out some desired task. The present contribution will focus on another class of robot-supported educational activities (almost never discussed in the literature), in which children are asked to explain the behavior of a robot which has been previously constructed and programmed by laboratory supervisor. It will be argued here that this sort of activities can contribute significantly to science education in primary schools. First, being engaged in a collaborative process of explanation of the behaviors of the robot, children have the opportunity to develop basic scientific research competences: they learn to observe, to formulate hypotheses, to devise and carry out proper experiments, and to revise their hypotheses on the basis of the experimental results – for short, they may "learn to explain". Second, which is mostly important in a meta-cognitive perspective, they are given the opportunity to reflect, through the interaction with a behavioral system, on what "explaining" amounts to: in other words, by encouraging children to analyze collaboratively their own patterns of explanatory reasoning, they may be induced to reflect on fundamental issues concerning the methodology of scientific research, including those related to the concepts of "explanation", "hypothesis", "experiment", and on the fallible character of science at

large. This sort of proto-epistemological reflection, enabled and triggered by specific meta-cognitive activities, is explicitly required by the 2007 Curricular Guidelines produced by the Italian Ministry of Education. These claims will be discussed in connection with a robot-supported science laboratory held in a primary school of Milan in 2011 (possibly including results of other four similar laboratories which are being currently held in two primary schools of the same city). The laboratory involved a LEGO Mindstorms robot programmed by the supervisor to realize three different Braitenberg-like vehicles reacting in various ways to the presence of objects. Children were asked to describe what the robot was doing and to explain why the robot was doing that; they were also asked to reflect, in a meta-cognitive perspective, on their own observation and reasoning processes. The meetings have been video- and audio-recorded; recordings have been subjected to an empirical, qualitative analysis following a grounded-theory-based ethnographic approach. The results of this experience will be reported and discussed with the broad aim of evaluating the potentialities of educational robots to support meta-cognitive activities in connection with science education.

## *An Italian validation of the Metacognition Awareness Inventory (MAI): Factorial structure and associations to self-esteem and anxiety*

Colombo, Barbara; Balzarotti, Stefania; Beretta, Angela

In this study, the Italian translation of the Metacognition Awareness Inventory (MAI: Schraw & Sperling-Dennison, 1994) was administered to a sample of 375 high school students (183 boys and 192 girls; 99% European/Caucasian and 1% Asian; age: M = 17.22 yrs., SD = 0.91). The MAI is a 52-item, self-report questionnaire, which consists of two scales corresponding to two related components underlying metacognition: Knowledge and Regulation of Cognition. The Italian translation of the MAI was developed with a back-translation procedure by two independent translators. Participants were also asked to answer the Rosenberg Self Esteem Scale and the State Trait Anxiety Inventory (STAI), to test the hypotheses that metacognition is positively associated to self-esteem and negatively related to both state and trait anxiety. An initial explorative factor analysis (Principal Axis Factoring, PAF) with oblique rotation (OBLIMIN) was performed. Several items were deleted because of low communalities and low factor loadings on all factors. Others were deleted because they loaded on more than one factor. The two-factor structure of the original questionnaire was not confirmed, nor the 8 subscales proposed by the authors. The final solution included 23 items and 5 scales: Monitoring (items 1, 8, 20, 28, 36, 49, 50; $\alpha$ = .78); Information Knowledge and Information Management (items 9, 10, 12, 13; $\alpha$ = .77); Evaluation of Alternative Solutions (items 2, 11, 23, 38; $\alpha$ = .74); Debugging Strategies (items 34, 40, 44, 51, 52; $\alpha$ = .70) and Scheduling (items 4, 45, 47; $\alpha$ = .76). This solution accounted for the 43% of variance. All factors were highly intercorrelated (mean r = .42).

Information Knowledge and Information Management were positively related to self-esteem ($r = .17$, $p < .01$) and negatively related to trait anxiety ($r = -.17$, $p < .01$).

## *Development of an instrument to investigate metacognition in French, Spanish and Vietnamese languages*

Escorcia, Dyanne

This contribution describes the development of a metacognitive scale in French language regarding the writing process, as well as the statistical validation procedure of this instrument in Spanish and Vietnamese languages. The hypothesis was that there are two main and independent components of metacognition: metacognitive knowledge and regulation of cognition. A total of 1205 university students of Psychology and Educational science were involved in this research: 708 French, 231 Colombian, and 266 Vietnamese. The data collected was analyzed with an exploratory factor analysis, using principal components examination followed by Varimax rotation and calculation of the internal consistency (Cronbach's alpha). Regarding the construction of the French scale, 101 subjects completed a first version of the instrument that consisted of 29 items using a 7-point Likert scale. This initial instrument was reduced to six items following an iterative process of factor analysis. Then, 607 participants completed the new version of the French scale comprised of the 6 items selected. An exploratory analyses factor indicated the existence of two factors: the metacognitive knowledge and the regulation of cognition (Coefficients alpha of .67 and .62 respectively). This final solution accounted for 59% of the sample variance. From the 6 item-scale, various translations and back translations to Spanish and Vietnamese languages developed by experienced translators were observed to obtain a semantic equivalence in the languages involved. After collecting data from 231 Colombian subjects, an analysis of the Spanish scale version revealed the same factors found in the French study, but with a few different coefficients alpha for each factor: .62 for metacognitive knowledge and .73 for regulation of cognition. This solution accounted for 62% of the sample variance. Finally, the Vietnamese version was administered to 266 participants, and the exploratory analyses indicated a one-factor solution that accounted for .45 of the sample variance (Coefficients alpha = .75). The results confirmed the main hypothesis. Results also revealed that individuals from two different cultures, European and South-American, are able to acknowledge their metacognitive characteristics in writing, taking into account both their knowledge about their own cognition and their cognitive strategies to regulate their writing process. However, this characteristic was not noticed in the Vietnamese subjects. This conclusion is relevant as it demonstrates that cultural considerations should be contemplated in studies about metacognition that aim to compare populations from different cultures. This research emphasizes the need to observe the occidental and oriental cultures' specificities. New studies should be conducted for the

purpose of improving the reliability of these scales, in particular by increasing the number of items considered.

POSTER SESSION 2

## *The role of implicit and explicit knowledge in metacognition and early years' language acquisition*

Xu, Chenyan

The proposed study focuses on two fundamental aspects of human cognition: metacognition and language acquisition. This aims to explore how these two aspects function and how they corporate to support children's development. Metacognition (self-regulated learning) has long being held as an important aspect of learning and achievement in academic contexts. Students who are self-regulating are much more likely to have successful performance in school and to achieve higher cognitive levels. Although there has long being an idea that metacognitive skills will not emerge until the age of 8-10 years old, recent research has provided apparent evidence that young children are capable of performing tasks and regulating their performance effectively by using metacognition. Significantly, research has facilitated the development of our understanding of children¡¯s general and internal structure of metacognition and its relationship with other aspects of our cognitive system. For children's language development, it is believed to play a crucial role in children's development. Currently, learning second language become a necessity rather than fashion, the research on how to develop children's language learning becomes increasingly essential. An early start of second language has been claimed as advantageous because learners could achieve better ultimate proficiency and cognitive development. Considering the fact that metacognition assists to improve learner's performance and build self-regulated learner, a thorough research into the relationship between metacognition and language acquisition will help children to achieve better language development and so conversely improve children's cognitive level. This study aims to explore the research questions from a particular angle: implicit and explicit knowledge. It is argued that both implicit and explicit cognitive processes are involved in metacognition and cooperate to enhance the results of metacognitive processes. In language learning studies, it has been long believed that implicit and explicit learning interact with each other to improve language proficiency. Therefore, it is of great necessity to conduct a thorough study on the role of implicit and explicit knowledge in metacognition and early year's language acquisition, which is significant in improving children's cognitive development and language proficiency and in fostering lifelong independent learners. In this study, three research questions will be studied: i) how does early years' metacognition develop and how does it function in English L2 acquisition in China? ii) What is the metacognition's role in the transfer process from unconscious language acquisition to conscious language learning

and the process of interaction between implicit knowledge and explicit knowledge? iii) How do language proficiency and mastery over cognition influence each other?

## *Understanding the effects of early childhood adversity and proximal parenting processes on children's developing self-regulation of attention and behavior: Implications for school readiness*

Skowron, Elizabeth A.; Cipriano-Essel, Elizabeth A.; Rodríguez-González, Martiño

Early exposure to childhood adversity and toxic stress (e.g., child abuse & neglect, family violence) is known to contribute to impairments across a multitude of cognitive domains including attention (Beers & DeBellis, 2002), working memory (Pollak et al., 1998), problem-solving and abstract reasoning (Rutter, Kreppner & O'Conner, 2001), which lead to school readiness delays and problems with subsequent school adjustment and achievement (e.g., Blair, 2002). Further, exposure to toxic stress has been implicated in altered stress physiology and impaired regulatory ability in emotional and behavioral realms. Grounded in a family systems perspective, this presentation is designed to highlight results from NIMH-funded research on risk exposure, micro-analytically observed parenting processes, mother and child autonomic physiology, and children's attentional and behavioral regulation (5R01 MH079328). Of particular interest is the relationship between parent's level of differentiation of self (Bowen Family Systems Theory) self-reported and observed, and children's self-regulation, given that previous research has established associations between greater maternal differentiation of self and children's vocabulary and math skills, even after controlling for parent education levels and children's stress exposure (Skowron, 2005). Participants were 160 mothers and their preschool children (3 to 5 years) who completed a 3-visit protocol over a 2-3 week period. Behavioral and cardiac physiology (ECG) recordings were collected remotely and monitored through a one-way mirror, and measures of children's self regulation, including Attentional/Inhibitory Control, Effortful Control, and others. Results are reported and interpreted in the context of Bowen family systems theory and existing research on stress physiology in high risk populations. Implications for children's school readiness, intervention, and next step research will be outlined.

## *Bowen Family Systems Theory as a framework for advancing cross-disciplinary research on self-regulation development in early childhood. Current developments and future directions*

Rodríguez-González, Martiño; Skowron, Elizabeth A.; Noone, Robert J.

Bowen Family Systems Theory (Bowen, 1978) is arguably considered the most comprehensive theory of human functioning from a systems perspective (Nichols & Schwartz, 2004). Grounded in natural systems theory, provide an exceptional framework for development research and intervention at the crossroads between developmental, familiar and educational variables. Together with concepts form Psychology of Education and Developmental Psychology, Bowen's Theory shape a new extraordinary field, still mostly unexplored, for study the childhood development of the capacity for self regulation of attention, emotion, and behavior (Skowron, Van Epps, Cipriano-Essel & Woehrle, forthcoming). In adults, differentiation of self involves the capacity to self regulate emotion and behavior in important relationships, engage in thoughtful reflection, maintain awareness of emotions and experience strong affect, or shift to calm, logical reasoning depending on circumstances (Bowen, 1978). In our opinion, in the early childhood the expression of differentiation is related with self-regulation capacity of attention, emotion and behavior. Recent research findings (Skowron et al., 2011; others, forthcoming) revealed that greater parent levels of differentiation of self (parenting processes characterized by warm connection AND support for children's autonomous ideas and actions) is associated with greater parasympathetic (i.e., vagal) tone, and inhibitory control in children across the spectrum of risk. What are the implications of these results for our understanding of self regulation development? How these results can fit with the previous knowledge from Developmental Psychology? Does it open new issues for the Psychology of Education? Can we intervene in these relationships? Through this presentation we synthesize the most relevant recent findings related with Bowen's Theory that can have implications for self-regulation development, explain some of the possibly connections with Developmental Psychology and Psychology of Education, and propose some of the questions and research that can be carry out in a new future from this interdisciplinary ground.

## *Self-regulated learning in late primary school: What can we learn from think aloud protocol analysis?*

Vandevelde, Sabrina; Van Keer, Hilde

Self-regulated learners (SRL) can be defined as metacognitively, motivationally, and strategically active participants in their own learning (Zimmerman, 1990). Although

recent research reveals that primary school children are capable of acquiring self-regulatory skills, research on this age group's SRL remains limited. This empirical shortage is related to the need for valid measures of SRL for primary school. Although research strongly supports the importance of SRL, many learners, especially at-risk students, encounter difficulties regulating their learning process. Additionally, SRL becomes increasingly important in transition periods in which students switch from a more closely monitored environment (e.g., primary education) to a setting in which they have to regulate their learning more by themselves (e.g., secondary education). In this respect, this study focuses on SRL of 5th and 6th graders at-risk due to their socio-economic and/or non-native background. In order to foster SRL in this target group, it is however important to gain more insight into the self-regulatory processes these children engage in. The goal of this study is twofold: (1) developing a think-aloud protocol (TAP) to assess late primary school children's SRL, and (2) exploring the growth of at-risk 5th and 6th graders' SRL during a school year. Methodology. A repeated measure design was used (3 measurement occasions during 1 school year). 9 at-risk 5th and 9 6th graders from 5 Flemish (Belgium) primary schools participated. During thinking-aloud, the participants were asked to individually solve a Sudoku and to study an informative text. The thinking-aloud sessions were videotaped, transcribed, and coded according 14 classes of SRL strategies. Descriptive analyses at the first measurement occasion show that SRL strategies are performed on a rather basic and superficial level. The children displayed a rather one-sided use of SRL, dominated by cognitive strategies (e.g., problem solving and rehearsal strategies). No significant upward trends could be observed across measurement occasions. In contrast, the occurrence of certain SRL strategies decrease throughout the school year. This study shows that TAP is a valuable method to reveal the micro-level processes late primary school students display during learning. Compared to cognitive and metacognitive aspects, motivational aspects of SRL seem more difficult to capture by means of TAP. Further, the descriptive findings confirm that at-risk children encounter difficulties to regulate their learning purposefully and profoundly. Moreover, the results confirm that SRL does not develop spontaneously and that explicit instruction and promotion is wanted to enhance the development of SRL within this target group.

## *Efforts to display metacognitive and self-regulatory skills of young children: A Turkish case*

Adagideli, Fahretdin Hasan; Ader, Engin

The aim of this study is to investigate metacognitive and self-regulatory skillfulness of young children at the age of five and six. Meanwhile, another aim is to understand weaknesses and strengths of use of a theoretical framework developed in the UK and an observational methodological approach for collecting and analyzing data in preschool

settings in a Turkish context. We attempt to contribute to the efforts of establishing a new methodology to display metacognitive and self-regulatory skills of young children in Turkey. This paper will draw on data obtained during our ongoing fieldwork in a preschool in Turkey. This study has a qualitative design. It is argued in the current literature that the methodology of early studies to display young children's metacognitive and self-regulatory skills could be considered as inadequate due to several reasons. In order to resolve such methodological problems, observational methodology has at least five advantages as suggested by Whitebread et al. (2009): (1) it does not rely upon children's verbal capability, (2) it can provide verbal as well as non-verbal indicators while examining self-regulated skills (3) it does not rely upon children's working memory, (4) it allows us to observe children in meaningful contexts to them, (5) it allows us to determine social interactions supporting development of self-regulated skills in young children. Reflective dialogues occurring between young children and researchers are valuable from perspectives of data collection while observing young children's behavior and verbalization due to two reasons. It creates a medium for children to articulate on their thinking so that the researcher can have a deeper understanding of children's behaviors. Besides, it provides further opportunities for observing children in a context meaningful for them. In the present study, young children's different activities were videotaped. Moreover, the reflective dialogues occurring between children and researchers while watching video episodes of children's own activities were also videotaped. The video episodes were analyzed using Cambridge Independent Learning (C. Ind. Le) framework (Whitebread et al., 2009). As far as the initial findings are concerned, metacognitive and self-regulatory skills were identified within 20 hours of video of children's activities and reflective dialogues with children while watching the video recordings. Metacognitive knowledge about persons (self, other), tasks and strategies; and metacognitive regulation (planning, monitoring, control and evaluation) were identified. These will be discussed through extracts from collected data.

## *Shared-regulation episodes within group-work activities in primary schools and their relation to individual self-regulation: A temporal analysis*

Grau, Valeska; Freire, Paulina

There has been a tension in relation to the conception of the social dimension in the traditional self-regulated learning (SRL) models. On one side, the socio-cognitive models conceive the social as influencing self-regulatory processes and, on the other side, the sociocultural models define regulatory processes as intrinsically social. Although it has been recognised the need for an explicit consideration of self and social aspects of regulation, there have been few studies attempting to make such integration (Hadwin & Oshige 2011; Volet et al., 2009). Following the conceptualization of self, co, and shared regulation described by Iiskala et al. (2004), the current study integrates the self and

social aspects of regulation in learning contexts through an analysis model that includes episodes of social regulation and individual evidence of SRL within collaborative learning activities in primary school. The research questions are: How can we relate individual utterances of self-regulation with group episodes of shared regulation? How can the episodes of social regulation be described and which dimensions are related to their emergence? In which way the specific contexts of activity facilitate – or not – the development of shared regulation? And finally, how can we describe the evolution of these groups across time? The relevance of the study relates to: the development of an analysis framework integrating self and social aspects of regulation in which individual utterances are related to the definition of an episode of shared regulation; the analysis of contexts of activities; and the development of temporal analysis of regulatory activity. The study consisted of a multiple case study, following up 4 groups of students (16 children) over 1 year (3rd and 4th grade) during sessions of collaborative group-work. 7 sessions of group-work were videotaped. Data analysis was carried out using a coding framework that includes individual and social aspects of regulation. Preliminary findings are pointing at individual behaviours as playing an important role on triggering episodes of shared regulation, such an individual statement monitoring or regulating previous activity. Also, some elements of the context of activity, such as the structure of the activity and certain specific interventions of the teacher are showing to have a major role in the initiation of these episodes. Analysis on how the temporal dimension plays a role in the group development of regulatory processes will be also presented.

## *Metacognition and mindreading: A developmental study*

Paulus, Markus; Proust, Joelle; Tsalas, Nike; Sodian, Beate

One area of research concerns the relationship between metacognitive and mindreading abilities and, in particular, whether metacognition can inform mindreading (e.g., Carruthers, 2009; Proust, 2007). Recent support for the latter comes from a study by Koriat and Ackerman (2010). They showed that adults relied on the memorizing-effort heuristic (cf. Koriat et al., 2006) when evaluating another person's learning achievements in a judgment-of-learning (JoL) task (i.e., judging longer studied items as being more difficult). Importantly, this was only the case when they performed this task themselves before evaluating the Other. This indicates that participants can derive insight from monitoring their own learning and transfer that insight to Other, providing support for a experience-based view on metacognition (Koriat, 1997). To investigate the developmental origins, we examined 17 elementary school children (7-11-year-olds) and 16 adults in a task following the design of Koriat and Ackerman (2010). Participants were administered with a Self-task and an Other-task. In the Self-task participants were required to study 20 pairs of pictures that showed an animal and an object, differing in degree of memorability (10 easy, 10 difficult). In the Other-task participants observed 20

movie clips showing a female person performing the learning task (without perceiving the animal-object pairs). Ten of the movie clips were of short duration (ca. 5 sec), whereas the other ten were of a longer duration (ca. 10 sec). For each item, participants were asked to indicate their estimate of the likelihood of recalling the target (JoL) by pointing to a scale of 5 points (5: high likelihood of recalling to 1: low likelihood of recalling). The order of presentation of the Self – and Other-task was counterbalanced across participants. The crucial analysis focused on participants' JoL of the Other when the Other condition followed the Self condition. We averaged for every participant his JoL evaluations across the short and across the long items. We conducted a mixed-model analysis of variance (ANOVA) with the between-subjects factor Age Group (Children, Adults) and the within-subjects factor Item Length (Short items, Long items). The ANOVA revealed an interaction effect of the factors Age Group and Item Length, $F = 5.66$, $p < .05$, indicating that the two age groups reacted differently to the short and long items. Post-hoc t-tests revealed a significant difference for the adults, $t = 2.67$, $p < .05$. Children showed no difference between their JoL for the short and long items, $t = –.85$, $p = .42$. For both age groups, no effect was found when the Other-task preceded the Self-task. The results provide empirical evidence that adults derive insight from monitoring their own learning and transfer that insight to Other (cf. Koriat & Ackerman, 2010). Yet, this was not the case for elementary school children, suggesting that this ability is a later developmental achievement.

## *Learning and thinking with analogies: Exploring the role of self-regulated learning in analogical reasoning*

Lin, Yen-Ju; Wang, Chia-Yu

Analogical reasoning (AR) is considered an important tool for thinking and communication in the field of science, as well as in science classrooms. In the present study, we applied a mixed-method research design to investigate the role self-regulated learning (SRL) skills play when middle school students use analogies to think about concepts of heat. The first part of the study involved 74 eighth-graders in four classes. An intervention was designed and implemented to use analogies to introduce the concepts of heat, followed by a problem-solving exercise which required the students to use the newly learned analogies in a new situation. Performance on the problem-solving exercise was scored. Prior to the instruction, an inventory of prior knowledge (PK) of concepts of heat and an SRL inventory were implemented, and the scores of the two instruments were used to predict the learners' AR problem-solving score. Analyses of simultaneous regression indicated that both the PK and SRL scores were significant predictors of AR problem-solving performance, explaining 23.4 % and 27.3% of variance, respectively, and together accounting for 38% of variance. We then categorized the students into high-, moderate-, and low-SRL groups based on their SRL inventory

score, and seven students from each group were interviewed. Participants were required to think aloud during the interviews in order to explore their ability of applying AR with the newly learned analogies in a new problem situation and to elicit their spontaneous SRL skills. Mason's (1994) levels of AR ability and Moos and Azevedo's (2008) SRL skills coding scheme were adopted and modified for the qualitative analyses. Analyses of AR ability across the three SRL groups showed that 85.7% of the high-SRL scorers fell into the two highest levels of AR ability, while all of the learners in the low-SRL group could identify only a little or no basic AR mapping (level 0 or 1). A wide distribution of AR ability, from the lowest level 0 to the highest level 5, was observed for the seven moderate-SRL learners. Chi-square tests revealed that high-SRL scorers showed significantly higher frequencies of SRL skills than their counterparts when reading descriptions of the problem, monitoring their use of prerequisite concepts and for the entire AR process, as well as for evaluating AR outcomes. No differences were found among the groups for frequency of planning, monitoring conflicts, or for strategies used during AR. The findings of our study suggest that PK and SRL scores are interrelated, but that each has its own unique contribution to AR. Also, SRL skills play a crucial role in successful learning and thinking with analogies. Investigating the role of SRL in AR has implications for developing effective instruction and environments for learning with and through analogies.

## *Metacognitive awareness, self-regulation and conceptions of learning in secondary schools*

Cera, Rosa; Bellingeri, Mara; Landi, Mariarosaria; Mancini, Michela; Morganti, Luca; Antonietti, Alessandro

The ability to manage study activities by themselves is one of the educational goals that learners should achieve at the end of secondary school. Self-regulation, however, includes a variety of metacognitive issues. Firstly, self-regulated students should be aware of the mental processes they rely on when performing cognitive tasks, of the degree of autonomy they are allowed in managing study activities and of how effective they are in facing school demands. Secondly, students should be able to plan and monitor study activities strategically. Thirdly, students should identify the kind of learning outcomes which they are expected to reach. The study was aimed at investigating these issues and their reciprocal relationships, as yet scarcely analysed, in students attending the last year of course of different types of secondary schools. A sample of 150 students were administered a set of self-report instruments in three separate sessions. General metacognitive awareness was assessed through the Metacognitive Awareness Inventory (MAI: Schraw & Dennison, 1994). The perception of autonomy in school learning was measured by means of the Awareness of Independent Learning Inventory (AILI: Elshout-Mohr, Van Daalen-Kapteijns & Meijer, 2004). The Adaptive Self-Efficacy

questionnaire (Italian adaptation of the General Self-efficacy Scale: Sibilia, Schwarzer & Jerusalem, 1995) was employed to assess self-efficacy. Strategic study attitudes were assessed by asking participants to fill in a shortened version of the Learning and Study Strategies Inventory (LASSI: Weinstein & Palmer, 2002). Finally, the Questionnaire About the Popular Conceptions Of Learning (QAPCOL: Antonietti, Liverta-Sempio, Marchetti & Pèrez-Tello, 2002) was applied to recognise the model of leaning the students had in mind. Preliminary analyses showed that students were mainly driven by extrinsic goals, with a poor awareness of both the mental processes they activate during study activities and of the level of autonomy and personal efficacy in facing school tasks. Respondents, however, revealed to possess relevant knowledge about the learning strategies needed to succeed in accomplishing the course of study they were attending. The conceptions of learning which emerged were rather traditional, being based mainly on intellectual effort. Response patterns appeared to vary according to the kind of school attended by respondents. Overall, findings provided evidence about discrepancies in what students perceive about the cognitive processes involved in learning, supporting the notion that metacognitive skills should be fostered in secondary school.

## *Effectiveness of a self-regulation learning programme with high school student*

Fernández, Estrella; Tuero, Ellián; Bernardo, Ana; Cerezo, Rebeca Fernández

Improving the academic performance of High School students and preparing them to face the demands of current society it is especially important in countries like Spain where the problems of school failure and early school leaving are particularly pronounced (http://ec.europa.eu/education/lifelong-learning-policy/doc2118_en.htm). Therefore, it's essential to have tools that support the development of metacognitive skills and autonomous learning among students. We have implemented "Testas in ESO first year", which is developed according to the "PLEJE" model of self-regulated learning (very close to the social-cognitive approach). It's a training program designed to promote strategic learning through stories wired to the self-regulation processes. Testas, the main character is a student like many others, tells his schoolmates about his successes, failures and troubles in his learning and studying process. He describes the way he handles learning contents and school challenges; helps his schoolmates with the learning tasks; and makes them think about and use an appropriate repertoire of learning, cognitive, metacognitive and motivational strategies, essential enablers of their academic performance. Through this methodology it is intended that the students, inductively, reflect on the strategies worked with this tool and from them build their own learning stories. This program was conducted in four High Schools in Spain, with 277 participating students (52.3% boys and 47.7% girls). They were studying their first ESO year (compulsory secondary education) and they received fourteen training sessions. The aim of this paper is to present the results of this programme, including its effectiveness analysis, which takes

into account the pupils points of view. It also aims at showing a satisfactory perception of the usefulness and interest of both the material that has been used and the procedure for its implementation.

## *Self regulated learning and emotions in high school students (first/fifth grades, scientific/technical schools): Are there any differences?*

Businaro, Nicoletta; Modica, Debora; Albanese, Ottavia; Gabola, Piera

Researchers agree that SRL comprises several components: cognitive, metacognitive, motivational, affective and behavioural/environmental (Pintrich, 2000; Cornoldi et al., 2001; Albanese et al., 2003; Boekaerts & Corno, 2005; Zimmerman, 2008). Learning to learn and being adequately motivated appear to be critical in reducing drop-out (Vallerand, Fortier & Guay, 1997) and to be predictors of academic achievement (Pekrun et al., 2002; Mega et al., 2007; Zimmerman, 2008). Emotions are also of crucial importance for students' learning. In academic settings, students experience a rich variety of emotions. Although anxiety is the most frequently reported, positive emotions are reported at the same rate of negative ones (Pekrun, Goetz, Titz et al., 2002; De Marco et al., 2011). In the Italian context, there are few studies regarding the relation between self regulation and emotions, specifically at high school. Based on these premises, the present study aims to explore:

1. the relation between self regulated competencies and emotions;
2. the impact of grades (the first vs. the fifth) and the type of school (scientific vs. technical) on self regulated competencies and emotions.

212 Italian students (104 females and 108 males; aged 13-19), who attended the first ($N = 101$) and the fifth ($N = 111$) grades at scientific and technical schools in Milano, filled in: Motivated Strategies for Learning Questionnaire (Pintrich et al., 1991; Italian version Bordin et al., 2009); Emotions in Studying Questionnaire (Mega et al., 2007). There is a positive relation between motivation and positive emotions ($r = .435$; $p < .001$) and a negative relation between self-efficacy and negative emotions ($r = -.392$; $p < .001$). Strategies scales have been found to be positively related to positive emotions ($r = .315$; $p < .001$) and negatively related to negative ones ($r = -.145$; $p < .05$). Mancova analysis indicates that the students attending the fifth grade report lower scores in extrinsic goals $F(1,207) = 8.85$; $p < .01$ and in task value $F(1,207) = 12.71$; $p < .001$ and higher scores in elaboration $F(1,207) = 6.26$; $p < .05$ and critical thinking $F(1,207) = 5.25$; $p < .05$ compared to the students at the first grade. There are no significant differences between scientific and technical schools. We also find gender differences in emotions: boys report lower frequency of negative emotions $F(1,207) = 4.33$; $p < .05$ than girls do. These results suggest promoting self regulated competencies at school, considering the robust relations with emotions. The differences between the first and the fifth grades indicate to take in account the development of self regulation in school

career. In this perspective, these findings could encourage researchers to develop instruments and activities aimed at fostering self regulation and positive emotions in academic settings.

## *Problem behaviours or emotion disorders? Regulating emotion in the middle school years*

Sinclaire-Harding, Lysandra; Whitebread, David

The consequences of childhood mental health problems cast a long shadow, imposing a huge burden on individuals, family and society. According to epidemiological studies, between 8 and 22% of preschool children exhibit moderate to clinically significant emotional and behavioural problems. Such problems interfere with learning, contribute to teacher burnout, undermine development of peer and teacher relationships and predict future social and academic difficulties. Whilst schools are well-placed to support the mental health needs of young people, assessment and identification of individuals at the borderline is unlikely, teachers are untrained to identify such problems and punitive disciplinary procedures concerned with reinforcing conduct conducive to learning, can exacerbate antisocial behaviour. Studies show that sustained exposure to negative early environmental influences of distress and conflict (such as divorce, economic uncertainty, premature birth, maternal depression, emotional neglect) may alter the stress response and lead to deficits in the child's capacity to autonomously regulate emotions. Early established patterns can become maladaptive in normative environments, for example at school, increasing vulnerability to behavioural and emotional difficulties. Educators are not necessarily trained to recognise the pathology of such individuals, and parents may be unlikely, or even avoid seeking advice. Whilst intervention programmes and social-emotional teaching curricular have reduced problems of aggression or depression, few have demonstrated long-term generalised benefits. This study offers the opportunity to enhance screening and assessment of emotional and conduct problems in the school context via a combination of physiological (skin conductance) measures, observation and questionnaire data. Participants (age 5 to 9) were observed during a collaborative problem solving task using LEGO© construction materials, known to generate high involvement and challenge in group play scenarios and requiring communication, problem-solving, creativity and joint attention. Coded-observations, combined with questionnaire items and bio-data, demonstrate the optimal and non-optimal strategies that children adopt to regulate their emotions. Preliminary results shed light on the interaction between risk/protective factors and arousal/regulatory strategies that impact behavioural problems in school.

## *Explanation of embarrassment and cognitive emotion regulation in early adolescence*

Valle, Annalisa; Cavalli, Giulia; Marchetti, Antonella

The present research investigates the embarrassing experience in 11-13 year-olds. Embarrassment is related to the ability to reflect on thought, judgment and self-representation in one's own and others' minds (Banarjee, 2002; Lagattuta & Thompson, 2007). The early adolescence is characterized by emotional and social changes, that are related to the metacognitive and mentalistic reasoning and the emotion regulation abilities (Schneider, 2008). Two groups of early adolescents (G1: N = 47; Mean age = 139.70.05 months; s.d. = 2.98. G2: N = 43; Mean age = 164.74 months; s.d. = 5.40) completed an embarrassment task (Liverta Sempio, Cavalli, Bottini & Valle, 2009; Cavalli & Valle, 2010), evaluating the intensity of the embarrassing experience in social situation and its explanation (descriptive vs. mentalistic), a cognitive emotion regulation questionnaire, assessing the cognition of thoughts regarding social negative situations (CERQ, Garnefski, Kraaij & Spinhoven, 2001; it. tr. Liverta Sempio & Di Terlizzi, 2007), and a vocabulary test (Wechsler, 2006; Orsini & Picone, 2006). All the variables were distributed normally. The linguistic performance was not related to other variables. Differences between groups in intensity and explanation of embarrassment were respectively: $t(88) = 4.703$, $p < 0.001$ (G2 mean = 19.34; G1 = 14.30); $t(88) = 6.050$, $p < 0.001$ (G2 mean = 14.11; G1 = 9.33). In both groups, the intensity of embarrassment positively correlates with its mentalistic explanation (G1: $r = 0.477$, $p = 0.001$; G2: $r = 0.489$, $p = 0.001$). A linear regression was run: the intensity of embarrassment was predicted by its mentalistic explanation and age ($R2adj = 0.36$). In G1, a positive correlation between explanation of embarrassment and CERQ "Putting into perspective" was found ($r = 0.355$, $p < 0.05$). In G2, positive correlations between explanation of embarrassment and CERQ "Positive refocusing" ($r = 0.344$, $p < 0.05$) and "Planning" ($r = 0.450$, $p < 0.01$) were found. The results show an evolutionary trend: the older subjects experience more embarrassment and use more mentalistic explanation of it than younger. The intensity of embarrassing experience is predicted by age and its mentalistic explanation: it is possible that the progressive construction of social identity implies that adolescents focus on thoughts and feelings within social situation and consequently they feel more embarrassed. The relations between emotion regulation and embarrassment underline the role of mentalistic explanation in the use of regulatory strategies involving reasoning about the social situation aimed to actively overcoming the problem.

## *Telling emotions felt by another person: The case of anger and sadness*

Biassoni, Federica; Ciceri, Rita

Understanding the emotions of another individual is a basic component in the Theory of Mind and in any empathic experience. Accounting for another person internal dimension asks for a further skill: to describe emotional states properly (Bar-On et al., 2000). The present work aims at investigating the way people tell a third person the emotions expressed by a companion, comparing the case of anger and sadness and focusing in particular on the semantic structure, on the emotional lexicon and on the thematic categories characterizing the speech. The two target emotions, both featured by negative hedonic valence, are opposite with regard to the arousal and the coping dimensions (Ellsworth & Scherer, 2003). 62 subjects read a narrative in which the protagonist tells the story of the same accident, expressing sadness (in one version) or anger (in the other one). The two narratives were equal as far as content, semantic and lexical structure is concerned, but different appraisals led the protagonist to feel and express different emotions. After reading the narrative, the subjects were asked to recognize the emotion(s) expressed by the protagonist, choosing three emotional labels among twenty of them (Bänziger et al., 2005) and to tell what they read to a researcher collaborator. Comparisons were made between the two target emotions. The semantic dimension was analyzed through a four-categories system, including: predicates, arguments, modifiers and adverbials; in each semantic category the emotional lexicon was distinguished; finally, the content dimension was analyzed through a five-categories system, including the subject, the narrator, the event, the event context and the emotional dimension. Results show that when accounting for sadness expressed by another person subjects use a wider number of predicates and arguments and refer more frequently to the event and to the context, while when accounting for anger they use a greater number of emotional predicates and arguments and refer to the narrator more frequently. Lexical and content choices show that not only the subjects grasp the other's emotion, but also attune to them adjusting their language.

## *The relations between children's social understanding and social reputation in Italian school age children*

Fiorilli, Caterina; De Stasio, Simona; Di Chiacchio, Carlo

Based on recent empirical research, children's theory of mind skills, their emotion competence and prosocial behaviors were significantly associated with peer acceptance (Ensor, Spencer & Hughes, 2010). These competences enables them to take into account the mental states of others, both cognitive (i.e., beliefs), as well as emotional (i.e., anger of fear), and help them to understand others' intentions and behaviors (De Stasio

et al., 2011; Ensor et al., 2010; Rieffe, Terwogt Meerum & Cowan, 2005). At school these abilities facilitate them to engage in appropriate social relationships with their classmates. Particularly, there are some evidences that preschool children's performance on emotion understanding tasks is associated with peer acceptance (Keogh, 2003; Denham, 2001; Pons, Doudin, Harris & de Rosnay, 2002). Moreover, children's positive relationships with their classmates is positively associated with their academic success (Ladd, Herald & Kochel, 2006; Rubin, Bukowski & Laursen, 2009). Our study aimed to analyse the impact of social behaviour, emotion comprehension and theory of mind on academic performance and peer-group's reputation. 91 children balanced for sex aged from 5,9 to 7 years were individually tested by using the Test of Emotion Comprehension (Pons & Harris, 2000 Italian version by Albanese & Molina, 2008), the Moreno's socio-metric test (Moreno, 1953) and two false belief tasks (Wimmer & Perner, 1983, Italian version by Liverta Sempio et al., 2005). Teachers rated pupil's achievement and evaluated their social behaviour using respectively a 4-graded scale and the Harter's Teacher Rating Scale of Children's Actual Behavior (Harter, 1985). Main results from path analyses showed that children's sociometric status was predicted by teachers' rating of their social behaviour, and academic performance was significantly predicted by teachers' rating of children social behaviour and performance of the two false beliefs tasks. The effects of teachers' evaluation of children's competences on their peer reputation are discussed, as well as, the role of theory of mind ability.

### *Peer tutoring groups as metacognitive learning environments?*

De Backer, Liesje; Van Keer, Hilde; Valcke, Martin

The study aims to explore the potential of reciprocal peer tutoring (RPT) to foster university students' metacognitive regulation, by analyzing RPT-interactions. Evolutions over time are studied concerning (a) frequency of occurrence; (b) execution (by tutor/tutees); (c) low/deep-level approach of metacognitive regulation in RPT-groups. Method. The RPT-program (8 sessions of 90 min) was based on empirical guidelines promoting effective tutoring (Topping, 2005). 67 students Educational Sciences were randomly assigned to 12 face-to-face RPT-groups, working on authentic group assignments. Session 1, 4, and 8 of 3 randomly selected groups were videotaped and analysed. A coding instrument was developed, representing a model of metacognitive regulation in collaborative settings, with orientation, planning, monitoring, and evaluation as main categories. The instrument also indicates whether a regulative action is low/deep-level and executed by tutor/tutees. Units of meaning (representing only one thematically consistent verbalisation of one metacognitive activity by only one student) were used as unit of analysis. In the first half of the intervention peers increasingly involve in metacognitive orientation (14.3%), planning (8.5%), monitoring (66.4%), and evaluation (10.8%). However, they demonstrate a slight regression in orientation (9%),

planning (4.6%), and evaluation (7%) during the second half. Results show increased initiative from tutees during the intervention. Whereas their involvement in regulation is limited at the start (13.6%), tutees' initiative grows up to 46% halfway the intervention and up to 56.9% during the closing session. Despite a permanent involvement in low-level regulation (51.7%) the results show an increased use of deep-level regulation (47.7%) during the second half of the intervention. Especially the trend towards deep-level comprehension monitoring is considerable. Despite growing consensus on the social dimension of metacognitive regulation, empirical evidence remains scarce (Volet et al., 2009). This study contributes in this respect and showes that RPT is promising to foster university students' regulation. The instrument used can help to refine the conceptualization of social regulation, an emerging research field lacking clear operationalisation and instruments (Iiskala et al., 2011). Our findings reveal how metacognitive regulation takes place within RPT. This can be inspirational for the search for metacognitive prompts to foster groups' regulation.

## *Socially shared metacognition in Swiss Vocational Education and Training system*

Motta, Elisa; Cattaneo, Alberto

In Swiss Vocational Education and Training, apprentices experience multiple learning contexts. Using technology as a means to capture professional situations faced at the workplace can help apprentices to reflect – through fitting activities at school – on captured experiences. Considering 1. the added value of a Portfolio to support metacognition and 2. the social aspects of learning emerging from the concepts of socially shared metacognition (Iiskala et al., 2004) and communities of metacognitive practice (Lin, 2001), this study aims to explore the effects of shared learning activities on apprentices' metacognitive development. The underlying assumption is that getting apprentices used 1. to an ePortfolio where to integrate professional situations and 2. to shared learning activities on such situations is an effective way to promote metacognitive awareness and skills. We planned a longitudinal study with two classes of apprentice cooks (N = 45) studying at the Vocational Centre in the Canton Ticino. Each apprentice in the experimental group (N = 22) was given an iPhone to collect pictures on professional procedures experienced at the workplace and an ePortfolio where 1. to write recipes enriched by their own pictures and 2. to fill in a learning journal to reflect on their practices. The control group (N = 23) used the classic paper-pencil learning journal. We conducted 10 learning activities, in class and in groups, based on the recipes and the learning journals elaborated by apprentices, for a total amount of 20 lesson hours in two years. The main measure is a self-reported questionnaire (5 waves are foreseen) on metacognitive skills, based on Metacognitive Assessing Awareness (Schraw & Dennison, 1994) and Motivated Strategies for Learning Questionnaire (Pintrich et al., 1991) scales. Additionally, we analyze the written production of Portfolios, the questionnaires on the

perceived usefulness of the learning activities and the video recordings of the group activities through a fitting coding scheme, inspired by Rogat & Linnenbrink-Garcia's work (2011). The analysis is still in progress: main results will be shown at the conference.

## *A metacognitive approach to empower children with behavioural difficulties*

Alvarez, Lionel

What can a teacher in the classroom do dealing with students' behavioural problems? Literature about the concept of social metacognition establishes a link between social psychology and cognitive psychology. These two frameworks represent the centre of teaching activities in classes. Interventions for pupils (6 to 9 years old) with behaviour disorders may involve social metacognition to optimise the spontaneous or delayed educational choices. Whether for behavioural problems' preventions or for crisis situations, the use of the analytical framework of social metacognition may guide reflections and practices. Briñol & DeMarree (2012) explain different influences of social aspects on metacognition. Social thoughts are sometimes the first level of cognition. Thus, the metacognitive intervention in the classroom would bring to consciousness both the experienced social thoughts and the non-conscious performed regulations. The social aspects are also involved in metacognition when the student wonders about how to share a thought: the time, the form, the purpose and the motivation. These aspects are also engaged in common thoughts and shared reflexions. How often must a child deal with these questions in a classroom, especially when social constructivism paradigm dominates? A metacognitive act may be influenced by someone else, as first level of cognition can. So, a teacher may theoretically modify the student's metacognitive activity. Social aspects are sometimes the subject, the motivation or the processes of the metacognition. A theoretical link exists and may guide teaching practices. There are several forms of metacognitive approach to support students with behaviour difficulties. Teachers can help the student to imagine himself/herself in every social situations he will live during the lesson. This allows the child to anticipate the expected behaviours and existing relationships by raising them to consciousness. After the learning situation, a discussion between the teacher and the child may be requested to talk about social situations experienced previously. The student will analyse his behaviours and imagine himself in a different context/time. He must decide what thoughts must be shared and what reflexions must be kept. These are just a few practical examples of how social interacts with metacognitive processes. Towards these theoretical and clinical perspectives, the poster will aim to present the goal of my thesis research. Currently, the theoretical knowledge helps to understand the specific results of ritual metacognitive interventions. The research aims to measure their influences.

## *Metacognition at school: Relationships between metacognitive approach in different school areas in early adolescence*

Magistro, Daniele; Settanni, Michele; Magno, Francesca; Rabaglietti, Emanuela

In physical activity and sport domains, movement learning is linked to the repetition and refining of gestures, but the processes carried out for learning and organizing motor tasks, despite their importance, have rarely been investigated to date (Schmidt & Wrisberg, 2008). Given the importance of metacognition during development and especially during school years (Brown, 1987), we are interested in investigating an analogous the relationship between metacognition applied to physical activity and metacognitive approach in different areas. Specifically, our aim is to analyze the relationships between the metacognition applied to physical activity and metacognitive strategies used in the non-physical school study activities. To measure metacognition applied to physical activity we used the recently developed self-report "Metacognition Applied to Physical Activity Scale" (MAPAs: Settanni et al., 2012); metacognitive strategies used in non-physical school areas were measured by means of a self-report questionnaire (MQS: Cornoldi et al., 2001). The sample consisted of 320 students, aged 11 to 15 (M = 12.5; SD = .99) attending the sixth to eighth grades of secondary school in northwestern Italy, who practice physical education during school hours as a part of their normal school curriculum. We expect to find a positive relationship between metacognition applied to physical activity and metacognitive approach used in other school areas.

## *Teenage pregnancy: Competencies of US teenagers to use news text as a knowledge source*

Feucht, Florian; Maziarz, Lauren; Hany, Susan; Nathan, Ziegler

Teenage pregnancy has become a public health burden in the US that is mediated by numerous factors. One mediating factor could be the cognitive ability to identify and evaluate relevant health information. The capacity of teenagers to identify arguments, opinions, and factual statements to make decisions based on reported health information does not come naturally, nor does their appreciation of the cognitive and meta-cognitive labor involved in these processes. The study explored the cognitive ability of US teenagers (N = 12; mean age 17; even gender distribution) to use news text as a knowledge source for information about teenage pregnancy. A combination of interview and observation techniques was utilized. First, semi-structured interviews were used to assess their mental models of teenage pregnancy encompassing their conceptions, opinions, and epistemic metacognition (i.e., understanding of the source and certainty of knowledge). While all teenagers were able to provide a basic definition, many elaborated

on their conceptions and opinions of teenage pregnancy as: self-inflicted problem, a lack of education, a future consequence, and a phenomenon in society. From an epistemic meta-cognition perspective, the majority believed in the uncertainty of teenage pregnancy knowledge and its source to be friends and family members. Second, a reading activity was used to examine their cognitive ability to analyze five news clippings about teenage pregnancy and their reading comprehension. Most participants used content as a criterion to analyze the news clippings, while few screened the clippings for supportive evidence and opinion. Furthermore, all teenagers were able to identify their own opinion in the news text, but experiences problems pointing out viewpoints opposing their own opinion. These findings indicate that they experience problems in using news text as knowledge source effectively due to the inability to enact relevant strategies and knowledge to analyze news text and monitor its progress. Reading comprehension could be excluded as a potential limiting factor. Third, the repeated interview questions revealed that teenagers did not change their conception and opinion about teenage pregnancy after reading the news text. However, several teenagers added scientists/research and news as new knowledge sources. Final, five data sources were triangulated to establish the epistemic metacognitive aspect of their mental (intertext) model of teenage pregnancy stemming from the five news texts. Most adolescent held a more relativist/evaluativist understanding, while some a more multiplist understanding (Kuhn, 1999). From a health education standpoint, young adults should be cognizant of criteria and strategies to assess health related news to make their own informed decisions. The study's results demonstrate the need for educators to develop educational materials and interventions to improve the skills necessary to critically analyze health news.

## *The analysis of the construct of literacy emerging in the construction of a "risk profile"*

Pepi, Annamaria; Maltese, Agata; Scifo, Lidia

Learning the written language, is characterized by an evolutionary continuity that develops from an early acquisition phase, traditionally defined as "emergent literacy" (Pinto, 1993; Whitehurst & Loningan, 1998; Pepi, 2004). Learning the written language has its origins in the earliest stages of a child's life, before the start of formal literacy and involves all those skills (cognitive, metacognitive, language, short-term, memory etc.), knowledges and attitudes presumed to be precursors of the development of conventional reading and writing forms (Lonigan et al., 2000). The current research shows the continuity of development between the first emergent literacy skills, starting from kindergarten, and early reading skills in primary school. An important issue is that you can identify individuals "at risk" for learning to read and therefore to calculate difficulties in the acquisition of academic skills from the start of kindergarten. Children who have difficulty in the early stages of learning to read is very likely continue to have for years more school failures in this area by triggering a process that will involve many

negative and problematic fields of their life (Cornoldi & Tressoldi, 1991). Significant research, has verified through a longitudinal research project, the predictive significance of the various components involved in the construct of emergent literacy in preschool Wilson & Lonigan, 2010). It is necessary to analyze this construct, through longitudinal analyzes in which the predictive data, are able to correlate positively or negatively with the performance of a given learning in the next step. This is to verify the significance of the different components involved in the literacy process and the nature of their relations in the preschool period and verify the burden evidence, that every component has for the learning to read and write. Through the analysis of the individual components of the construct, then, we will determine its "predictive relationship" and elaborate a profile for the risk of difficulty and/or disability in reading and writing competences.

## *Metacognitive functioning in neglectful parents*

Di Pasquale, Roberta; Rivolta, Andrea; Zanchi, Valentina; Baccanelli, Nadia

Physical and emotional neglect constitute the most widespread and insidious source of deleterious effects on childrens'cognitive and socio-emotional child development. Within the multifactorial etiology of child neglect, dysfunctional cognitive processes underlying parental neglectful behavior hold a prominent place. However, studies concerning the role of metacognitive processes, whose relevance for optimal parenting has recently been postulated through the construct of meta-parenting (Hawk & Holden, 2006), are lacking. The most relevant construct currently available to investigate global features of impaired parental metacognition appears to be parental reflective function (Fonagy & Target, 1997). In our opinion, this construct could be integrated with that of metacognitive functions (Semerari et al., 2008) which usefully subdivides metacognition into a series of specific sub-functions: monitoring, differentiation, integration and decentration. This preliminary study aims at empirically investigating the hypothesis that neglectful parent exhibit lower levels of metacognitive functions than their non-neglectful counterparts when asked to reflect upon critical parenting episodes in the relationship with their child. The study has been conducted on 10 neglectful parents and 10 matched non-neglectful parents. An adapted version of Metacognition Assessment Interview (Semerari et al., 2008), specifically modified to address parental metacognitive functioning, was administered to both groups of parents. The interviews were integrally transcribed and codified in order to come to the assessment of each metacognitive sub-function, according to criteria inspired by the assessment of parental reflective functioning. The results seem to confirm the research hypothesis and to suggest a prominent role of impaired parental metacognition in neglectful parental behavior.

# List of authors

| NAME | AFFILIATION | E-MAIL ADDRESS |
|---|---|---|
| Ackerman Rakefet | Technion-Israel Institute of Technology, Haifa, Israel | ackerman@ie.technion.ac.il |
| Adagideli Fahretdin Hasan | Boðaziçi University, Istanbul, Turkey | fahretdin.adagideli@boun.edu.tr |
| Ader Engin | Boðaziçi University, Istanbul, Turkey | ader@boun.edu.tr |
| Ajello Anna Maria | University "La Sapienza", Roma, Italy | annamaria.ajello@uniroma1.it |
| Albanese Ottavia | University of Milano-Bicocca, Italy | ottavia.albanese@unimib.it |
| Alesi Marianna | University of Palermo, Italy | marianna.alesi@unipa.it |
| Allwood Carl Martin | University of Gothenburg, Sweden | cma@psy.gu.se |
| Alvarez Lionel | University of Fribourg, Switzerland | lionel.alvarez@unifr.ch |
| Amano Shogo | Osaka Prefecture University, Japan | sr502001@edu.osakafu-u.ac.jp |
| Andrès Eric | German Research Center for Artifical Intelligence (DFKI), Saarbrücken, Germany | eric.andres@dfki.de |
| Antonietti Alessandro | Catholic University, Milan, Italy | alessandro.antonietti@unicatt.it |
| Asik Gursu | Bogazici University, Istanbul, Turkey | gursu@boun.edu.tr |
| Aus Kati | Tallin University, Tallin, Estonia | katiaus@tlu.ee |
| Azevedo Roger | McGill University, Montreal, Canada | roger.azevedo@mcgill.ca |
| Baars Martine | Erasmus University, Rotterdam, The Netherlands | baars@fsw.eur.nl |
| Baccanelli Nadia | University of Bergamo, Italy | nadia.baccanelli@libero.it |
| Balboni Giulia | University of Pisa, Italy | giulia.balboni@med.unipi.it |
| Balconi Michela | Catholic University, Milan, Italy | michela.balconi@unicatt.it |
| Balzarotti Stefania | Catholic University, Milan, Italy | stefania.balzarotti@unicatt.it |
| Banerjee Robin | University of Sussex, UK | robinb@sussex.ac.uk |
| Bannert Maria | University of Würzburg, Germany | maria.bannert@uni-wuerzburg.de |
| Bartimote-Aufflick Kathryn | University of Sydney, Australia | kathryn.aufflick@sydney.edu.au |
| Baruch Dorit | Bar-Ilan University, Ramat – Gan, Israel | doritb6@gmail.com |
| Baruffaldi Francesca | Center for Mind/Brain Sciences, University of Trento, Italy | baruffaldifrancesca@libero.it |
| Basilio Marisol | Universidad Autónoma de Madrid, Spain | marisol.basilio@uam.es |
| Bellingeri Mara | Catholic University, Milan, Italy | mara.bellingeri@tin.it |
| Beretta Angela | University of Pavia, Italy | angela.beretta01@ateneopv.it |
| Bernardo Ana | University of Oviedo, Spain | bernardoana@uniovi.es |
| Bianco Federica | University of Pavia, Italy | federica.bianco@unipv.it |
| Biassoni Federica | Catholic University, Milan, Italy | federica.biassoni@unicatt.it |
| Bicchieri Cristina | University of Pennsylvania, Philadelphia, USA | cbicchieri@gmail.com |
| Biswas Gautam | Vanderbilt University, Nashville, USA | gautam.biswas@vanderbilt.edu |
| Boily Élisabeth | Université du Québec, Montreal, Canada | eli_boily@hotmail.com |
| Bol-Arreba Alfredo | University of Burgos, Spain | vic.profesorado@ubu.es |
| Bouchet François | McGill University, Montreal, Canada | fbouchet@gmail.com |
| Bove Chiara | University of Milano-Bicocca, Italy | chiara.bove@unimib.it |
| Braga Piera | University of Milano-Bicocca, Italy | piera.braga@unimib.it |
| Brambilla Paola | University of Milano-Bicocca, Italy | p.brambilla3@campus.unimib.it |
| Bråten Ivar | University of Oslo, Norway | ivar.braten@ped.uio.no |
| Brenner Charlotte | University of British Columbia, Vancouver, Canada | cb21289@gmail.com |
| Brew Angela | University of Sydney, Australia | angela.brew@sydney.edu.au |
| Brodin Eva | University of Lund, Sweden | Eva.Brodin@ced.lu.se |
| Bromme Rainer | University of Münster, Germany | bromme@uni-muenster.de |
| Bulgarelli Daniela | University of Turin, Italy | daniela.bulgarelli@unito.it |
| Buratti Sandra | University of Gothenburg, Sweden | sandra.buratti@psy.gy.se |
| Burke LeFever Jennifer | News Juicer, Toledo, USA | Jennifer.E.Burke.42@nd.edu |
| Businaro Nicoletta | University of Milano-Bicocca, Italy | nicoletta.businaro@unimib.it |
| Cacciamani Stefano | University of Val d'Aosta, Italy | s.cacciamani@univda.it |
| Cantoia Manuela | Catholic University, Milan, Italy | manuela.cantoia@unicatt.it |

| | | |
|---|---|---|
| Caputi Marcella | University of Pavia, Italy | |
| Carassa Antonella | University of Lugano, Switzerland | antonella.carassa@usi.ch |
| Carbonero Martín Miguel-Ángel | University of Valladolid, Spain | carboner@psi.uva.es |
| Carcione Antonino | Terzo Centro di Psicoterapia Cognitivo, Rome, Italy | carcione@terzocentro.it |
| Castelli Ilaria | Catholic University, Milan, Italy | ilaria.castelli@unicatt.it |
| Castiglioni Marco | University of Milano-Bicocca, Italy | marco.castiglioni@unimib.it |
| Cattaneo Alberto | Swiss Federal Institute for Vocational Education and Training, Lugano, Switzerland | alberto.cattaneo(at)iuffp-svizzera.ch |
| Catteau Olivier | Université Paul Sabatier-IRIT, Toulouse, France | catteau@irit.fr |
| Cavalli Giulia | University Ecampus, Italy | giulia.cavalli@uniecampus.it |
| Cavioni Valeria | University of Pavia, Italy | valeria.cavioni@unipv.it |
| Cera Rosa | University of Foggia, Italy | r.cera@unifg.it |
| Cerezo Rebeca | University of Oviedo, Spain | cerezorebeca@uniovi.es |
| Chan Lap Ki | University of Hong Kong, China | lapki@hkucc.hku.hk |
| Chang Judy Wen-Hua | National Taiwan Normal University, Taipei, Taiwan | sujudy@ntnu.edu.tw |
| Charalabidou Maria | University of Western Macedonia, Greece | mariaxarg7@yahoo.gr |
| Chavez Alex | University of Pennsylvania, Philadelphia, USA | alexkchavez@gmail.com |
| Chen Mei-Rong Alice | National Taiwan University of Science and Technology, Taipei, Taiwan | mralice@mail.ntust.edu.tw |
| Chen Sufen | National Taiwan University of Science and Technology, Taipei, Taiwan | sufchen@mail.ntust.edu.tw |
| Cherubin Elisa | University of Milano-Bicocca, Italy | elisa.cherubin@gmail.com |
| Chifari Antonella | CNR – Istituto per le tecnologie Didattiche, Palermo, Italy | antonella.chifari@itd.cnr.it |
| Ciceri Rita | Catholic University, Milan, Italy | maria.ciceri@unicatt.it |
| Cipriano-Essel Elizabeth A. | Penn State University, University Park (PA), USA | ecipriano0211@gmail.com |
| Colle Livia | Università degli studi di Torino and Terzo Centro di Psicoterapia Cognitiva, Rome, Italy | livia.colle@unito.it |
| Collie Rebecca | University of British Columbia, Vancouver, Canada | rcollie@interchange.ubc.ca |
| Colombo Barbara | Catholic University, Milan, Italy | barbara.colombo@unicatt.it |
| Cornoldi Cesare | University of Padua, Italy | cesare.cornoldi@unipd.it |
| Coscarelli Alessandra | University of Valle d'Aosta – University of Turin, Italy | a.coscarelli@univda.it |
| Costa Daniel | University of Sydney, Australia | danielc@psych.usyd.edu.au |
| Costa Hiwet Mariam | University of Trieste, Italy | hiwetmariam.costa@phd.units.it |
| Cruz-Panesso Ilian | McGill University, Montreal, Canada | ilian.cruz-panesso@mail.mcgill.ca |
| Cueli Marisol | University of Oviedo, Spain | fernandezmarisol.uo@uniovi.es |
| Daffi Gianluca | Catholic University, Milan, Italy | gianluca.daffi@unicatt.it |
| D'Amico Antonella | University of Palermo, Italy | antonella.damico@unipa.it |
| Danielson Robert | California State University, Chico, USA | bobbydaniels07@gmail.com |
| Datteri Edoardo | University of Milano-Bicocca, Italy | edoardo.datteri@unimib.it |
| De Backer Liesje | University of Ghent, Belgium | Liesje.DeBacker@UGent.be |
| De Bruin Anique | Maastricht University, The Netherlands | anique.debruin@maastrichtuniversity.nl |
| De Luca Picione Raffaele | University of Napoli Federico II, Italy | raffaele.delucapicione@unina.it |
| De Stasio Simona | Università del Foro Italico, Rome, Italy | simona.destasio@uniroma4.it |
| Dehler Zuefferey Jessica | University of Fribourg, Switzlerland | jessica.dehler@unifr.ch |
| Demicheli Patrizia | University of Pavia, Italy | |
| D'Eredità Giuliano | University of Palermo, Italy | deredita@math.unipa.it |
| Destan Nesrin | University of Bern, Switzerland | nesrin.destan@psy.unibe.ch |
| Di Chiacchio Carlo | INVALSI, Rome, Italy | carlo.dichiacchio@invalsi.it |
| Di Paola Benedetto | University of Palermo, Italy | dipaola@math.unipa.it |
| Di Pasquale Roberta | University of Bergamo, Italy | roberta.di-pasquale@unibg.it |
| Dignath-van Ewijk Charlotte | University of Mannheim, Germany | cdignath@mail.uni-mannheim.de |
| Doganca Zerrin | Bogazici University, Istanbul, Turkey | zerrin.doganca@boun.edu.tr |
| Doudin Pierre-André | Haute école pédagogique Vaud, Lausanne, Switzerland | pierre-andre.doudin@hepl.ch |
| Dubé France | Université du Québec, Montreal, Canada | dube.france@uqam.ca |
| Duffy Melissa | McGill University, Montreal, Canada | melissa.duffy@mail.mcgill.ca |
| Dupeyrat Caroline | Université Toulouse-Le-Mirail, France | dupeyrat@univ-tlse2.fr |
| Durksen Tracy | University of Alberta, Edmonton, Canada | tdurksen@ualberta.ca |

| | | |
|---|---|---|
| Ebert Susanne | Universitity of Bamberg, Germany | susanne.ebert@uni-bamberg.de |
| Ee Jessie | National Institute of Education, Nanyang Technological University, Singapore | jessie.ee@nie.edu.sg |
| Efklides Anastasia | Aristotle University of Thessaloniki, Greece | efklides@psy.auth.gr |
| Eichelmann Anja | Technische Universität Dresden, Germany | anja.eichelmann@tu-dresden.de |
| Escorcia Dyanne | University de Poitiers, France | dyanne.escorcia@univ-poitiers.fr |
| Esposito Giovanna | University of Napoli Federico II, Italy | giovanna.esposito@inwind.it |
| Fantini Paola | Liceo Scientifico "A. Einstein", Rimini, Italy | paofantini@libero.it |
| Farina Eleonora | University of Milano-Bicocca, Italy | eleonora.farina1@unimib.it |
| Ferguson Leila E. | University of Oslo, Norway | l.e.ferguson@ped.uio.no |
| Fernández Estrella | University of Oviedo, Spain | fernandezestrella@uniovi.es |
| Ferrari Chiara | Catholic University, Milan, Italy | chiara.ferrari.uni@gmail.com |
| Ferro Mario | University of Palermo, Italy | ferro@math.unipa.it |
| Feucht Florian | News Juicer, Toledo, USA | florian.feucht@utoledo.edu |
| Feyzi-Behnagh Reza | McGill University, Montreal, Canada | reza.feyzibehnagh@mail.mcgill.ca |
| Fiorilli Caterina | LUMSA, Roma, Italy | fiorilli@lumsa.it |
| Freda Maria Francesca | University of Napoli Federico II, Italy | fmfreda@unina.it |
| Freeman Norman H. | University of Bristol, UK | N.Freeman@bris.ac.uk |
| Freire Paulina | University "Pontificia Católica de Chile", Santiago, Chile | |
| Fritzsche Eva Susanne | Friedrich-Alexander-Universität Erlangen-Nürnberg | eva.fritzsche@ewf.uni-erlangen.de |
| Furnes Bjarte | University of Bergen, Norway | Bjarte.Furnes@psybp.uib.no |
| Gabola Piera | University of Milano-Bicocca, Italy | p.gabola@campus.unimib.it |
| Gaciu Nicoleta | Oxford Brookes University, Oxford, UK | ngaciu@brookes.ac.uk |
| García Fernández Trinidad | University of Oviedo, Spain | garciatrinidad.uo@uniovi.es |
| García María Rosa | University "Pontificia Católica de Chile", Santiago, Chile | mrgarci1@uc.cl |
| Gatti Monica | Catholic University, Milan, Italy | monica.gatti@unicatt.it |
| Gauggel Siegfried | University Hospital RWTH, Aachen, Germany | sgauggel@ukaachen.de |
| Gerjets Peter | Knowledge Media Research Center, Tuebingen, Germany | p.gerjets@iwm-kmrc.de |
| Geva Ronny | Bar-Ilan University, Ramat-Gan, Israel | ronny.geva@biu.ac.il |
| Ghetti Simona | University of California, Davis, USA | sghetti@ucdavis.edu |
| Gilli Gabriella | Catholic University, Milan, Italy | gabriella.gilli@unicatt.it |
| Giordano Enrica | University of Milano-Bicocca, Italy | enrica.giordano@unimib.it |
| Girani De Marco Barbara | University of Milano-Bicocca, Italy | barbara.demarco1@unimib.it |
| Giudici Claudia | Reggio Children, Reggio Emilia, Italy | c.giudici@reggiochildren.it |
| Goguadze George | Saarland University, Saarbrücken, Germany | george@activemath.org |
| González-Pienda Julio | University of Oviedo, Spain | julioag@uniovi.es |
| Goren Ilana | Bar-Ilan University, Ramat – Gan, Israel | goren.ilana@gmail.com |
| Gössling Jill | Ruhr-University Bochum, Germany | jill.goessling@uni-due.de |
| Grau Valeska | University "Pontificia Católica de Chile", Santiago, Chile | vgrau@uc.cl |
| Grazzani Gavazzi Ilaria | University of Milano-Bicocca, Italy | ilaria.grazzani@unimib.it |
| Guerra Monica | University of Milano-Bicocca, Italy | monica.guerra@unimib.it |
| Gurtner Jean-Luc | University of Fribourg, Switzlerland | jean-luc.gurtner@unifr.ch |
| Haberkorn Kerstin | Otto-Friedrich-University Bamberg, Germany | kerstin.haberkorn@uni-bamberg.de |
| Hadjitheodoulou-Loizidou Pavlina | Cyprus Pedagogical Institute, Nicosia, Cyprus | loishadj@cyearn.pi.ac.cy |
| Haendel Marion | University of Erlangen-Nuremberg, Germany | marion.haendel@ewf.uni-erlangen.de |
| Hany Susan | University of Toledo, USA | |
| Harley Jason | McGill University, Montreal, Canada | jason.harley@mail.mcgill.ca |
| Haukenes Silje B. | University of Bergen, Norway | sbhauk@gmail.com |
| Hembacher Emily | University of California, Davis, USA | emily.hembacher@gmail.com |
| Henderson Janine | Hull-York Medical School, UK | janine.henderson@hyms.ac.uk |
| Henrotay Pierre | Athénée Royal de Spa, Belgium | pierre.henrotay@skynet.be |
| Hillel Mor | Bar-Ilan University, Ramat – Gan, Israel | |
| Hirschfeld Gerrit | German Peadiatric Pain Centre and Vodafone Foundation, Children's and Adolescents' Hospital and Herdecke University, Datteln, Germany | g.hirschfeld@kinderklinik-datteln.de |
| Hmelo-Silver Cindy | Rutgers University, New Brunswick (NJ) USA | cindy.hmelo-silver@gse.rutgers.edu |
| Hsu Ying-Shao | National Taiwan Normal University, Taipei, Taiwan | yshsu@ntnu.edu.tw |
| Huet Nathalie | Toulouse-Le-Mirail University, France | huet@univ-tlse2.fr |

| | | |
|---|---|---|
| Iiskala Tuike | University of Turku, Finland | tuike.iiskala@utu.fi |
| Irving Paul W. | Kansas State University, Manhattan, USA | pwirving@ksu.edu |
| Jackson Simon | University of Sydney, Australia | sjac9712@uni.sydney.edu.au |
| Jimenez François | University of Fribourg, Switzlerland | françois.jimenez@unifr.ch |
| Jõgi Anna-Liisa | Tallin University, Tallin, Estonia | aljogi@tlu.ee |
| Junyent Andrea Anahi | SISSA (Scuola Internazionale Superiore di Studi Avanzati), Trieste, Italy | aajunyent@hotmail.com |
| Kanizsa Silvia | University of Milano-Bicocca, Italy | silvia.kanizsa@unimib.it |
| Kapp Felix | Technische Universität Dresden, Germany | kapp@psychologie.tu-dresden.de |
| Karlen Yves | University of Zurich, Switzerland | ykarlen@ife.uzh.ch |
| Kazemitabar Maedeh | McGill University, Montreal, Canada | maedeh.kazemi@mcgill.ca |
| Kienhues Dorothe | University of Münster, Germany | kienhues@uni-muenster.de |
| Kikas Eve | Tallin University, Tallin, Estonia | ekikas@tlu.ee |
| Kinnebrew John S. | Vanderbilt University, Nashville, USA | john.s.kinnebrew@Vanderbilt.Edu |
| Klassen Robert | University of Alberta, Edmonton, Canada; University of York, United Kingdom | robert.klassen@york.ac.uk |
| Klausen Søren Harnow | University of Southern Denmark, Odense, Denmark | harnow@ifpr.sdu.dk |
| Kleitman Sabina | University of Sydney, Australia | sabinak@psych.usyd.edu.au |
| Koerndle Hermann | Technische Universität Dresden, Germany | hermann.koerndle@tu-dresden.de |
| Kohen Zehavit | Bar-Ilan University, Ramat-Gan, Israel | zehavit.kohen@biu.ac.il |
| Kolic-Vehovec Svjetlana | University of Rijeka, Croatia | skolic@ffri.hr |
| Konstantinopoulou Eleni | Aristotle University, Thessaloniki, Greece | elinappg@yahoo.com |
| Kramarski Bracha | Bar-Ilan University, Ramat-Gan, Israel | bracha.kramarski@biu.ac.il |
| Kramer Tim | University of Freiburg, Germany | tim.kramer@ph-freiburg.de |
| Kuteeva Maria | University of Stockholm, Sweden | |
| Kuvalja Martina | University of Cambridge, UK | mk584@cam.ac.uk |
| Laguesse Céline | Athénée Royal de Spa, Belgium | celine_laguesse@hotmail.com |
| Lajoie Susanne P. | McGill University, Montreal, Canada | susanne.lajoie@mcgill.ca |
| Landi Mariarosaria | Catholic University, Milan, Italy | narg80@virgilio.it |
| Landis Ronald | Illinois Institute of Technology, USA | rlandis@iit.edu |
| Laudisa Federico | University of Milano-Bicocca, Italy | federico.laudisa@unimib.it |
| Lecce Serena | University of Pavia, Italy | slecce@unipv.it |
| Lecciso Flavia | University of Salento, Lecce, Italy | flavia.lecciso@unisalento.it |
| Leclercq Dieudonnéx | University of Liege, Belgium | d.leclercq@ulg.ac.be |
| Lee Jihyun | National Institute of Education, Nanyang Technological University, Singapore | jl6022003@yahoo.com |
| Lehtinen Erno | University of Turku, Finland | erno.lehtinen@utu.fi |
| Leidinger Manuela | Saarland University, Saarbruecken, Germany | manuela.leidinger@mx.uni-saarland.de |
| Chen Leighanne Jamie | Koo Foundation Sun Yet-sen, Taipei, Taiwan | jamie.spacey@gmail.com |
| Leiser David | Ben-Gurion University, Negev, Israel | dleiser@exchange.bgu.ac.il |
| Leseman Paul | Utrecht University, The Netherlands | p.p.m.leseman@uu.nl |
| Leutner Detlev | Ruhr-University Bochum, Germany | detlev.leutner@uni-due.de |
| Levrini Olivia | University of Bologna, Italy | olivia.levrini2@unibo.it |
| Leyton Carolina | Ministerio de Educación de Chile, Santiago, Chile | caleyton@uc.cl |
| Lifshitz Irit | Bar-Ilan University, Ramat – Gan, Israel | iritlif@gmail.com |
| Lin Shu-Sheng | National Chiayi University, Taiwan | lin-s-s@mail.ncyu.edu.tw |
| Lin Yen-Ju | National Chiayi University, Hsinchu, Taiwan | cwg25@mail.nctu.edu.tw |
| Lippmann Marie | Technische Universität Dresden, Germany | lippmann@psychologie.tu-dresden.de |
| Lo Dico Giuseppe | Catholic University, Milan, Italy | giuseppe.lodico@unicatt.it |
| Lockl Kathrin | Otto-Friedrich-Universität Bamberg, Germany | kathrin.lockl@uni-bamberg.de |
| Maag Merki Katharina | University of Zurich, Switzerland | kmaag@ife.uzh.ch |
| Magistro Daniele | University of Turin, Italy | daniele.magistro@unito.it |
| Magno Francesca | Center of Research of Motor Science S.U.I.S.M, Turin, Italy | francesca.magno@unito.it |
| Maillard Adeline | Toulouse-Le-Mirail University, France | adeline.maillard@univ-tlse2.fr |
| Maltese Agata | University of Palermo, Italy | |
| Mancini Michela | Catholic University, Milan, Italy | michela_mancini82@yahoo.it |
| Mangiagalli Matteo | University of Pavia, Italy | matteo.mangiagalli01@libero.it |
| Mantovani Susanna | University of Milano-Bicocca, Italy | susanna.mantovani@unimib.it |

| | | |
|---|---|---|
| Manzo Stefano | University of Napoli Federico II, Italy | info@stefanomanzo.org |
| Marchetti Antonella | Catholic University, Milan, Italy | antonella.marchetti@unicatt.it |
| Mason Lucia | University of Padua, Italy | lucia.mason@unipd.it |
| Massaro Davide | Catholic University, Milan, Italy | davide.massaro@unicatt.it |
| Mauroux Laetitia | University of Fribourg, Switzlerland | laetitia.mauroux@unifr.ch |
| Maziarz Lauren | University of Toledo, USA | |
| McKendree Jean | Hull-York Medical School, UK | jean.mckendree@hyms.ac.uk |
| Meier Angelika | University of Teacher Education, St.Gallen, Switzerland | angelika.meier@phsg.ch |
| Merlo Gianluca | CNR – Istituto per le tecnologie Didattiche, Palermo, Italy | gianluca.merlo@itd.cnr.it |
| Metallidou Panayiota | Aristotle University of Thessaloniki, Greece | pmetall@psy.auth.gr |
| Mevarech R. Zemira | Bar-Ilan University, Ramat-Gan, Israel | Zemira.Mevarech@biu.ac.il |
| Milani Luca | Catholic University, Milano, Italy | luca.milani@unicatt.it |
| Ming Zhou Ming | National Institute of Education, Nanyang Technological University, Singapore | |
| Minguela Marta | University of Barcelona, Spain | martaminguela@ub.edu |
| Mirandola Chiara | University of Padua, Italy | chiara.mirandola@unipd.it |
| Modica Debora | University of Milano-Bicocca, Italy | d.modica@campus.unimib.it |
| Moè Angelica | University of Padua, Italy | angelica.moe@unipd.it |
| Mokos Evagelos | University of Aegean, Rhodes, Greece | emokos@rhodes.aegean.gr |
| Molenaar Inge | Radboud University Nijmegen | I.Molenaar@uva.nl |
| Molina Paola | University of Turin, Italy | paola.molina@unito.it |
| Molteni Stefania | Catholic University and University of Milano-Bicocca, Milan, Italy | stefania.molteni@alice.it |
| Montero-Garcia Eduardo | University of Burgos, Spain | emontero@ubu.es |
| Moran Mary Jane | University of Knoxville, TN | moran.maryjane@gmail.com |
| Morganti Francesca | University of Bergamo, Italy | francesca.morganti@unibg.it |
| Morganti Luca | Catholic University, Milan, Italy | lucamorga@tiscali.it |
| Morony Suzie | University of Sydney, Australia | smorony@gmail.com |
| Moták Ladislav | Université Toulouse-Le-Mirail, France | ladislav.motak@univ-tlse2.fr |
| Motta Elisa | Swiss Federal Institute for Vocational Education and Training, Lugano, Switzerland | elisa.motta@iuffp-svizzera.ch |
| Mulder Hanna | Utrecht University, The Netherlands | h.mulder2@uu.nl |
| Muñoz Liz | University "Pontificia Católica de Chile", Santiago, Chile | lavelaa@hotmail.com |
| Naismith Laura | McGill University, Montreal, Canada | laura.naismith@mail.mcgill.ca |
| Narciss Susanne | Technische Universität Dresden, Germany | susanne.narciss@tu-dresden.de |
| Nicolò Giuseppe | Terzo Centro Psicoterapia Cognitiva, Rome, Italy | nicolo@terzocentro.it |
| Neale Dave | University of Cambridge, UK | dan28@cam.ac.uk |
| Negretti Raffaella | Stockholm University, Sweden | raffaella.negretti@english.su.se |
| Neuenhaus Nora | University of Bamberg, Germany | nora.neuenhaus@uni-bamberg.de |
| Nigris Elisabetta | University of Milano-Bicocca, Italy | elisabetta.nigris@unimib.it |
| Nola Marta | University of Pavia, Italy | |
| Noone Robert J. | Center for Family Consultation, Illinois, USA | bobnoone@comcast.net |
| Norman Elisabeth | University of Bergen, Norway | Elisabeth.Norman@psysp.uib.no |
| Nuñez J. Carlos | University of Oviedo, Spain | jcarlosn@uniovi.es |
| Øistein Anmarkrud | University of Oslo, Norway | oistein.anmarkrud@ped.uio.no |
| Okamoto Masahiko | Osaka Prefecture University, Japan | okamoto@hs.osakafu-u.ac.jp |
| Onida Monica | University of Milano-Bicocca, Italy | Monica.onida@unimib.it |
| Opfermann Maria | Ruhr-University Bochum, Germany | maria.opfermann@uni-due.de |
| Ornaghi Veronica | University of Milano-Bicocca, Italy | veronica.ornaghi1@unimib.it |
| Orr Edna | Bar-Ilan University, Ramat-Gan, Israel | ednaorr@macam.ac.il |
| O'Sullivan Lisha | University of Cambridge, England | lisha.osullivan@mic.ul.ie |
| Ouellet.Chantal | Université du Québec, Montreal, Canada | ouellet.chantal@uqam.ca |
| Paas Fred | Erasmus University, Rotterdam, The Netherlands | |
| Pagnin Adriano | University of Pavia, Italy | adriano.pagnin@unipv.it |
| Pahljina-Reinic Rosanda | University of Rijeka, Croatia | rosanda@ffri.hr |
| Palermo Alessandra | Fondazione Sandretto Re Rebaudengo, Turin, Italy | dip.educativo@fsrr.org |
| Palladino Paola | University of Pavia, Italy | paola.palladino@unipv.it |
| Papasolomontos Christina | Cyprus Pedagogical Institute, Nicosia, Cyprus | cpapasolomontos@cytanet.com.cy |

| | | |
|---|---|---|
| Passolunghi Maria Chiara | University of Trieste, Italy | passolu@units.it |
| Paulus Markus | Ludwig Maximilian University, Munich, Germany | Markus.Paulus@psy.lmu.de |
| Pedone Roberto | Seconda Università degli Studi di Napoli and Terzo Centro di Psicoterapia Cognitiva, Rome, Italy | roberto.pedone@gmail.com |
| Peets Kätlin | University of Turku, Finland /University of Tallin, Estonia | kapeet@utu.fi |
| Pennati Alessandro | Catholic University, Milan, Italy | pennatialessandro@gmail.com |
| Pepi Annamaria | University of Palermo, Italy | annamaria.pepi@unipa.it |
| Perels Franziska | Saarland University, Saarbruecken, Germany | f.perels@mx.uni-saarland.de |
| Perrucci Vittore | University of Valle d'Aosta, Italy | v.perrucci@univda.it |
| Perry Nancy | University of British Columbia, Vancouver, Canada | nancy.perry@ubc.ca |
| Petrocchi Serena | Keele University, Newcastle under Lyme, UK | s.petrocchi@ilcs.keele.ac.uk |
| Pieschl Stephanie | Westfälische Wilhelms University of Münster, Germany | pieschl@psy.uni-muenster.de |
| Pino-Pasternak Deborah | Murdoch University, Australia | d.pinopasternak@murdoch.edu.au |
| Piralli Francesca | University of Milano-Bicocca, Italy | francescapiralli@yahoo.it |
| Pizzingrilli Paola | Catholic University, Milan, Italy | paola.pizzingrilli@unicatt.it |
| Pohl Steffi | Otto-Friedrich-Universität Bamberg, Germany | steffi.pohl@uni-bamberg.de |
| Poitras Eric | McGill University, Montreal, Canada | eric.poitras@mail.mcgill.ca |
| Pons Francisco | University of Oslo, Norway | francisco.pons@psykologi.uio.no |
| Proske Antje | Technische Universität Dresden, Germany | antje.proske@tu-dresden.de |
| Proust Joelle | École Normale Supérieure, Paris, France | jproust@ehess.fr |
| Rabaglietti Emanuela | University of Turin, Italy | emanuela.rabaglietti@unito.it |
| Ramseier Erich | Pädagogische Hochschule (PH), Bern, Switzerland | erich.ramseier@phbern.ch |
| Ranjan Jayanthi | Institute of Management Technology, Ghaziabad, India | jranjan@imt.edu |
| Ranjan P.P. | JR Creations, Greater Noida, India | ppranjanjr@gmail.com |
| Reber Rolf | University of Bergen, Norway | rolf.reber@psysp.uib.no |
| Reimann Peter | University of Sydney, Australia | preimann@edfac.usyd.edu.au |
| Renati Roberta | University of Pavia, Italy | roberta.renati@unipv.it |
| Rezzonico Giorgio | Università Bicocca, Milano, Italy | giorgio.rezzonico@unimib.it |
| Rieß Werner | University of Freiburg, Germany | riess@ph-freiburg.de |
| Rikers Remy | Erasmus University Rotterdam, Rotterdam, The Netherlands | rikers@fsw.eur.nl |
| Rinaldi Carla | Reggio Children, Reggio Emilia, Italy | carlarinaldi@reggiochildren.it |
| Ristic Dedic Zrinka | Institute for Social Research – Centre for Educational Research and Development, Zagreb, Croatia | zrinka@idi.hr |
| Rivolta Andrea | University of Bergamo, Italy | rivolta7@gmail.com |
| Robertson Jan | University of Waikato, New Zealand | info@janrobertson.co.nz |
| Rodríguez Cintia | Universidad Autónoma de Madrid, Spain | cintia.rodriguez@uam.es |
| Rodríguez-González Martiño | University of Santiago de Compostela, Spain | martino.rodriguez@usc.es |
| Roebers Claudia | University of Bern, Switzerland | roebers@psy.unibe.ch |
| Román-Sánchez José María | University of Valladolid, Spain | jmroman@psi.uva.es |
| Roncevic Zubkovic Barbara | University of Rijeka, Croatia | roncevic@ffri.hr |
| Rossi Sabrina | University of Milano-Bicocca, Italy | Sabrina.rossi@unimib.it |
| Rossini-Drecq Emmanuelle | Scuola Universitaria Professionale Svizzera Italiana (DSAN, SUPSI), Manno, Switzerland | emmanuelle.drecq@supsi.ch |
| Rotenberg Ken J. | Keele University, Newcastle under Lyme, UK | k.j.rotenberg@psy.keele.ac.uk |
| Rozzi Francesca | Catholic University, Milan, Italy | rozzifrancesca@gmail.com |
| Ruggi Simona | University E-Campus, Italy | simona.ruggi@uniecampus.it |
| Sáiz-Manzanzares María Consuelo | University of Burgos, Spain | mcsmanzanares@ubu.es |
| Sakdavong Jean-Christophe | Toulouse-Le-Mirail University, France | jcs@univ-tlse2.fr |
| Sanchez-Santillan Miguel | University of Oviedo, Spain | UO167275@uniovi.es |
| Sangster Jokic Claire | Unversity of Cambridge, UK | sangsterjokic@gmail.com |
| Santa Cruz Josefina | University "Pontificia Católica de Chile", Santiago, Chile | msanta@uc.cl |
| Santos Melgoza David Martín | Chapingo University, Mexico | dmsm21@correo.chapingo.mx |
| Sarmento David | California State University, Chico, USA | dbsarmento@gmail.com |
| Savazzi Federica | Catholic University, Milan, Italy | federica.savazzi@unicatt.it |
| Sayre Eleanor C | Kansas State University, Manhattan, USA | esayre@ksu.edu |
| Scarantino Claudia | Catholic University, Milan, Italy | claud.sc@hotmail.it |
| Scheiter Katharina | Knowledge Media Research Center, Tuebingen, Germany | k.scheiter@iwm-kmrc.de |

| | | |
|---|---|---|
| Schiffhauer Silke | University of Duisburg-Essen, Germany | silke.schiffhauer@uni-due.de |
| Schmidt Henk | Erasmus University Rotterdam, Rotterdam, The Netherlands | Schmidt@fsw.eur.nl |
| Schnaubert Lenka | Technische Universität Dresden, Germany | lenka.schnaubert@tu-dresden.de |
| Schneider Wolfgang | University of Wuerzburg, Germany | schneider@psychologie.uni-wuerzburg.de |
| Schuette Melanie | Ruhr-University Bochum, Germany | melanie.schuette@rub.de |
| Schwartz Neil | California State University, Chico, USA | NSchwartz@csuchico.edu |
| Scifo Lidia | University of Palermo, Italy | |
| Segedy James R. | Vanderbilt University, Nashville, USA | james.segedy@Vanderbilt.Edu |
| Segurini Alessandro | Catholic University, Milan, Italy | alesegu87@hotmail.it |
| Semerari Antonio | Third Center of Cognitive Psychotherapy, Rome, Italy | semerari@terzocentro.it |
| Settanni Michele | University of Turin, Italy | michele.settanni@unito.it |
| Shabtay Galit | Bar-Ilan University, Ramat-Gan, Israel | galis_1212@bezeqint.net |
| Shamir Adina | Bar-Ilan University, Ramat – Gan, Isreael | shamir_a@netvision.net.il |
| Sharma Vandna | BIT Deemed University, Ranchi – Noida Campus, Uttar Pradesh, India | vandnash@gmail.com |
| Shpigelman Maya | Technion-Israel Institute of Technology, Haifa, Israel | mmaya8@gmail.com |
| Sinclaire-Harding Lysandra | University of Cambridge, UK | ls547@cam.ac.uk |
| Skowron Elizabeth A. | University of Oregon, Eugene (OR), USA | eskowron@uoregon.edu |
| Sleegers Peter | University of Twente, The Netherlands | P.J.C. Sleegers@utwente.nl |
| Slot Pauline | Utrecht University, The Netherlands | P.L.Slot@uu.nl |
| Sodian Beate | Ludwig Maximilian University, Munich, Germany | Beate.Sodian@psy.lmu.de |
| Song Xin | University Koblenz-Landau, Germany | song@uni-landau.de |
| Soriæ Izabela | University of Zadar, Croatia | isoric@unizd.hr |
| Sosnovsky Sergey | German Research Center for Artifical Intelligence (DFKI), Saarbrücken, Germany | sergey.sosnovsky@dfki.de |
| Stahl Elmar | University of Education, Freiburg, Germany | elmar.stahl@ph-freiburg.de |
| Stalbovs Kim | Knowledge Media Research Center, Tuebingen, Germany | k.stalbovs@iwm-kmrc.de |
| Stankov Lazar | University of Western Sydney, Australia | lazondi@rocketmail.com |
| Stephanou Georgia | University of Western Macedonia, Greece | gstephanou@uowm.gr |
| Strepparava Maria Grazia | University of Milano-Bicocca, Italy | mariagrazia.strepparava@unimib.it |
| Strømsø Helge | University of Oslo, Norway | h.i.stromso@ped.uio.no |
| Suarez Natalia | University of Oviedo, Oviedo, Spain | suareznatalia.uo@uniovi.es |
| Taub Michelle | McGill University, Montreal, Canada | michelle.taub@mail.mcgill.ca |
| Terminello Anna | MIUR – Agenzia Nazionale per lo Sviluppo dell'Autonomia Scolastica, Palermo, Italy | a.terminello@irresicilia.it |
| Thomm Eva | University of Münster, Germany | eva.thomm@uni-muenster.de |
| Thommen Evelyne | Ecole d'études sociales et pédagogiques (EESP HES-SO), Lausanne, Switzerland | evelyne.thommen@eesp.ch |
| Thompson Valerie | University of Saskatchewan, Saskatoon, Canada | valerie.thompson@usask.ca |
| Tornatora Maria Caterina | University of Padua, Italy | caterina.tornatora@unipd.it |
| Torres Pablo | University "Pontificia Católica de Chile", Santiago, Chile | pabloto@uc.cl |
| Tova Michalsky | Bar-Ilan University, Ramat-Gan, Israel | Tova.Michalsky@biu.ac.il |
| Trevors Gregory | McGill University, Montreal, Canada | gregory.trevors@mail.mcgill.ca |
| Tsai Cheng-Yue | National Taiwan University of Science and Technology, Taipei, Taiwan | tsai0215@mail.ntust.edu.tw |
| Tsalas Nike | Ludwig Maximilian University, Munich, Germany | Nike.Tsalas@psy.lmu.de |
| Tuero Ellián | University of Oviedo, Spain | tueroellian@uniovi.es |
| Tupac-Yupanqui Ana | Ludwig-Maximilians-Universität (LMU, München, Germany | Ana.Tupac@web.de |
| Valcke Martin | University of Ghent, Belgium | Martin.Valcke@UGent.be |
| Valle Annalisa | Catholic University, Milan, Italy | annalisa.valle@unicatt.it |
| van Boxtel Carla | University of Amsterdam, The Netherlands | C.A.M.vanboxtel@eur.nl |
| Van den Broek Paul | University of Leiden, The Netherlands | broekpwvanden@fsw.leidenuniv.nl |
| van der Stel Manita | University of Leiden, The Netherlands | mvdstel@planet.nl |
| van Gog Tamara | Erasmus University, Rotterdam, The Netherlands | vangog@fsw.eur.nl |
| van Haaren Marieke | University of Leiden, The Netherlands | MHaaren@iclon.leidenuniv.nl |
| Van Keer Hilde | University of Ghent, Belgium | Hilde.VanKeer@UGent.be |

| | | |
|---|---|---|
| van Loon Mariëtte | Maastricht University, The Netherlands | m.vanloon@maastrichtuniversity.nl |
| van Merriënboer Jeroen | Maastricht University, The Netherlands | j.vanmerrienboer@maastrichtuniversity.nl |
| Vandevelde Sabrina | University of Ghent, Belgium | sabrina.vandevelde@ugent.be |
| Vauras Marja | University of Turku, Finland | marja.vauras@utu.fi |
| Vecchi Vea | Reggio Children, Reggio Emilia, Italy | |
| Veenman Marcel V.J. | University of Leiden, The Netherlands | veenman@fsw.leidenuniv.nl |
| Verma Mohini | University of Cambridge, UK | mv318@cam.ac.uk |
| Veronese Guido | University of Milano-Bicocca, Italy | guido.veronese@unimib.it |
| Vogt Franziska | University of Teacher Education, St.Gallen, Switzerland | franziska.vogt@phsg.ch |
| Volz-Sidiropoulou Eftychia | University Hospital RWTH, Aachen, Germany | evolz-sidiropoulou@ukaachen.de |
| Wachsmuth Claudia | Technische Universität Dresden, Germany | claudia.wachsmuth@phil.tu-chemnitz.de |
| Wagner Anne | Université du Québec, Montreal, Canada | anne0510@gmx.net |
| Wang Chia-Yu | National Taiwan Normal University, Taipei, Taiwan | cwg25@mail.nctu.edu.tw |
| Weinert Sabine | University of Bamberg, Germany | sabine.weinert@uni-bamberg.de |
| Whitebread David | University of Cambridge, United Kingdom | dgw1004@cam.ac.uk |
| Wirth Joachim | University of Duisburg-Essen, Germany | joachim.wirth@rub.de |
| Wiseman Jeffery | McGill University, Montreal, Canada | jeffrey.wiseman@mcgill.ca |
| Xu Chenyan | University of Cambridge, UK | cx216@cam.ac.uk |
| Zachariou Antonia | University of Cambridge, UK | az292@cam.ac.uk |
| Zanchi Valentina | University of Bergamo, Italy | zanchivalentina@libero.it |
| Zanetti Maria Assunta | University of Pavia, Italy | zanetti@unipv.it |
| Zecca Luisa | University of Milano-Bicocca, Italy | luisa.zecca@unimib.it |
| Zhang Wen-Xin | National Taiwan Normal University, Taipei, Taiwan | 697440114@ntnu.edu.tw |
| Ziegler Nathan | University of Toledo, USA | |
| Zuccoli Franca | University of Milano-Bicocca, Italy | franca.zuccoli@unimib.it |

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