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Editorial

The Development of Attitudes and Emotions Related to Mathematics

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Attitudes and emotions regarding mathematics are an important topic, especially in view of the fact that many people have very negative attitude to mathematics, sometimes to the point of serious mathematics anxiety, which is distressing in itself and also tends to impair mathematical performance [1]. Attitudes toward mathematics, and mathematics anxiety in particular, have been topics of interest to researchers for a long time [2–5]. However, until recently most such studies dealt with adolescents and adults and gave relatively little attention to attitudes in younger children, or to the factors that influence their development. There has been increased emphasis on attitudes to mathematics in elementary school children in recent years [6–8]) but the database has still been small, with far more research needed, especially as the results are somewhat conflicting: some studies suggest that mathematics anxiety is rare in young children, and that attitudes only become seriously negative later on, while others suggest that mathematics anxiety is a very significant problem from an early age.

Moreover, perhaps in part as a result of the paucity of research on the early development of attitudes to mathematics, we have relatively little knowledge as yet about their antecedents or even their correlates. We know a certain amount about what attitudes people have toward mathematics, but not very much about why or how they develop. There are also questions to be asked about the specificity of mathematics anxiety, and the extent to which it may reflect more general academic-related anxieties or cognitive difficulties.

This special issue attempts to examine attitudes to mathematics at different ages, with a particular emphasis on early ages and to investigate some of the factors associated with attitudes and emotional reactions toward mathematics.

Research reported in this special issue indicates that young children's attitudes should indeed receive more study, not only for their own sake, but because they may have an influence on subsequent mathematical development. M. M. M. Mazzocco et al. describe a longitudinal study of primary school children's spontaneous comments about mathematics. The children's likability comments were similar for "math" and "reading," but they were more likely to describe math than reading as difficult. Achievement at Grade 3 was predicted by comments at Grade 2. This indicates that young children's spontaneously expressed attitudes to maths can be a predictor of later achievement.

A. Dowker et al. report a study which gives data about primary school children's attitudes to mathematics and leads to some hypotheses about the development of relationships between attitudes and performance. English primary school children in Grades 3 and 5 took a Mathematics Attitude and Anxiety Questionnaire, using pictorial rating scales to record their self-rating for maths, liking for maths, anxiety about maths, and unhappiness about poor performance in mathematics. They were also given the British Abilities Scales Basic Number Skills test. Anxiety as such was not related to actual performance, but self-rating was. Although a relatively small sample size means a need for caution in drawing conclusions, it is of interest that the relationship between self-rating and

actual performance seemed to develop between Grade 3 and Grade 5, suggesting that attitudes and performance may become increasingly linked with age.

G. Wood et al. extend research on young children's attitude development cross-culturally. They describe a study, where they gave German and Brazilian 7- to 12-year-old school children the same Mathematics Anxiety Questionnaire. They found a similar factor structure in both groups, but much more negative attitudes in the Brazilian group. The Brazilian children liked mathematics less than the German children did, were more anxious about it, and were more unhappier if they could not do a mathematics task. They did not, however, differ in their self-ratings of their own performance. Mathematics anxiety increased with age in both groups. In both groups, attitudes were related to actual mathematics performance.

One question that arises with regard to mathematics anxiety is that of whether it is just one form of academic performance anxiety. It is generally assumed that mathematics anxiety is greater than anxiety about other subjects; but it could be argued that this simply reflects a lack of research on anxiety about other subjects. L. Punaro and R. Reeve report a study that compares mathematics and literacy anxiety in Australian 9-year-olds and relates their anxiety to their actual academic abilities. Although children expressed anxiety about difficult problems in both mathematics and literacy, worries were indeed greater for mathematics than literacy. Moreover, anxiety about mathematics was related to actual mathematics performance, whereas anxiety about literacy was not related to actual literacy performance.

A related issue is whether mathematics anxiety really is specific to mathematics, or is just one consequence of general anxiety and/or of difficulties with attention and executive functions, especially in view of Ashcraft and Krause's [1] findings of important links between mathematics anxiety, working memory, and mathematical performance. V. G. Haase et al. report here that psychosocial competencies (general anxiety and attention deficits) and self-rating in mathematics are independent predictors of children's mathematics performance. Moreover, general psychosocial competencies predict both mathematics and spelling performance, while self-rating in mathematics predicts only mathematics performance. This gives support to the view that, though general anxiety and attentional factors do affect academic skills in general, including mathematics, there is also a more specific relationship between attitudes and performance in mathematics, that cannot be reduced to a more general emotional or cognitive problem.

There are many questions to be asked as to what factors lead to individual and perhaps gender and cultural differences in attitudes to arithmetic. M. L. Mata et al. report a study examining several factors that may influence attitudes to mathematics. They investigated Portuguese fifth to twelfth grade pupils' motivation and their perceptions of teacher and peer support and also assessed their attitudes to mathematics. Most pupils had positive attitudes to mathematics. There was no overall gender effect on attitudes, but there was an interaction between gender and grade, such that girls but not boys showed a steady decline in attitudes to mathematics as grade level increased. A hierarchical analysis using structural equation modelling indicated that motivational variables were the strongest predictors of attitudes to mathematics, but that perceived social support from teachers and peers was also a very important factor.

It is often assumed that the quality of teaching in mathematics has an influence on attitudes, and also that attitudes to mathematics influence reactions to the teaching. There had, however, been few studies of the relationships between attitudes to mathematics and pupils' perception of the quality of their instruction. R. Lazarides and A. Ittell report a study of German secondary school pupils perceptions of the quality of their mathematics instruction. Nearly half of the sample perceived their teaching as poor, and girls were more likely than boys to have this perception. There was a strong relationship between such negative perceptions of teaching and experiencing negative attitudes toward mathematics.

Parents are also regarded as a strong influence on their children's attitudes, and in particular intergenerational transmission of attitudes to mathematics is sometimes postulated as important. S. Sonnenschein et al. report a study of parents' beliefs about children's development and about the extent to which their children engaged in mathematics-related activities at home. The children were preschool or in the early years of elementary school. Parents who considered it important to have their children do math activities at home, saw themselves as role models, and considered it as important to involve children in daily living math activities, also reported that their children were in fact more frequently involved in math activities at home. Parents' own enjoyment of math and perception of their own mathematical skills were not related to the extent of their children's engagement in mathematical activities, suggesting that, at least in this age group, the provision of mathematical activities at home was directly related to whether parents thought it was important to do so, but not to their own attitudes to mathematics.

The consequences of attitudes to mathematics are as important as their causes and are here investigated in terms not just of effects on overall performance, but on particular key aspects of mathematics. S. Chinn reports a study, not of the factors that cause mathematics anxiety, but of an important but often neglected consequence: a tendency to avoid attempting mathematics problems at all out of fear of failure. This paper presents data taken from over 2500 mathematics test papers from both children and adults. A large number of responses to questions were in the "no attempt" category; that is, the problems were avoided. This avoidance strategy was more common for multiplication than addition, and commonest of all for division.

Attitudes can also have an effect on the type of strategy used. There have been a number of studies (e.g., [9, 10]) of children's use of derived fact strategies, where they use a known fact, combined an arithmetical principle such as commutativity, inversion, or associativity, to obtain the answer to another problem without performing a full calculation. Here, K. M. Robinson (gave Canadian elementary school children three sets of three-term addition problems, that could be solved by shortcuts involving associativity or inversion. They

were then given an intervention where they were shown how to use the shortcut strategies and a standard algorithm and asked which they preferred. The intervention increased the use of shortcuts for subsequent problems, but more so if they expressed a preference for the shortcuts to the standard algorithm. This shows that attitudes may influence strategy use.

We hope that this special issue will inspire further research on the nature, causes, and consequences of children's attitudes and emotional reactions toward mathematics.

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