Investigating Feelings towards Mathematics among Chinese Kindergarten Children

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Prior to entering schooling settings, many children exhibit intuitive knowledge of mathematics and many have mastered basic addition combinations. However, often as a result of formal instruction, some children begin to dislike or fear mathematics. In this study, children at a kindergarten in China took a smiley-face survey to determine how their feelings and beliefs about mathematics were affected throughout their kindergarten years. Results suggest that even children in this study have a better number sense and mathematics achievement, they appear to develop mathematics anxiety in Chinese cultural context.

Introduction

Many East Asian countries are all more or less influenced by the Confucian-Culture (Tamai & Lee, 2002; Yang, 1993). In Confucius' opinion, schooling is a way to educate government officers (Gao, 1998), resulting in a very strict and competitive examination system, as it aims at selecting the top students. Students and their parents therefore, are very anxious about school test scores, which are considered as a ladder to get into the upper class, and honour the family. Hence, families' involvement in their children's education has become more and more popular, especially, since the one child policy was implemented in 1970s in China (Vaughan, 1993; Zhang & Zhou, 2003).

Parents always have high expectations towards their children. The main family concern is even focused on the child passing the university entrance exam in China. Driven by exams in this cultural context, lecturing and memorization in mathematics education are very important means to help students gain more points in their University Entrance Exams (Zhang, 1998), which put children under high pressure. Watkins and Biggs (1996) have highlighted the effects of an exam-based schooling culture, stating that many students experience academic stress and this can lead to depression and even suicide, sometimes in pre-teenage children.

This study is part of the original research (Sun, 2007) on interrelationship among number sense, achievement in addition, feelings about mathematics, and instructional interventions, and aims at addressing the importance of studying mathematics anxiety in young children.

Literature Review

The mathematical knowledge and skills that children acquire before and during preschool and kindergarten facilitate their understanding of the meaning of numbers and of numerical relationships and therefore lead to later achievement in mathematics (Geary, 1994; Gersten & Chard, 1999), children's positive feelings of self-confidence and low anxiety with respect to dealing with quantitative problems (Gersten & Chard, 1999).

Definition of Mathematics Anxiety

"Mathematics anxiety" has been studied as a topic in mathematics education literature for more than 30 years. However, there is no agreement on its definition. In 1972, Richardson and Suinn (1972) first published a rigorous assessment instrument for examining mathematics anxiety. They defined mathematics anxiety as involving "… feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (p. 551). Other

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researchers have described mathematics anxiety as mathophobia. According to Lazarus (1974), "Mathophobia is an irrational and impeditive dread of mathematics" (p.16). Further, Tobias and Weissbrod (1980) defined mathematics anxiety as a term "to describe the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem" (p.65). It seems that "math anxiety is the beginning of a vicious cycle that leads to educational and societal mathophobes" (Williams, 1988, p.96).

However, mathematics anxiety is not innate, and people do not have mathematics anxious before going to school (Williams, 1988). Suggested causes include teacher anxiety, societal, educational or environmental factors, innate characteristics of mathematics, failure and the influence of early-school experiences of mathematics (Newstead, 1998). Many researchers also believe that most mathematics anxiety has its roots in the teachers and their teaching approaches (Greenwood, 1984; Williams, 1988), one of which is the rote learning with an emphasis on explain-practice-memorize teaching model (Greenwood, 1984; Skemp, 1986).

Some studies further suggest that there is a negative relationship between mathematics anxiety and achievement in mathematics even for children (Hembree, 1990). Later studies indicate that mathematics anxiety also results from the experience of failure in schools to promote the learning of fundamental mathematics skills to mastery levels (Wittman, Marcinkiewicz, & Hamodey-Douglas, 1998). Therefore, mathematics anxiety is the result of lacking knowledge rather than the result of a pre-existing anxiety (Wittman et al., 1998).

It seems that students' confidence in their mathematical ability influences their views of themselves as mathematics learners and their future decisions about studying mathematics (Malofeeva, Day, Saco, & Young, 2004; Valeski & Stipek, 2001). Poor school achievement may have negative effects on motivation, which in turn could undermine learning and future academic performance. On the contrary, children who are confident in their abilities and skills tend to be more successful in their school life and are more likely to attain academic achievement and future learning.

According to Newstead (1998), once formed, "negative attitudes and anxiety are difficult to change and may persist into adult life, with far-reaching consequences" (p. 53). Since mathematics anxiety threatens both performance and participation in mathematics, it makes studies of mathematics anxiety in children, especially preschool children, of extreme importance to help reduce the mathematics anxiety. As China's tradition of putting emphasis on early education, especially children's learning of mathematics (Zhang & Zhou, 2003), the purpose of this study is to investigate whether or not those children who have better mathematics achievement will develop mathematics anxiety at a very young age.

Methodology

Participants

Seventy-two children, aged from 3 to 6 years, enrolled in a public Kindergarten in Baoding, middle sized city in China, participated in this study. These children achieved in the Basic addition facts test and had good sense of number (for details, see Sun, 2007). Children were grouped by year levels: Group K1 consisted of children in their first year of kindergarten; Group K2 consisted of children in their second year of kindergarten, and Group K3 consisted of children in their third year of kindergarten. The specific number, gender and mean age of the children within each of these three groups are displayed in Table 1.

Table 1
Number, Gender and Mean Age of the Children within Each of Three Groups in the Study

Kindergarten Year	Number of Boys	Number of Girls	Mean Age
K1	11	11	3 years, 5 months
K2	13	9	4 years
K3	15	13	5 years, 5 months

Instrument

Each child was tested on the Feelings about Mathematics Smiley-Face Survey. The Feelings about Mathematics Smiley-Face Survey was used to assess children's perceptions of their competence in Mathematics, their feelings and attitudes towards Mathematics. It was adapted from the measurement of Feelings about School developed by Valeski and Stipek (2001), which was used for preschool, kindergarten, and elementary school children to assess their self-perceptions of how they felt about their school. Eight items are included (see Table 2).

Table 2
Feelings about Mathematics Smiley-Face Survey

Item	Question
1	How much do you like mathematics?
2	How good do you think you are at mathematics?
3	How much do you like your mathematics teacher?
4	How much do you like to go to mathematics class?
5	How fun are your mathematics activities?
6	How do you feel when the teacher asks you a question in mathematics class?
7	How much do you worry about making mistakes in mathematics class?
8	How much do you worry about doing things right in mathematics class?

The response scale is 5 points measured by smiling faces ranging from a big frown to a big smile, which indicates children's feelings about each statement and each face is assigned a score of –2, -1, 0, +1, and +2 from the big frown to the big smile respectively (see Figure 1).

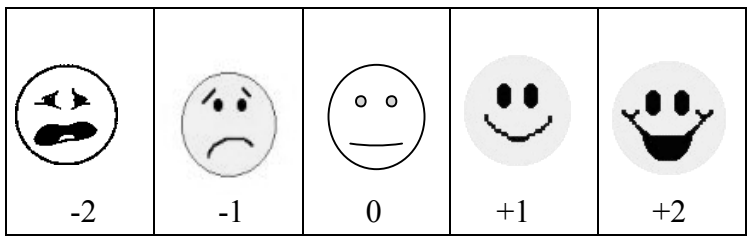

Figure 1. Smiley faces contained on the Smiley Face Survey.

Procedure

Children were asked to colour one of the faces that best represented their feelings.

Administering the Smiley-Face survey was slightly different for each cohort of children (K3, K2, and K1). For K3, the task was completed by students in their usual mathematics class and all children took the test together at the same time. Children were instructed to colour the smiley face that best matched how they felt about each statement on the worksheet. Each statement was read out and children selected the smiley face before proceeding to the next item. They were allowed to use any colours for each selected face. Meanwhile, children were repeatedly told to ask questions at any time if there was something they did not understand.

In a similar fashion to K3, children in K2 took this test together.

Considering children were at very young age in K1 (3 or 4 years old), the procedure used was different. Children were individually interviewed in a separate room that was attached to their classroom to do the survey. When undertaking the survey, the child sat opposite to the interviewer and some preliminary questions were asked, such as "How old are you" and "What is your name"? This was an effort to make each child feel more comfortable before taking the survey. The instructions were explained in detail, and each child was guided to colour the smiley face that matched their feelings for each statement.

Results

K3 Responses to Smiley-Face Survey

Twenty-eight K3 (15 boys and 13 girls) children completed the Smiley-Face Survey. The age of the children ranging from 4 years and 8 months (56 months) to 6 years 5 months (77 months) with the average age of the K3 children being 5 years and 5 months (65 months) at the date of the test.

The children's individual responses to the survey items were tabulated. A single score for each child was determined by totalling responses. As each face was assigned a value between –2 and +2, each child's total score could range from -16 to +16. Using this as a scale, a child's overall score could be predominantly positive or predominantly negative.

Four children (two boys and two girls) selected the extreme smiley face for all survey items, with a total score of +16. In terms of predominantly positive scores, there was only one female child who scored +15, and two other children (one boy and one girl) scored +14.

A second analysis was to look at scores around +8 and -8, to indicate moderate positive and negative responses. One child had a score of +10, one child had a score of +8, and ten children had scores between +5 and +7. Nine children had scores between +4 and -3 suggesting that many children had relatively neutral feeling about mathematics. Three of them had negative scores of -1, -2, and -3 respectively.

To look more closely at how children responded to each of the survey items, the number of children who responded to each particular smiley face for each survey item was totalled. Results suggested that the majority of children selected positive response for most of the items although a considerable number (approximate up to 25%) selected neutral responses for many items. The figures were then recalculated to more clearly indicate positive, negative, and neutral responses by collapsing columns together. Hence, if children selected either of the two positive faces, the scores were grouped to indicate a positive response, and if children selected either of the two negative faces, their score was indicated as negative.

The item that drew the strongest response was item 8 (How much do you worry about doing things right in mathematics class?) with 82% indicating that they were worried about doing things right. Twenty-five percent of the total was worried about making mistakes. The item that drew the most equal number of responses across all three categories (negative, neutral, and positive) was item 6 (How do you feel when the teacher asks you a question in

mathematics class). Thirty nine percent of the children had negative feelings about this item, whereas only thirty six percent of the children had positive feelings, and 25% were neutral.

Little gender difference was found in terms of responses to items. However, when positive and negative responses are collapsed into one category a slightly different pattern emerges. Compared with boys, girls in K3 are likely to give positive answers. The score shows that girls (85%) like mathematics more and they liked to take mathematics class. In general, K3 boys cared more about making mistakes in mathematics class than girls with 53% and 23% respectively. It also appears that, more girls (85%) worried about doing things right in mathematics class (Item 8). Interestingly, more boys (67%) felt strongly positive about this question. Most of children liked their mathematics teacher (Item 3), although 2 boys indicated they had negative feeling about their mathematics teacher. No girl indicated having negative feeling about their mathematics teacher.

K2 Responses to Smiley-Face survey

Twenty-two K2 children participated in the Smiley-Face survey. There were thirteen boys and nine girls. The oldest child in K2 was 5 years and 1 month old (61 months) and the youngest was 4 years old (48 months) at the date of the survey. The average age of the K2 children was 4 years and six months (54 months).

Generally K2 Children were positive and confident. Only one boy in this class felt not satisfied with his mathematics performance at all with a score of -2 (Item 2), while two children scored -2 on Item 1 (How much do you like mathematics?), which indicated that they disliked mathematics.

Two girls responded positively to all total items with a score of +16. Seven children (4 boys and 3 girls) had predominantly positive feelings about mathematics with a total score ranging between +12 and +16. In terms of moderate positive and negative response, there were 5 children whose scores were between +8 and +12. Two boys got the total score of +7 and +4 respectively, which indicated that they had a somewhat positive feeling, while one boy had a somewhat negative feeling with a score of -5. Five children had a score between -4 and +4, which showed they had relative neutral feelings.

Results also indicated that children who were above their average age felt mathematics activities were interesting and liked to take mathematics class more than the children who were under their average age.

The number of children who responded to each particular smiley face for each survey item was totalled. The figures were then collapsed to indicate positive, negative, and neutral responses.

Item 1 (How much do you like Mathematics?) drew the strongest positive response with 77% of the K2 children indicating that they had very positive feelings. Results also indicated that eighty-six percent of the children liked mathematics. The item that drew the strongest negative response was item 7 (How much do you worry about making mistakes in mathematics class?) with 32% of the total indicating that they worried about making mistakes in mathematics class. Seventy-three percents of the total worried about doing things right in mathematics class (item 8).

Girls in K2 were unlikely to give negative responses, while the boys were more worried about making mistakes and doing things right in mathematics class than girls (item 7) with 46% of the boys and only 11% of the girls indicating that they had negative feelings. In addition, girls were more confident as there were 67% of them scored +2 on Item 2 (How good do you think you are at mathematics), whereas, only 38% of the boys scored +2 on this item. There was no girl who gave negative response to item 2. Another interesting finding was that all girls in K2 had positive feelings about being questioned in mathematics class (item 6).

K1 Children's Responses to Smiley-Face Survey

Twenty-two K1 children (11 boys and 11 girls) undertook the Smiley-Face survey. The youngest child in K1 was 2 years and 11 months old (35 months), while the oldest was 4 years and 1 month old (49 months). The average age was 3 years and 5 months (41 months).

There are some differences in gender and age groups. Children who were under the average age liked mathematics more than those children who were beyond the average age. There was only one girl who got a negative point with a score of -2 in total. Four other children (two boys and two girls) whose scores ranged between +12 and +16, which indicated they had predominantly positive feelings about mathematics. There were 6 children (three boys and three girls) who had moderate positive feelings with a score between +8 and +12. Eight children who scored from +4 to +8 had somewhat positive feelings. The other four children had neutral feelings. No children with negative feelings were found in K1.

The item that drew the strongest positive response was item 3 (How much do you like your mathematics teacher?) with a percentage of eighty-six.

Fifty-five percent of the boys chose the big smiling face for item 2 "How good do you think you are at mathematics", which showed that they were more confident than girls (with a percentage of twenty-seven). Forty-five percent of the girls had neutral feeling about this item. Ninety-one percent of the K1 girls felt mathematics activities were interesting, whereas only 55% of the boys felt the same way.

Cross Age Analysis

A cross-age analysis of children's responses to the smiley-face survey was conducted. It appears that as children grow older and move through K1 to K2 and K3, they do not like to go to mathematics class. There is also a rising percentage of negative response to item 5, which also indicates that children do not think their mathematics activities are as fun as they used to think. The percentage of positive responses to their feelings about their mathematics teachers shows a decline as well. It is interesting to note that in K1, the number of children who stated that they liked mathematics was 68%, which increased to 86% in K2. However, in K3, the percentage is 68% with an increasing number of neutral responses given (21%). Of all levels, K2 children were the most confident about how good they are at mathematics (Item 2) with 82% positive responses as opposed to 55% and 68% for K1 ands K3 respectively. Also, K2 children indicated that they liked to be asked questions in mathematics class more than K1 and K3 children (Item 6). But interestingly, K2 children were the ones who did not like to go to mathematics class, as there were only 59% of the K2 children who held positive opinion on item 4. However, all children appear to become more worried about doing things right in mathematics class, as they are getting older (Item 8), with the percentage of children who gave positive responses to this item being 59% in K1, 73% in K2 and up to 82% in K3.

To look at responses to the survey in total, all K1, K2 and K3 responses were combined. Responses to all items are predominantly positive although around 20% of responses are neutral. Results indicate that boys' responses are predominantly more negative than those given by girls. Girls thought mathematics activities were more fun (Item 5) and they were more positive about being questioned in mathematics class (Item 6). However, girls were much more worried about making mistakes in mathematics class than boys (Item 7), but about the same number of boys as girls indicated that they worried about doing things right in mathematics class (Item 8).

Discussion

A large body of literature (Fuchs, Fuchs, & Karns, 2001; Funkhouser, 1995; Ginsburg, 1997; Griffin, Case, & Siegler, 1994; Van Luit & Schopman, 2000) links number sense to

mathematics achievement, describing how one supports the other. Research (e.g., Malofeeva et al, 2004) has also argued that if children have good number sense, they will not only perform better on tasks, but will have high confidence. Yet, the findings of this study are in contrast to the strong relationship reported between a child's level of confidence and his or her scholastic mastery (Malofeeva et al., 2004; Valeski & Stipek, 2001). Results suggest that performance on the number sense and mathematics achievement is not related to children's feelings of self-confidence in mathematics.

A link between teaching approaches, length of time in kindergarten, and children's attitude towards mathematics was found in this study. Findings suggest that formal mathematics instructions may help children develop their number sense and do well on basic fact tests. However, children appear to develop mathematics anxiety through the kindergarten years and formal direct instruction on mathematics in the early years may be one of the reasons why children in this study have mathematics anxiety. This finding is echoed in the literature that identified mathematics anxiety in children at a very young age (Hembree, 1990; Newstead, 1998).

Young children are supposed to be in a rich and meaningful environment to study (Clements & Sarma, 2005; NCTM, 2000), in order to build on their intuitive mathematics knowledge. Especially in the early years, education should not focus on teaching children how to do the achievement tests, but to offer them a better way to build up their knowledge and enjoy learning.

Research by Walkins and Biggs (1996) suggested that many Chinese children experience academic stress from a very early age. It is widely accepted that Chinese parents have extremely high expectations of their single child's academic success, and this study has provided a glimpse of the early onset of mathematics anxiety. Clearly the children in this study are developing good number sense, but would a more relaxed and informal classroom environment achieve the same results and make children less mathematics anxious? Answering this question is beyond the focus of this study and is something worth considering in further research.

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