This PhD thesis examines the relationship between motivational beliefs and cognitive–metacognitive functioning during professional mathematics learning activities, specifically in adolescents and young adults engaged in their first year of vocational education. While motivational and affective factors are recognized as playing a significant role in cognitive functioning (Dai & Sternberg, 2004), few researchers have investigated how the prior influenced the latter in the context of vocational education. The two empirical studies conducted in this thesis explored how a set of motivational affective beliefs—referring to the domain of professional mathematics (achievement goals, perceived competence, anxiety, interest, and utility)—can explain: (a) online metacognitive processes (metacognitive experiences and metacognitive self-regulation) in specific mathematic problem-solving situations and (b) strategies usually applied for learning the material. The relations were controlled for differences in multiple cognitive aptitudes (numerical reasoning abilities, nonverbal intelligence, and working memory). The third and final research question addressed was whether distinct motivational profiles (in terms of achievement goals) existed and to what extent they related to learning strategies, cognitive aptitudes, and certain motivational beliefs.

The sample size for the first and second study were $n = 200$ and $n = 281$, respectively. The participants answered self-reported questionnaires, solved math problems, and completed standardized aptitude tests. The mean age of the participants was approximately 18 (might as well give exact value here) and two-thirds (here too) of the sample was male in both studies. The first study allowed for the initial testing of the instruments and the first set of hypotheses. The second study served to confirm the results and to thoroughly explore the research questions.

Structural equation modeling paradigms confirmed that metacognitive experiences, both before and after solving problems, are largely predicted by achievement goals. Specific goals, however, have different implications on the experiences: for example, mastery challenge goals negatively predict reported feeling of difficulty, and mastery approach goals positively predict reported estimation of effort expenditure. Metacognitive self-regulation was indirectly related to motivational beliefs in that the effects of the latter motivational beliefs were mediated by metacognitive experiences before the participant solved the problem. Concerning performance goals (both approach and avoidance forms), these were revealed to be largely independent of online
metacognitive processes. Numerical aptitudes also played a significant but minor role, compared to motivational beliefs, in explaining online metacognitive processes.

The relation between learning strategies and motivational beliefs was modeled as an influence of beliefs related to the course (task value) to the self (perceived competence) and anxiety on achievement goals. Achievement goals directly predicted the use of learning strategies (rehearsal, elaboration, and metacognitive self-regulation). The results confirmed that achievement goals do play a mediating role and that different beliefs are associated with different goals. For example, if both performance avoidance goals and work avoidance goals are linked to anxiety, they are oppositely related to individual interest (intrinsic value for the domain). In fact, performance avoidance goals are positively related to individual interest, whereas work avoidance goals are negatively related to it. In regard to the prediction of learning strategies by achievement goals, mastery approach goals were revealed to be associated both with adaptable strategies (metacognitive self-regulation) and less adaptable strategies (rehearsal). Mastery challenge goals were the most favorable in their relation to learning strategies, predicting the use of elaboration and metacognitive self-regulation, but did not show any association to rehearsal strategies.

Finally, the results addressed the third research question through the revelation of four distinct profiles of achievement goals that were recognized and deduced from the sample. These profiles are significantly different in terms of motivational beliefs (especially individual interest) and learning strategies and are slightly different in terms of cognitive abilities. This reveals that a typological approach can meaningfully represent the type of students in our samples and that a person-centered analysis may bring valuable information for teachers in vocational education.

In conclusion, the rich results of the studies support this thesis and provided a large description of the motivational factors influencing metacognition and learning strategies. The role of achievement goals was especially highlighted, while other beliefs, such as utility value and anxiety, also displayed an important role. Based on the results, recommendations formed from the findings should be brought to teacher training courses for teachers of students in vocational education. This would imply a larger recognition of the students’ motivation and affect and an enrichment of teacher education.

REFERENCES

STRATEGY ACQUISITION AND TRANSFER THROUGH METACOGNITIVE INTERVENTION FOR CHILDREN WITH LEARNING DIFFICULTIES

This study (Bosson, 2008) is part of collaborative research in the Learning Center of the University of Geneva that offers a metacognitive intervention to children with learning difficulties.
Children with learning difficulties are often passive learners who do not spontaneously apply the strategies they know. They also show a lack of metaknowledge, lower executive functioning, and low self-efficacy. Our interventions are aimed at remediation of these factors.

Participants in this study were 16 children between 8 and 12 years of age with learning difficulties and with an IQ above 80. They were divided into evenly distributed experimental and control groups. The study comprised a pretest and two posttests (one just after training and another 9 weeks later) with which we evaluated metacognition, executive functions, mathematics, and French. In between these test sessions, an individual metacognitive training was provided during 12 weeks (one 50-minute session per week), based on both noncurriculum-related tasks (for the metacognitive programs, DELV [Büchel & Büchel, 1997] and PEI [Feuerstein, Rand, Hoffman, & Miller, 1980]) and curriculum-related tasks (mathematics and French). During the intervention, children were indirectly taught cognitive (i.e., comparing and selecting information, note taking) and metacognitive strategies (anticipation, planning, and control) through guided prompting. All sessions were videotaped so that verbalizations and behaviors could be analyzed with a computer program. The application of the strategies and the children’s metacognitive knowledge were evaluated by means of a category system based on different metacognitive theories.

Our hypotheses were that the metacognitive intervention would allow children to acquire cognitive and metacognitive strategies that, in turn, would lead to better performance on the first posttest. We also expected that the learned strategies would be maintained 9 weeks after the intervention (posttest 2) and that the acquired strategies would be transferred to mathematics tasks.

The results showed that, at the first posttest, children from the experimental group used more strategies than children in the control group, but no significant differences existed between the two groups with regard to their performance. We assume that the newly acquired strategies still required too much attention and that this hindered children from increasing their performance. At the second posttest (9 weeks later), we saw an improvement in both the application of strategies and performance. It seems that, over time, the children were able to assimilate the strategies and use them appropriately, leading to better performance.

Although many differences existed, we found transfer of strategies to a mathematical task. The interindividual differences were not related to a general factor such as intelligence (e.g., there is no correlation between IQ and number of strategies transferred), but they were related to more specific factors such as the type of strategies used, the metaknowledge the children had about strategies, and to executive control and motivational factors (self-efficacy).

The metacognitive intervention allowed children with learning difficulties to acquire cognitive and metacognitive strategies and to use them in different types of tasks. We also found that it takes time to completely master these strategies and that they need practice in multiple contexts. However, more research about such metacognitive interventions in a nonlaboratory setting and with more participants is needed in order to confirm these results.

REFERENCES


CULTURE AND COGNITIVE TRANSFER IN CHILDHOOD

The ability to cognitively transfer information from one situation to another is an important element of everyday human intelligence and it has been widely studied (see Barnett & Ceci, 2002, for an extensive review). Nevertheless, some important questions about cognitive transfer remain. One of these questions concerns the notion of context. Previous research has shown that the success of transfer significantly depends on crossing the temporal, physical, or functional boundaries that separate contexts from each other, but the specificity of contexts remains unclear. The hypothesis throughout this dissertation is that a person’s cognitive potential for transfer is a positive function of the amount of information available to him or her. The hypothesis follows from the assumption that the human mind represents information in an associative network. Associations between nodes lead to stable constructs when groups of nodes become more strongly related and boundaries with other nodes become more established. When one has much information available, a new piece of information is able to establish many new associations. With little information available, any new piece of information has less potential.

Information can stem from several sources (Cole, 1996). One source of information is what culture has stored up over culture-historical time and that young children gradually learn from their caregivers. A second source of information is schooling. In school, children are taught many skills they would not learn outside of school. A third source of information is personal experience during the lifetime. The studies in the dissertation address the three sources separately. The first study addresses variation in Raven’s Progressive Matrices (RPM) scores across historical time. The second and third study took place in a tribal community in India. The second study addresses a natural experiment of schooling, and the third focuses on the specificity of representational change.

The first study addresses variation in RPM scores across time and place. RPM are a series of multiple-choice items that assess fluid reasoning. Test takers pick the segment that is missing from the lower right corner of a (usually three-by-three) matrix from the row of alternatives below the matrix. In a meta-analysis that covered 45 countries and 60 years \( N = 244,316 \), we found support for Flynn’s (2007) finding that test performance steadily increases across consecutive generations. In addition, our analysis revealed that country characteristics also explain part of the variation in RPM performance. The Flynn effect is strongest in developing countries, where the largest gains are to be made, and is weaker in developed countries.

The second study involves a natural experiment in which we tried to avoid the correlations of educational age and chronological age and of educational age and socioeconomic status. These correlations complicate any comparison of schooling and everyday cognitive development but are impossible to avoid in Western settings. We took advantage of a specific setting among the Kharwar in India, where the above-mentioned correlations are weak. The sample comprised 201 6- to 9-year-old children who were either enrolled in grades 1 to 4 or were unschooled. Our test battery contained measures of memory, reasoning, picture vocabulary, and
mathematics. The comparison of chronological and educational age revealed that chronological age affects many more tests than educational age. Averaged across all measures, the effect size of chronological age was twice as large as the effect of educational age.

The third study is a longitudinal extension of the second study. To gain a better insight into the roles of chronological and educational age in cognitive transfer, we compared any variation within modes of development across both ages for 191 of the 201 children of the second study by means of a two-wave longitudinal design with a 3-year interval. Analysis showed two distinct processes of development: one that depicts the differentiation of implicit constructs and one that reflects the actualization of mental representation across explicit particulars. This distinction of implicit and explicit representation highlights the availability of different types of information. Analysis of the net development per year revealed a decrease in the effect of chronological age and an increase in the effect of educational age.

The studies in this dissertation have implications for our understanding of the constraints on cognitive transfer and their development. We show that the effects of learning are confined to the domains they address. Thus, while contexts largely overlap when little is known about them, they gradually are better differentiated with growing availability of information. Psychologically, contexts thus grow increasingly different. Transfer becomes more likely when children and adults become more knowledgeable.

REFERENCES

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THE QUALITY OF MEDIATED LEARNING INTERACTION BETWEEN OLDER AND YOUNGER SIBLINGS WITH OR WITHOUT INTELLECTUAL DISABILITY: THE EFFECTS OF MOTHER’S MEDIATION AND SIBLING RELATIONS

Previous studies on mother–child mediated learning experience (MLE) interactions were based on the assumption that the mother is the most meaningful figure for the child’s cognitive development in the formative years (e.g., Klein, 1988, Tzuriel, 1999). Recent research shows that siblings (and peers) were found to serve as meaningful role models to their younger siblings (and peers), thus affecting the child’s cognitive, social, and emotional development (Klein, Feldman &, Zarur 2002, Tzuriel & Shamir 2007). The main objectives of this study were to investigate (a) the amount and quality of MLE interactions (Feuerstein, Rand, & Hoffman, 1979) between older siblings and younger siblings with intellectual disability as compared with the MLE interaction between older siblings and younger typically developing siblings; (b) the effect of situation (free play versus structured learning) on MLE in sibling interaction; (c) the effect of the mother’s quality of MLE on siblings’ MLE; and (d) the relation between the quality of sibling relationships and siblings’ MLE interaction.
The focus of this study was on five MLE criteria: (a) intentionality and reciprocity (focusing), (b) meaning (excitement/labeling), (c) transcendence (expanding), (d) feeling of competence (rewarding), and (e) self-regulation. In addition, we examined two behavioral responses of the younger sibling: verbal behavior and nonverbal behavior.

The sample included 75 pairs of siblings and their mothers, who were divided into three research groups: (a) older siblings at the age of 10.5 to 14 years and young intellectually disabled (ID) siblings at the age of 6.5 to 11.5 years \( (n = 25) \), (b) a comparison group that included typically developing siblings with mental age (MA) gap between pairs similar to that of the ID group \( (n = 25) \), and (c) a comparison group that included typically developing siblings with chronological age (CA) gap between pairs similar to the ID group. The siblings’ and mother–child interactions were videotaped in free-play and structured learning situations and analyzed by the Observation of Mediation Interaction (Klein, 1988). Siblings’ relationships were examined by a questionnaire developed by Furman and Buhrmester (1985). The research findings showed that older siblings in the ID group provided more mediation to younger siblings than older siblings of typically developing children in all MLE strategies except transcendence. Older siblings in the MA group provided significantly more mediation than older siblings in the CA group. It seems that siblings adapt their mediation style according to the cognitive level of the child with which they mediate. Another finding was that younger siblings with ID showed more verbal responses in the interaction with their older sibling than typically developing siblings in the CA group and higher nonverbal responses than those shown by CA or MA groups. This result indicates that the level of mediation the young sibling is willing to accept increases according to the mediator’s effort to mediate. Those older siblings mediated more in the structured condition than in the free-play situation on four MLE criteria: intentionality and reciprocity, meaning, transcendence, and feelings of competence. These findings were repeated in each of the study’s groups, except for mediation for meaning, where the CA group scored higher than the other groups. Of most interest is the finding that, even in the mediation for transcendence, considered to require a higher level of abstraction, the ID group significantly scored higher (in the free-play situation) than the other groups. Positive and significant correlations were found between the mother’s MLE strategies and the older sibling’s MLE strategies. These correlations were especially higher in the CA group than in the other groups. These findings might indicate that older siblings who internalized the mother’s mediation become aware of the needs and difficulties of their younger sibling and consequently adapt their mediation strategies as needed. The siblings’ relationship was found to be significantly related to the quality of the older sibling’s mediation. The higher the older sibling perceived him- or herself as having high status and authority relative to the younger sibling, the higher the quality of MLE strategies he or she revealed. On the other hand, the more conflict the older sibling reported having with the young sibling, the lower the quality of mediation. The older sibling’s conception of parental preference of the younger sibling was positively correlated with the quality of mediation. The findings were discussed in relation to the MLE theory and recent findings on siblings’ mediation in families with children with special needs.

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