



BISHOP
GROSSETESTE
UNIVERSITY

[BG Research Online](#)

Compton, A. and Unwin-Berrey, A. (2018). I can do it: Year 3 children's perceptions of mathematics lessons identified through their drawings. *Research Proceedings of the 9th British Congress on Mathematics Education*. p.24-31.

This is the final, published version of a document published by British Congress on Mathematics Education on 7 November 2018 at

<http://www.bsrlm.org.uk/wp-content/uploads/2018/11/BCME9-Research-Proceedings.pdf>

Copyright is retained by the author/s and/or other copyright holders.

End users generally may reproduce, display or distribute single copies of content held within BG Research Online, in any format or medium, for personal research & study or for educational or other not-for-profit purposes provided that:

- The full bibliographic details and a hyperlink to (or the URL of) the item's record in BG Research Online are clearly displayed;
- No part of the content or metadata is further copied, reproduced, distributed, displayed or published, in any format or medium;
- The content and/or metadata is not used for commercial purposes;
- The content is not altered or adapted without written permission from the rights owner/s, unless expressly permitted by licence.

For enquiries about BG Research Online email bgro@bishopg.ac.uk.

I can do it: Year 3 children's perceptions of mathematics lessons identified through their drawings

Ashley Compton¹ and Adam Unwin-Berrey²

Bishop Grosseteste University, UK¹; Academies Enterprise Trust, UK²

This research involved children drawing themselves in a mathematics lesson, in order to access some of their perceptions about mathematics lessons. Drawings can provide a rich source of data and allow children to communicate emotional and social characteristics while focusing on other features that are important to them. The sample was 234 Year 3 pupils (7 and 8 years of age) from ten primary schools in Lincolnshire, England. The drawings were analysed for teacher-pupil interactions, pupil-pupil interactions and pupils' perceptions of themselves as learners of mathematics, using a coding system devised for a similar study in Finland. The majority of pupils indicated perceived competence in mathematics. Some gender differences were noted in terms of teacher position and teacher-pupil interactions. Teacher-pupil interactions are an important aspect of mathematics lessons which emphasise communicating reasoning, so teachers should be aware that girls and boys may perceive teacher-pupil interactions differently.

Key Words: Mathematics; competence; teacher-pupil relationships; drawings

Introduction

The National Curriculum for mathematics in England is underpinned by three aims: conceptual fluency, reasoning and problem solving (Department for Education, 2014). These involve explaining your thinking to others, such as the teacher or other pupils (Askew, 2016; Zijlstra, Wubbles, Brekelmans, & Koomen, 2013). However, many people, including some teachers, have a more limited view of mathematics as calculations and procedures that must be memorised and performed quickly, which can result in maths anxiety and negative attitudes towards mathematics (Boaler, 2016). The 2012 PISA results of English 15-year olds found higher maths anxiety in girls, along with lower confidence and motivation, even in those achieving the same scores as the boys (Organisation for Economic Co-operation and Development [OECD], 2013). There were also gender differences in English children's performance on the TIMSS and PISA international tests, with boys outperforming girls at Year 5 and 15 years old (Mullis, Martin, Foy, & Hooper, 2016; Greany, Barnes, Mostafa, Pensiero, & Swensson, 2016; Jerrim & Shure, 2016).

Links between confidence and competence have also been found with younger children and these are further related to teacher-child relationships. Stephanou's (2014) research, with 200 kindergarten children in Greece, found that the more positive children were about their relationship with the teacher, the higher their attainment in mathematics, beliefs in their own competence and motivation. Zijlstra et al. (2013), studying 828 first and second grade children and 40 teachers in Dutch primary schools,

found a positive correlation between children's attainment in mathematics and their perceptions of their teacher as friendly, organised and helpful. The opposite has also been found, with negative perceptions of the teacher-child relationship associated with lower attainment; gender differences were a factor, with teachers reporting more frequent negative relationships and conflict with boys (Koepke & Harkins, 2008; McFarland, Murray, & Phillipson, 2016; White, 2016). Relationship issues between boys and teachers have also been identified in the UK (Myhill & Jones, 2006).

Pupil perceptions are often gathered through direct approaches, such as questionnaires and psychometric tests involving Likert rating scales (Stephanou, 2014; Zijlstra et al., 2013; McFarland, Murray & Phillipson, 2016), although in a comparative study Harrison, Clarke and Ungerer (2007) found that the indirect approach of asking children to draw a picture proved to be a better measure of teacher-pupil relationships. Observations have also been used but these have been found to vary depending on factors such as length and timing (Pianta & Cash, 2004).

Leitch (2008) and Hannula (2007) consider the use of children's drawings in research to provide a richer source of data and to support children in communicating both their emotional and social worlds, compared with more traditional research tools such as interviews and questionnaires. Barlow, Jolley and Hallam (2010) noted that drawings encourage children to include more details than they would in discussion, without having to ask leading questions. Drawings are a way that children share their perceptions of the world and identify aspects that are important to them, even when they struggle with the vocabulary to communicate these verbally (Papandreou, 2014; Cugmas, 2004). Within the research setting of mathematics classrooms Dahlgren and Sumpter (2010) suggest drawings may be used to support inferences regarding the pedagogical approach regularly experienced by pupils during the teaching of mathematics. These views are supported by Selwyn, Boraschi and Ozkula (2009), who also emphasise the greater opportunities that drawings give to children to express themselves, although they concede that a lack of artistic skill can be a constraint.

There have been several studies about young children's perceptions of mathematics using drawings as a research method. Perkkilä and Aarnos (2009) asked 300 six to eight-year olds in Finland to draw themselves in math land. The researchers analysed the emotions portrayed in the pictures and found that girls were more likely to display joy (53% v. 21%), whereas boys were more likely to draw sad expressions (19% v. 5%). However, it may be that the girls were conforming to stereotype pressures on girls to present themselves as cheerful rather than this indicating a greater liking of mathematics.

Towers, Takeuchi and Martin (2018) also looked at young children's emotions and mathematics, with 46 four to nine-year old children in Canada. They used semi-structured interviews, alongside asking children to complete two drawings: one which showed how they felt while doing mathematics and another that showed what mathematics is. The children in this study drew very different images of mathematics to those in Perkkilä and Aarnos' (2009) study, which were mostly outdoors and focused on real-world applications of mathematics. The children Towers et al. (2018) studied mostly drew children in school. These drawings gave access to many details about the learning environment and included features that the children had not spoken about. Towers et al. (2018) reported that the young children were generally positive about mathematics, but they also identified that children were already forming ideas about mathematics being hard or easy and whether they were able to do mathematics. They reported that both perceptions were problematic and recommended that early years teachers explore these ideas about mathematics with children.

Borthwick (2011) analysed 162 drawings completed by primary aged children from four schools in Norfolk to determine the children's perceptions about their mathematics lessons. She looked at emotions and attitudes in mathematics lessons, perceptions of peers, perceptions of the teacher and the type of mathematics presented. The drawings showed a range of emotions but, similar to Perkkilä and Aarnos (2009), there was evidence that younger boys were already showing disaffection for mathematics. A factor that led to this disaffection, determined through the drawings and interviews, was the teaching approach that had children seated in groups but working independently, although they would rather work as a group.

Foley (2015) was particularly interested in girls' perceptions of mathematics and their identity as mathematicians. She used a wide range of data collection methods with 14 eight and nine-year old girls from a single class. She was determined to ensure that the girls' voices were heard so included methods such as the children drawing themselves doing mathematics and then annotating the picture to explain what they were thinking. Similar to Towers et al. (2018), most of the drawings showed mathematics as number and calculation, taking place in a classroom at a desk. The majority of these showed mathematics to be a solitary activity, as found by Borthwick (2011).

All of these authors (Borthwick, 2011; Foley, 2015; Perkkilä & Aarnos, 2009; Towers et al., 2018) commented that children's drawings were an effective method for eliciting children's perceptions about mathematics. The children responded easily to the task of creating a drawing related to mathematics. These were often annotated by the child or followed up with interviews to assist in interpreting the drawing.

Methodology

This study was modelled on research undertaken by Tikkanen et al. (2001) from Helsinki University, about third-graders' drawings of mathematics lessons in Finland, because the Finnish team requested that a parallel study be done in England for comparative data. The core research question was: *What are children's perceptions of mathematics classrooms?* The aspects considered were: teacher-pupil interactions; pupil-pupil interactions and perceptions of mathematics. The participants were 7 and 8 year olds in Year 3 (n=234, 119 boys and 115 girls) from 10 primary schools in Lincolnshire, United Kingdom. The schools ranged in size, number of children eligible for free school meals, children with English as an additional language and children with Special Educational Needs. However, results of national testing in Year 6 showed that children from these schools showed above average attainment in mathematics. This may be due to schools being recruited through teachers who had completed the MaST (Mathematics specialist teachers) programme taught by the researchers.

Informed consent was obtained from the headteachers of the schools, the teachers involved in the study and the parents of the children. Informed consent from the children was obtained by explaining the purpose of the study orally and providing the children with the option of not submitting their drawing. Only one child chose not to take part. One of the researchers instructed the class of children:

Draw yourself in a maths lesson. Use speech and thought bubbles to show what different people are saying or thinking. Label yourself as 'me' on the drawing.

The researcher and class teacher acted as a scribe for the speech / thought bubbles if requested. Explanations of what was happening in the picture were either written on the back by the pupil or verbalised by the pupil and then recorded by an adult. This is in accordance with suggestions that children should be given the opportunity to explain

their drawing rather than it being left entirely to the adult's interpretation (Leitch, 2008; Cugmas, 2004).

The drawings were analysed using codes developed by Tikkanen et al. (2011) that related to the teacher's position in the class, teacher's interaction with pupils, interaction between pupils, perceptions of mathematics, teacher-centred and pupil-centred working methods. This resulted in some difficulties because the Finnish codes did not always fit the English context, particularly those related to working methods, which is why those aspects are not discussed in this paper. Each coding category included the option of 'non-recognisable', which accounted for a lack of evidence (e.g. no teacher drawn in the picture), an inability to interpret that aspect of the drawing (e.g. scribbles rather words in the speech bubbles) and data which did not fit other codes. Coding was done by the researcher who had gathered the data, which allowed knowledge of the setting to inform interpretations, though may introduce bias. A sample of the coded drawings was exchanged to check inter-rater reliability. Where differences occurred, these were discussed between the researchers and then clarified with the Finnish team who devised the codes. The subsequent sample check had identical coding from both researchers. Frequency tables were used to organise the data.



Figure 1 Example of drawing from a boy (I can do it / It is easy)

Figure 1 is an example of a pupil's drawing. In this picture there are three pupils, with the teacher standing at the whiteboard. There is an addition on the board with 'rainbows', which are meant to indicate that the numbers should be partitioned with the tens added together and the ones added together. Two of the children make comments related to competence ('I can do it' and 'It is easy'). The data analysis codes for this picture are: teacher position at whiteboard; teacher gives mathematical instruction through explicitly pointing at the board; several pupils separately remark / think in connection to the instruction; pupil thinks mathematics is easy; pupil can do mathematics. The type of mathematics was not coded but most drawings showed number and calculation, as found by Towers et al. (2018) and Foley (2015).



Figure 2 Example of drawing from a girl (Millie is right)

Discussion of findings

Statistical tests, including chi squared, were used to check the significance of outcomes grouped by schools and gender. Gender differences are often researched in education but this is a complex area, with questions raised about whether these promote equality or entrench stereotypes by ignoring the intersections that gender has with other factors such as race and class (Dhar, 2014). Three aspects were found to be significant with gender: teacher position $\chi^2(3, N = 234) = 15.39, p = .02$; teacher-pupil interaction $\chi^2(7, N = 234) = 15.9, p = .03$ and perceptions of mathematics (Fisher's Exact Test) $p = .01$. Boys were more likely than girls to draw the teacher away from them, at the board (Figure 1) or teacher's desk, or draw no teacher. While many girls did draw the teacher at the board, it was more common for girls to draw the teacher among the pupils (Figure 2). Grouping data by school did not prove significant, which means that the differences in the pictures result from differing perceptions of shared experiences. This suggests that interpreting the drawings as an indicator of typical practice should be considered with some caution. During a lesson it is common for teachers to move about and interact with pupils in different ways. Therefore, it is likely that there were times when the teacher was at the board and other times when the teacher was among the pupils so both perceptions could be accurate. Nevertheless, the differences in position might be an indication of what teacher position the child subconsciously perceives as more important to her or his learning.

There was a wide range of responses for teacher-pupil interaction. Both genders had a large number coded 'teacher is quiet' because they did not include speech bubbles or other indications of communication, such as pointing at mathematical instruction on the board (Figure 1). Where communication was evident, boys were most likely to show mathematical instruction or behavioural orders. Girls included even more behavioural orders but were far more likely than boys to show the teacher giving positive feedback (Figure 2) or asking questions. These findings are consistent with research into the gender differences in teacher-pupil relationships, where girls have warmer relationships (Koepke & Harkins, 2008; McFarland, Murray, & Phillipson, 2016; White, 2016). According to Papandreou (2014) drawings allow children to focus on aspects of the

experience which are important to them. Therefore, it may be that boys see the teacher as a more distant figure and have a greater focus on the instructional elements, while girls may focus more on physical closeness with the teacher and emotional closeness through receiving positive feedback. However, it is also possible that children's drawings were reflecting gender stereotypes, rather than true perceptions.

The category 'Pupils are competent' was identified through what the child said in speech bubbles (e.g. I can do it.), through the teacher's praise (e.g. Well done) or through the pupil showing the correct answer to a mathematical task in the drawing. Both Figure 1 and Figure 2 show children who are confident about their mathematical ability. In the boy's picture (Figure 1) the two other children have thought bubbles which indicate competence and confidence, although the artist's own competence is unknown since there is no speech bubble or other clues. The girl (Figure 2) has demonstrated her competence by getting the right answer to the question on the board ($6+6=12$) and by receiving praise from the teacher. Competence in mathematics was by far the most frequent code in this category for both genders. In the discussion of the sample it was noted that the English schools participating in the study were broadly typical of English schools except for above average test results in mathematics. Therefore, the sample might be skewed towards higher competence in mathematics which would impact on the generalisability. However, the TIMSS 2015 data for Year 5 found England to be in the top ten countries for confidence, which correlated with increasing competence (Mullis et al., 2016), so this may be an accurate portrayal. It was very rare for either gender to show a child asking for help. This could be due to the high levels of competence being displayed or may relate to a classroom ethos that discourages seeking help.

There were some drawings which presented polarised views regarding confidence and competence in mathematics, with pupils identifying themselves as "good at mathematics", while identifying peers as unhappy with mathematics or unable to do questions. Such polarisation may suggest pupils are developing the common misconception that people either can or cannot do mathematics (Boaler, 2016). However, it may also indicate an attempt to emphasise their own level of competence by contrasting it with their peers' ability. Several examples of this type of drawing came from children sitting in the same row, with the drawing process accompanied by giggling, and so may have been a form of teasing rivalry rather than a serious perception of their own and their peers' abilities.

Girls were more likely than boys to comment on mathematics being difficult or easy, with nearly twice as many choosing difficult. It is not clear whether the children who rated mathematics as difficult saw this as positive (i.e. a challenge) or negative (i.e. beyond their capabilities). Boys were more likely than girls to comment on whether mathematics was fun or boring, with slightly more choosing fun. However, all 10 of the drawings which showed mathematics as boring were from boys. This may be evidence of the early disaffection in boys noted by Borthwick (2011).

Conclusions

This is a small-scale study so any conclusions must be considered with caution and should not be assumed to be generalisable. Further caution should be exercised since this study was about children's perceptions of their mathematics lessons, rather than attempting to determine what was objectively happening in these lessons. Although teachers need to be careful not to make stereotypical gender assumptions about children, gender differences were found in the data. This study found that perceptions

about teacher position and teacher-child interactions differed by gender, which suggests that teachers should consider not only their physical position and interactions but also how these may be perceived by the children. There were further gender differences regarding perceptions of mathematics as easy or hard, boring or fun. Since teacher-child relationships and perceptions about mathematics have been found to impact on confidence, competence and commitment to mathematics (Towers et al., 2018; Stephanou, 2014; Zijlstra et al., 2013), teachers may benefit from exploring the perceptions their own pupils have of mathematics. The pupils' attitudes towards mathematics in this study were generally positive and the majority of pupils positioned themselves as people who could do mathematics but there was little evidence of being willing to ask for help. In order to address perceptions of mathematics being too hard, teachers might need to encourage a classroom ethos that encourages children to ask for help. This may help to develop further positive perceptions towards mathematics, including the belief that all can learn mathematics.

References

- Askew, M. (2016). *Transforming primary mathematics: Understanding classroom tasks, tools and talk*. Abingdon: Routledge.
- Barlow, C. M., Jolley, R. P., & Hallam, J. L. (2010). Drawings as memory aids: Optimising the drawing method to facilitate young children's recall. *Applied Cognitive Psychology*, 25, 480-487.
- Boaler, J. (2016). *Mathematical mindsets*. San Francisco: Jossey-Bass.
- Borthwick, A. (2011). Children's perceptions of, and attitudes towards, their mathematics lessons. In C. Smith (Ed.), *Proceedings of the British Society for Research into Learning Mathematics*, 31(1), 37-48.
- Cugmas, Z. (2004). Representations of the child's social behavior and attachment to the kindergarten teacher in their drawing. *Early Child Development and Care*, 174(1), 13-30.
- Dahlgren, A., & Sumpter, L. (2010). Children's conceptions about mathematics and mathematics education. In K. Kislenko (Ed.), *Proceedings of the MAVI-16 Conference*, (pp. 77-88). Estonia: Tallinn University of Applied Sciences.
- Department for Education. (2014). *National curriculum for mathematics*. London: Department for Education.
- Dhar, D. (2014). *Education and gender*. London: Bloomsbury.
- Foley, C. (2015). Girls, mathematics and identity: Creative approaches to gaining a girls' -eye view. In G. Adams (Ed.), *Proceedings of the British Society for Research into Learning Mathematics*, 35(3), 43-48.
- Greany, T., Barnes, I., Mostafa, T., Pensiero, N. & Swensson, C. (2016). *Trends in Maths and Science Study (TIMSS): National report for England*. London: Department for Education.
- Hannula, M.S. (2007). Finnish research on affect of mathematics: Blended theories, mixed methods and some findings. *ZDM The International Journal on Mathematics Education*, 39(3), 197-203.
- Harrison, L., Clarke, L., & Ungerer, J. (2007). Children's drawings provide a new perspective on teacher-child relationship quality and school adjustment. *Early Childhood Research Quarterly*, 22, 55-71.
- Jerrim, J., & Shure, N. (2016). *Achievement of 15 year olds in England: PISA 2015 national report*. London: Department for Education.

- Koepke, M., & Harkins, D. (2008). Conflict in the classroom: Gender differences in the teacher-child relationship. *Early Education and Development, 19*(6), 843-864.
- Leitch, R. (2008). Creatively researching children's narratives through images and drawings. In P. Thomson (Ed.), *Doing visual research with children and young people* (pp. 37–57). London: Routledge.
- McFarland, L., Murray, E., & Phillipson, S. (2016). Student-teacher relationships and student self-concept: Relations with teacher and student gender. *Australian Journal of Education, 60*(1), 5-25.
- Mullis, I. V. S., Martin, M. O., Foy, P., & Hooper, M. (2016). *TIMSS 2015 International Results in Mathematics*. Retrieved from <http://timssandpirls.bc.edu/timss2015/international-results/>
- Organisation for Economic Co-operation and Development. (2013) *PISA 2012 Results in Focus*. Retrieved from <http://www.oecd.org/pisa/keyfindings/pisa-2012-results.htm>
- Papandreou, M. (2014). Communicating and Thinking Through Drawing Activity in Early Childhood, *Journal of Research in Childhood Education, 28*(1), 85-100.
- Perkkilä, P., & Aarnos, E. (2009). “Me in the land of mathematics”: Children's drawings and gender issues. *IOWME Newsletter, 23*(1), 6-11. Retrieved from http://www.mathunion.org/fileadmin/ICMI/files/IOWME/newsletters/newsletter_23_1_june_09.pdf
- Selwyn, N., Boraschi, D., & Ozkula, S. M. (2009). Drawing digital pictures: An investigation of primary pupils' representations of ICT and schools. *British Educational Research Journal, 35*(6), 909-928.
- Stephanou, G. (2014). Feelings towards child-teacher relationships, and emotions about the teacher in kindergarten: effects on learning motivation, competence beliefs and performance in mathematics and literacy. *European Early Childhood Education Research Journal, 22*(4), 457-477.
- Tikkanen, P., Ahtee, M., Pehkonen, E., Laine, A., Heinilä, L., & Näveri, L. (2011). Mathematics lesson in third-graders' drawings. In M. Kontoniemi, & O.-P. Salo (Eds.), *Educating teachers in the PISA paradise. Perspectives on teacher education at a Finnish university* (pp. 187–203). University of Jyväskylä: Publications of the Jyväskylä normaalikoulun.
- Towers, J., Takeuchi, M., & Martin, L. (2018). Examining contextual influences on students' emotional relationships with mathematics in the early years. *Research in Mathematics Education, 20*(2), 146-165. <https://doi.org/10.1080/14794802.2018.1477058>
- White, K. (2016). “My teacher helps me”: Assessing teacher-child relationships from the child's perspective. *Journal of Research in Childhood Education, 30*(1), 29-41. <https://doi.org/10.1080/02568543.2015.1105333>
- Zijlstra, H., Wubbles, T., Brekelmans, M., & Koomen, H. (2013). Child perceptions of teacher interpersonal behaviour and associations with mathematics achievement in Dutch early grade classrooms. *The Elementary School Journal, 113*(4), 517-540.