Mathematics: A Place of Loving Kindness and Resilience-Building

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Abstract:
Places of mathematical learning are not always places of loving kindness. Instead, they are sometimes loci of undetected cultural violence (Galtung, 1969) and associated harm. We explore how Cousin's (2015) interpretation of love in the context of early years relates to building mathematical resilience across the lifespan. Our interpretation of loving kindness in the context of older learners includes unconditional positive regard (Rogers, 1961) and the explicit building of this into the classroom milieu. Education is understood in this work in a broad sense, not only as a means of acquiring knowledge and skills, but also an arena for making connections and gaining a shared understanding about what it is to be human (Tagore, 1933). One of the tools found helpful in the practice of loving kindness, especially where learners have experienced significant prior harm, is the growth zone model (Lugalia, Johnston-Wilder, & Goodall, 2013), informed by the hand model of the brain (Siegel, 2010) and the relaxation response (Benson, 2000). With unconditional positive regard, and with such tools, learners may be empowered to become less avoidant and more engaged with mathematics. They may also acquire resilience, including coping skills, to take on greater challenges, once perceived as dangerous. Loving kindness in mathematics is enabling.

Keywords: mathematics education; mathematical resilience; loving kindness; unconditional positive regard; conditions of worth

Mathématiques : Un lieu d'amour bienveillant et de renforcement de la capacité de résilience

Résumé :
Les lieux d'apprentissage de mathématiques ne sont pas toujours des lieux d'amour bienveillant. Au contraire, ce sont des fois des centres de violences culturelles non-détectées (Galtung, 1969) et, en relation, du mal. Nous explorons la relation entre l'interprétation d'amour en contexte des jeunes années proposé par Cousin (2015) et le développement d'une capacité de résilience en mathématiques tout au long de la vie. Notre interprétation de l'amour bienveillant en contexte des étudiants plus âgés, inclut un regard positif inconditionnel (Rogers, 1961) et sa mise en œuvre expresse dans le milieu scolaire. L'éducation, compris au sens large du terme, n'est pas seulement un moyen d'accumuler des connaissances et des compétences, c'est une scène pour établir des liens et acquérir une compréhension commune de ce que signifie être humain (Tagore, 1933). Un des outils jugés nécessaire dans la pratique de l'amour bienveillant, particulièrement là où les apprenants ont une expérience significative des méfaits antérieurs, est le modèle de zone de croissance (Lugalia, Johnston-Wilder, & Goodall, 2013), enrichi du modèle du cerveau dans la main (Siegel, 2010) et de celui de la réponse de relaxation (Benson, 2000). Avec un regard positif inconditionnel et de tels outils, c'est fort possible que les apprenants soient capables de devenir moins évitants et à s'investir dans les mathématiques. Ils pourraient également acquérir une capacité de résilience, y compris des stratégies d'adaptation, afin d'assumer des défis plus difficiles, une fois considérée dangereux. L'amour bienveillant en mathématiques est habilitant.

Mots clés : éducation en mathématiques; capacité de résilience; amour bienveillant; regard positif inconditionnel; conditions supposées nécessaires

Although mathematical learning in the early years typically benefits from an atmosphere of loving kindness, that atmosphere is not typically experienced in older school mathematics. Indeed, some older learners may feel threatened by school mathematics. They may develop *mathematics anxiety*, a phenomenon studied for over 60 years (Dowker, Sarkar, & Looi, 2016) and defined as a "feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in ordinary life and academic situations" (Hopko, Mahadevan, Bare, & Hunt, 2003, p. 648). A report on mathematics anxiety in the UK (Carey, Devine, Hill, Dowker, McLellan, & Szucs, 2019) highlights the prevalence of mathematics anxiety, even in children as young as six years. The research concludes that mathematics anxiety is debilitating.

In this paper, we define *mathematical resilience* as maintaining self-efficacy in the face of perceived personal or social threat in the context of mathematics. We take loving kindness in school mathematics classrooms to mean explicit opposition to practices that develop mathematics anxiety, and explicit engagement with practices that promote mathematical resilience. We propose that Rogers' (1961) construct of *unconditional positive regard* is fundamental to such opposition and engagement. We suggest that, unless all learners experience unconditional positive regard in their mathematics classroom, such a classroom will not be a place of loving kindness.

Unconditional positive regard involves respect for the learners, allowing them autonomy to choose how to respond to their situations, and assuming that learners are doing their best. Rogers believes that learners have an inherent tendency towards growth, development and autonomous functioning. According to Myers (2007), growth is nurtured by acceptance; unconditional positive regard is an attitude of value and acceptance without fear of loss of self-esteem. Unconditional positive regard involves understanding and including people who are different, and consequently involves a reduction of frustration, impatience and other forms of ill-will.

Unconditional Positive Regard and Mathematical Resilience

Earlier work in mathematical resilience (Lee & Johnston-Wilder, 2017) identified four important aspects in which unconditional positive regard is implicit, but in which the role of unconditional positive regard has not yet been specifically elaborated.

The first of these is a growth mindset rather than a fixed mindset (Dweck, 2006). A fixed mindset holds that "some people can't do maths". This mindset can lead to excluding people from the study of mathematics (Nardi & Steward, 2003). A learner with this belief may become anxious when confronted with challenging mathematics. A teacher with this belief may either avoid setting challenging mathematics or ignore or fail to notice the distress of many learners (Alderton & Gifford, 2018). Unconditional positive regard means trusting learners' inherent tendencies toward growth, developing a growth mindset with its associated emphasis on "can't do yet", and providing support for learners to experience success and develop their own growth mindset.

The second aspect is value: learners need to experience mathematics as intrinsically valuable and also experience themselves as valued members of a mathematical community. Unconditional positive regard involves helping learners to understand the purpose and utility (Ainley, Pratt, & Hansen, 2006) of mathematical tasks they are asked to perform and giving learners the freedom to choose tasks and approaches that are personally meaningful, in the context of a supportive classroom environment.

The third aspect is agentic struggle: learners need to feel engaged in mathematics, to be encouraged to try different strategies to help themselves, and to address being stuck (Mason, Burton, & Stacey, 2010). Agentic struggle also involves learners recognizing and managing emotional distress, identifying and meeting their needs, developing self-regard and believing in their own possibilities for growth, and focusing on tackling tasks that are "almost out of reach" (Williams, 2002),

The fourth aspect is support: learners need to experience unconditional positive regard when seeking support in order to gain confidence that such support is available. Needing support is often seen as weakness, but a core premise of unconditional positive regard is that everyone needs connection and support. Recruiting support when needed can be thought of as perseverance (Williams, 2014). Much of this support can come in the context of a community of learners.

We consider the wide prevalence of mathematics anxiety to mean that school mathematics is not always experienced as a place of unconditional positive regard. Indeed, mathematics anxiety is usually a symptom of psychological harm, resulting from situations such as social humiliation, and it needs addressing before a learner can progress effectively with mathematics (Lyons & Beilock, 2011).

Why is School Mathematics Not Always a Place of Loving Kindness?

The prevailing culture of school mathematics, at least in the UK, has been described by those who wish to leave it behind as *TIRED*—tedious, isolated, rote, elitist and depersonalised (Nardi & Steward, 2003)—leading to disaffection for many learners. In particular, many learners feel excluded and do not experience unconditional positive regard in the classroom (Nardi & Steward, 2003; Cousins, Brindley, Baker, & Johnston-Wilder, 2019). In this paper, we focus on one particular aspect of this lack of unconditional positive regard: recognizing and responding appropriately to the needs of learners who differ with respect to *empathizing* and *systemizing* (Escovar, Rosenberg-Lee, Uddin, & Menon, 2016).

According to Baron-Cohen (2002), systemizing involves a focus on analysis of rules and patterns. Empathizing involves recognizing another person's perspective and emotions and responding appropriately. According to Baron-Cohen (2002) each develops independently on a continuum. On Baron-Cohen's five-point scale, people can experience themselves currently as one of the following: much more systemizing than empathizing (SS); more systemizing than empathizing (S); roughly equal (B); more empathizing (E); or much more empathizing than systemizing (EE). No matter whether this is personality, skill or perspective, if a person has only experienced themselves as systemizing or empathizing, or if one or the other is seen as less valuable, then there can be a fundamental breakdown in understanding and communication—particularly between teachers and learners (Escovar et al., 2016). People who are much more systemizing than empathizing (SS) or much more empathizing than systemizing (EE) can experience impatience with the contrasting thinkers, not understanding the value of the other (Baron-Cohen, 2002). Systemizers may experience empathizers as overly emotional, while empathizers may experience systemizers as cold and clinical, lacking compassion (Riess, 2017).

Whilst most literature we have examined discusses these characteristics as if they were static, both empathizing and systemizing can be developed across the lifespan (Siegel, 2010; Baron-Cohen, 2002). According to Warrier et al. (2018), only 10% of empathy is determined by genes; the majority of the ability to recognize and respond to the needs and feelings of others is based on social factors and experience. In particular, teachers and peers, who might initially approach mathematics via systemizing, and who find learners who prefer empathizing difficult to understand, can learn both to appreciate the needs of these learners and to develop their capacity to empathize, and hence respond more appropriately to those needs.

We conjecture that the TIRED (tedious, isolated, rote, elitist, de-personalised) approach to teaching mathematics (Nardi & Steward, 2003) is used when teachers are more comfortable with systemizing than empathizing. This approach tends to suit learners who prefer predictability and logic but not others who prefer context and applicability. The consequence of this mismatch for learners with an empathizing preference may explain why such learners are more likely to acquire mathematics anxiety (Escovar et al., 2016). We note that both empathizing and systemizing skills are valuable for the critical thinking which is at the heart of mathematics.

In a classroom dominated by a systemizing approach, learners who predominantly empathize are unlikely to be experiencing unconditional positive regard. When unconditional positive regard is not present in the classroom, then *conditions of worth* (Rogers, 1961) develop. These are conditions that learners think they must meet in order to be worthy of the positive regard of their teacher or peers. Conditions of worth emerge when the learners' needs for positive regard from others becomes greater than their self-regard (Iberg, 2001), leading to learners feeling less able to meet their own needs.

Such learners are unable to follow and develop their innate guidance mechanisms (Griffiths & Griffiths, 2013) in their search for understanding and meaning in school mathematics. Instead, they gain success by following the teacher's instructions without a good understanding of the mathematics, a situation we can describe as *conditional regard* (Assor, Roth, Gurion, & Deci, 2004), as opposed to unconditional positive regard. Use of conditional regard can "promote enactment of the desired behaviours but does so with significant affective costs" (Assor, et al., p. 48). The cost is that the mathematical well-being of such learners is placed under threat.

The emphasis on systemizing is not simply a matter of individual teacher skill or preference: teachers face huge pressures in the classroom, pressures created by cultural assumptions and structures. An example is the pressure to "cover the syllabus", even if it involves knowingly leaving learners behind (Alderton & Gifford, 2018). Here we draw upon Galtung's (1969) notion of *cultural violence*, in which, rather than holding individuals to account, the harm is recognized as being caused by the cultural structures which constrain individual beliefs and actions. For example, learners, teachers and parents come to believe the messages that success at mathematics matters more than the needs of an individual learner, and a learner's value becomes judged by their success at mathematics, which becomes a condition of worth.

Thus, while it is possible to develop an individual teacher's ability to recognize and respond appropriately to learners, it is also important to develop learners' resilience in mathematics in order to better cope with future situations and messages from the wider culture.

Methodology: Emotions and Scholarship

In this paper, the experience of one of the authors, Sarah Cousins, is reflected upon to provide a lived context to the literature review and discussion. Lived experiences are valued as "a source of knowledge and understanding" (Clandinin, 2007, p. 42). It is through stories that people come to know and understand phenomena (Lewis, 2011). Such an approach is appropriate in research about emotions, allowing a confluence of the authors' own emotional experiences and their thinking about their subject. It was important that this paper, about emotional responses to mathematics, involved not only scholarship but feelings. For our inquiry, Sarah talked about her childhood experiences of learning mathematics in two languages across three continents and two hemispheres, whilst Sue Johnston-Wilder (co-author) took notes. We then drew on this conversation and engaged in shared writing about love and resilience in the context of learning mathematics.

We co-constructed the text. We shared our lived stories and drew on relevant scholarship. We worked digitally, communicating virtually and asynchronously to construct something new. This was a dynamic process whereby our piece emerged from a sense of growing trust between us. As in work by West (2007), our confidence grew, and we talked about a number of related issues that arose from the conversations. We took an interest in each other's lives.

Collaborative writing creates something new. We accepted and suggested changes to pieces of text. Some text was lost in the process. As Koro-Ljungberg and Ulmer (2015) express, "first ideas come and go. As soon as the first appears, another first lurks behind and waits for its turn. Some get materialized and written about, yet always only partially" (p. 101). We experienced the collaborative process as a creative space (Koro-Ljungberg & Ulmer, 2015). New *lines of flight* (Deleuze & Guattari, 1987) came into being. We found this co-construction of text to be both problematic, in that it was not referable to any one reality, and rich in its potential for shared understanding and the creation of unforeseen new connections (Koro-Ljungberg & Ulmer, 2015).

Experiences of an Early Years Teacher Learning Mathematics in Argentina, the United States and England

From ages 5 to 12, Sarah learned school mathematics during turbulent times in the 1960s in Argentina. The prevalent restrictive, dominating and physically violent social context was transposed in various ways onto the prevalent educational context. Sarah remembers her mathematics teacher wearing a white overall, like a scientist. She has written about it as "stark white against the black of the board" (1993, unpublished). She reflects that, for her, this was a cold and clinical environment. Personal relationships were not encouraged as part of the learning experience. Sarah cannot even remember the teacher's name. Sarah was not encouraged to talk with her peers as part of the learning process. Teaching adopted a detached, formulaic, authoritarian approach (Mortimer & Scott, 2003). The curriculum was transmitted by the teacher, repeated by the learners and then tested. Some readers might find it shocking that this was an experience of primary mathematics. Sarah's description of successfully navigating a school environment which effectively lacked unconditional positive regard describes a response that prioritized conditions of worth (pleasing the teacher) over learning. Sarah was proud to be awarded the best conduct prize in appreciation of her compliance rather than her thinking, in recognition of her obedience rather than her mastery of a particular mathematical topic.

This resonates with the TIRED approach (Nardi & Steward, 2003). Although it suited Sarah at the time, she has since become aware that she did not learn very much mathematics. She was not encouraged to develop her own ways of solving problems or to work things out for herself. She learned mathematics, not because of effective pedagogy, but because she was comfortable with mathematics and at ease with the regimented environment. With hindsight, it seems likely that, early on, Sarah had a systemizing preference.

Sarah spent a brief interlude in the United States, from ages 12 to 13. A child-centred approach to the teaching and learning of mathematics was in place in the United States in the 1970s. Teachers responded to individual children and adapted their approach to meet their needs. This was a far cry from the systematising approach adopted at Sarah's school in Argentina. In Wisconsin, USA, Sarah experienced the mathematics environment as friendly and supportive. She remembers that "the teacher sat with us on a one-to-one basis and helped us." At age 13, Sarah moved with her family to England where she studied school mathematics to age 15.

Sarah continued to do well in school mathematics in England. The approach was similar to that used in Argentina. The teacher presented the lesson from the front of the class, wrote things out on a green board, expected everyone to keep up and marked work in books on a regular basis. There was little in the way of problem-solving or working in groups. There was some naming and shaming. For Sarah, it was a question of keeping up with the pace and staying afloat. Sarah felt her actions "pleased the teacher", although she was aware that others were left behind and were distressed.

Sarah's success in mathematics was not replicated in other subjects, where she struggled to keep up with her English peers. Two factors, then, less reliance on language and an early preference for systemizing, resulted in Sarah feeling safe and able to succeed in school mathematics.

Early Experiences of Becoming a Teacher

Sarah trained as a teacher as a mature student, as a mother of three young children. She had developed an interest and ability in drama, storytelling and music, so an early years specialization seemed a good fit. Sarah enjoyed highly skilled teachers. They solved problems together and learned about different mathematical systems from different periods and parts of the world. The tutors were inspiring and friendly, treated the students as equals and helped them to experience mathematics as enjoyable, thereby demonstrating how to make it enjoyable for children.

Nevertheless, Sarah reflects that she was still more developed in systemizing than empathizing when she began as a young teacher. She was more comfortable with systems than with processes and with formulas than with discussions. Sarah remembers feeling impatient with the children at times as a newly qualified teacher. For example, when playing board games, children found it difficult to count on from a place and included the place they were on in their counting. As we have seen, impatience can be a feature of the communication gap between systemizers and empathizers.

The impact of repeated impatience on learners is that they adapt and develop patterns of avoidance such as learned helplessness and crying (Abramson, Seligman, & Teasdale, 1978). When that avoidance is of mathematics, the consequences can be serious. As traditionally encountered in school, mathematics is an abstract, cultural construction and can require mediation by a patient, loving, empathetic person, as Sarah came to realize. Even though Sarah had an early systemizing preference, she learned to adopt an empathizing approach, moving beyond her initial, more clinical style of teaching mathematics. Whilst recognizing some systemizing learners thrive in a systemizing milieu, Sarah championed a loving, kind, inclusive approach for her young learners with a preference for empathy, feeling and value, yet adapted her approach to meet the needs of different children, such as those who were able to move from concrete to abstract calculations more quickly. Sarah remembers how she tried to make the mathematics accessible through engaging and enjoyable experiences. For example, she told puppet stories, recited number rhymes and sang number-songs to illustrate different mathematical concepts. These were activities the children were familiar with. The narrative of a meaningful context makes the mathematics more accessible to the young empathizing learner. The activities happened at particular times on most days and children felt comfortable with these routines. For the puppet stories, Sarah had two puppets that became familiar characters in the classroom. They were used to enact a range of mathematical concepts with four- and five-year olds. The Cheeky Monkey would take away toys from the One-Eyed Bear, for example, to help children learn new vocabulary such as “one more” and “one less”. Such experiences helped children to learn new mathematical concepts and vocabulary without being aware of it, effortlessly, as part of a play activity.

It was important for Sarah that she grew to know every child and to build a relationship with each one of them, so that each felt valued. Thus, she was able to pitch the mathematics at an appropriate level and set it in a context that all learners could engage with. As a “systemizer”, such empathy needed to be learned and did not always feel natural, as described by Duval (2018): “I had to remind myself to be sure to write things like ‘I’m sorry to hear your mother was sick,’ because this sort of attention did not come naturally to me.”

It is possible to help change teacher impatience to loving kindness in order to address learner avoidance of mathematics. Such a change may need to take place consciously, or be learned, and it involves considerable self-reflection as new strategies are superimposed over old ones to change firmly ingrained habits. This is difficult work. Sarah recognized that her impatience got in the way of learning and that she needed to learn some key aspects of loving kindness: listening to learners, respecting their differences and responding accordingly, with reasonable adjustments or extra scaffolding.

An Approach to Loving Kindness at the Secondary Level

The need for loving kindness is more visible with younger learners and is to some extent promoted and practiced in early years and primary teacher training (as in Sarah's experience). Early childhood practitioners study child development as part of their training and are taught to consider the developmental needs of very young children in their teaching. Thus, like Sarah, they have opportunities to develop empathetic behaviours.

Older mathematics learners still need loving kindness. They need their personal experiences with mathematics to matter to the teacher, particularly for the empathizing learners who are the most likely to develop mathematics anxiety. According to Baron-Cohen (2002), many mathematics undergraduates, from whom secondary mathematics teachers are selected, have highly developed systemizing skills, but often less developed empathizing skills—and hence, like Sarah in her early career, may tend to favour systemizing learners and be impatient with others.

However, as with Sarah, it is possible to enable systemizing teachers to respond in a more empathetic way to learners' differences and needs, and vice-versa. We have found it helpful that mathematics teachers become aware of the way in which their approach relates to systemizing and empathizing, giving names to emotions, for example, and consulting with their learners to develop a good fit pedagogy (Johnston-Wilder et al., 2017). It is also important that teachers enable learners to become more resilient so that they are better able to cope with teachers whose teaching approach does not meet their needs.

We can summarize an alternative pedagogy as *ALIVE*—accessible, linked, inclusive, valued and engaged. We suggest that systemizing learners would thrive in a TIRED pedagogy in comparison to empathizers, that empathizing learners would thrive in an ALIVE pedagogy, and that some learners may thrive in either. We suggest that teachers need to be aware of the empathizing–systemizing spectrum of preferences of their learners and to be sensitive to a wide range of possible reactions as they develop an appropriate approach. In order to support all learners of mathematics with loving kindness, systemizing teachers of mathematics might need to acquire more empathizing skills, and empathizing teachers might need to acquire more systemizing skills, as is possible across the lifespan. In the meantime, particularly for empathizing learners, it is important to build learner resilience so that when they find themselves with a contrasting teacher, communication about emotions in the classroom can be enhanced in order to build a place of loving kindness.

Prevalent Conditions of Worth

We contend that, as opposed to unconditional positive regard, conditions of worth (Rogers, 1961) are particularly easily and inadvertently created in a school mathematics environment. Learners who describe mathematics as TIRED are expected to succeed in a subject that they find tedious, isolating, rote, elitist and depersonalised. Thus, they are learning mathematics, not for personal motives of interest, enjoyment and personal value, but for external motivation such as meeting the expectations of parents and teachers. This creates a crucible for the development of conditions of worth that limit progress, with increased likelihood of psychological disorder and distress (Assor et al., 2004), contributing to mathematics-specific anxiety. Mathematics anxiety has a reciprocal relationship with the amount of working memory available to the learner (Carey et al., 2019) and has the effect of reducing progress significantly. On average, attainment is delayed by mathematics anxiety by one year according to the Organisation for Economic Co-operation and Development (OECD; 2013).

However, if learners, who have existing and limiting conditions of worth related to learning mathematics, then experience unconditional positive regard, they are enabled to develop mathematical resilience (Iberg, 2001). According to Rogers (1980), "individuals have within themselves vast resources for self-understanding and for altering their self-concepts, basic attitudes and self-directed behavior; these resources can be tapped if a definable climate of facilitative psychological attitudes can be provided" (p. 115). Unconditional positive regard and empathy from a respected individual, or indeed self-empathy (Riess, 2017), can help learners move from the anxiety of being driven by the need to meet external demands to a position of resilience, in which they develop the self-esteem and autonomy to expect and request learning support that is appropriate for their needs. In our experience, once the threat of not meeting conditions of worth is removed, learners can become more able to undertake mathematical challenges (Cousins et al., 2019; Johnston-Wilder & Moreton, 2018).

Can the Mathematics Classroom Become a Place of Loving Kindness?

Negotiating Classroom Norms

Unconditional positive regard can be developed by agreeing on explicit classroom norms in collaboration with learners (Yackel & Cobb, 1996). In our practice, we ask learners to suggest classroom expectations that would enable them to feel safe enough to learn mathematics (Johnston-Wilder, Lee, Brindley, & Garton, 2015). In response, learners have suggested rules such as the following: laugh with, not at, one another; don't laugh at people making mistakes; remember that mistakes are often a sign of effort and learning; take an active interest in the contributions of others; listen to what others say; take risks; ask questions; work together; don't procrastinate—get on with it; have fun; be generous; be supportive; and give each other space. Interestingly, these suggestions fit the preconditions for unconditional positive regard. This approach has proved accessible and beneficial in many research studies with teachers (e.g., Johnston-Wilder & Moreton, 2018; Johnston-Wilder, et al., 2017). Learners become prepared to reveal what they understand and to listen attentively to one another, building connections and shared understanding (Tagore, 1933).

Tools for Regulation of Emotions

To further develop an atmosphere of mutual respect and support, we use three tools to facilitate emotion regulation in the mathematics classroom. The first tool, which helps to make emotions explicit, valued and respected, especially where learners have experienced significant prior harm, is the *growth zone model* (Lugalia et al., 2013).

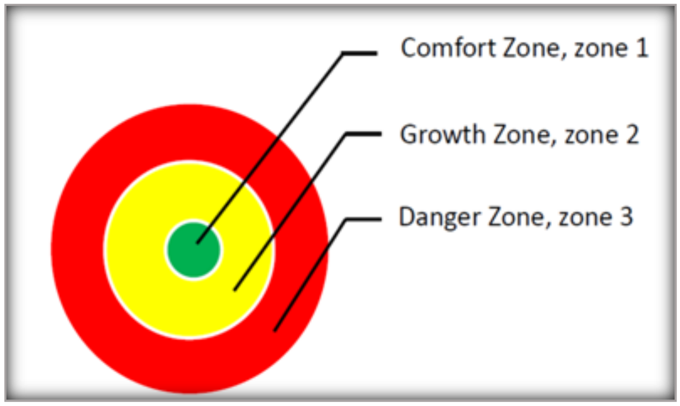

Figure 1. The Growth Zone Model (Lugalia et al., 2013). Permission from article authors.

This tool (see Figure 1) allows the learner to recognize and track their emotions, using green to designate the comfort zone (where learners experience calm, and can reflect, practice and automate their mathematics skills), orange for the growth zone (where learners experience excitement, uncertainty, nervousness, may make mistakes from which they can learn and recruit support when needed) and red for the (perceived) danger zone (where learners experience reduced ability to think clearly, if at all, racing heart or desire to run or cry).

Use of the growth zone model has been found to facilitate communication about the affective domain, where it is not already established (Johnston-Wilder & Moreton, 2018). This tool can help learners and teachers to communicate the presence of mathematics anxiety more effectively with themselves and one another, thus enabling other learners and the teacher to respond with loving kindness to anxiety that would otherwise be hidden.

Another tool is the hand model of the brain (Siegel, 2010), which can help learners to understand their responses to threats, such as those created by not meeting conditions of worth. The tool is a portable model of the brain (see Figure 2) which can demonstrate the effect of the fight or flight response to any perceived threat, and why that threat makes learners feel stupid or experience their minds going blank when triggered. In a typical mode, the cerebral cortex reviews stimuli from the limbic regions, calms fear and works on cognition. In survival mode, when a threat is perceived or triggered by a painful memory, the cerebral cortex goes "off-line" whilst the limbic region focuses on life-saving fight or flight strategies, temporarily impairing cognitive processes.

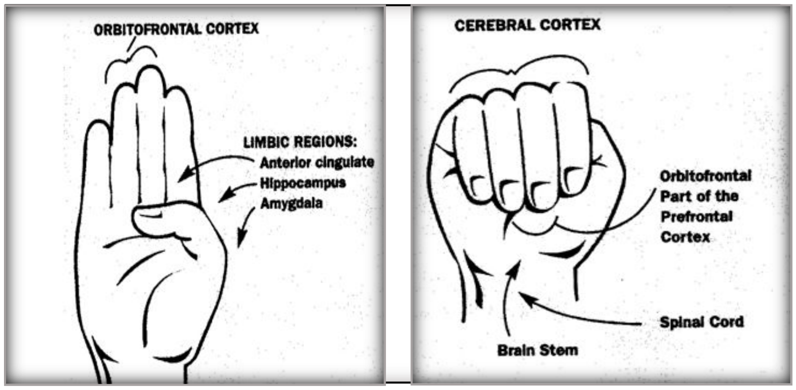

Figure 2. The Hand Model of the Brain (Siegel, 2010). Permission from article authors.

Use of this tool may reassure learners that their psychological experiences are neither unusual nor permanent, and it may help to promote understanding and acceptance of temporary negative emotions. According to Siegel (2010), the first step in controlling those negative responses is to name them. Learners can use the hand model of the brain to identify that they have moved into the danger zone and for the moment cannot think clearly. A teacher or peer responding with loving kindness does not expect the learner to be mathematically productive until they have first moved back from the danger zone to the growth zone. Learners can thus also develop self-empathy, which "involves accepting painful thoughts and feelings without being judgemental or self-pitying" (Griffiths & Griffiths, 2013, p. 169), simply noticing that they are in the danger zone and addressing that. Longer term, increasing self-empathy and unconditional positive regard "can lead to a decrease in an individual's conditions of worth" (Griffiths & Griffiths, 2013, p. 169) and an associated reduction in anxiety.

The third tool is the relaxation response (Benson, 2000), a simple and effective way of moving out of the danger zone back into the growth zone. It is well-known by divers that they can learn to reduce their heart rate through breathing. This quick and effective strategy is widely applied. The relaxation response can be activated, for example, through controlled breathing or through a focus on immediate sensory experience. Learners come to appreciate that anxiety can be a temporary state that is under their proactive control; this is powerful, practical support, particularly for those learners who have previously been harmed, and who believe that their subsequently developed mathematics anxiety is outside of their control.

As learners are empowered to become less avoidant and more engaged with mathematics through the tools and teaching approaches described above, some teachers may worry that they will lose control and that classroom behaviour may deteriorate. However, one of the causes of poor behaviour is mathematics anxiety, as learners seek to safeguard themselves by avoiding mathematics (Carey et al., 2019); empowering learners through loving kindness increases the learners' innate urge for socially constructive behaviours (Rogers, 1961). Learners can be trusted to want to learn in situations in which mathematics anxiety is recognized and responded to with unconditional positive regard; behaviours can improve as a welcome side-effect (Johnston-Wilder & Moreton, 2018).

Conclusion

Teaching with loving kindness as practised in early years is complex (Cousins, 2015), involving teachers' skills, feelings, knowledge, sensitivity, emotions and intellect (Noddings, 2001; Goldstein 1998). In this paper, we sought to take what we know about loving kindness from early years pedagogy to consider school mathematics with older learners and to explore one model of difference, namely variations in systemizing and empathizing, that helps us to consider why school mathematics is not always experienced as a place of loving kindness.

We explored and considered the mathematical experiences of a teacher of early years whose first approach to mathematics was most affected by her systemizing, but who later developed in empathizing. We then reported on some tools that have enabled learners and teachers to understand and communicate how they are experiencing mathematics, facilitating both teacher understanding and learner autonomy in classrooms ranging from primary to secondary school education. These tools enable teachers and learners of mathematics to develop effective behavioural empathy, leading to practices of loving kindness (Johnston-Wilder & Moreton, 2018).

We have demonstrated that one important expression of loving kindness occurs when teachers and learners become aware of and respond to mathematics anxiety, helping each other to build resilience through empathetic behaviours, unconditional positive regard and self-regard. According to Griffiths and Griffiths (2013), internal conditions of worth correlate with anxiety. Thus, we have argued, if conditions of worth are decreased and unconditional positive regard and self-regard are increased, mathematics anxiety will be reduced.

We have discussed how learners can use three tools to build inner resources and increase their ability to communicate needs in the mathematics classroom. unconditional positive regard comes not only from the teacher, but also from learners to themselves and each other. As Riess (2017) says, "self- and other-empathy leads to replenishment and renewal . . . [and] working to enhance our native capacities to empathize is critical to strengthening individual, community, national, and international bonds" (Riess, 2017, p. 76), and to creating a supportive community of mathematical practice.

As stated by Lyons and Beilock (2013), "educational interventions emphasizing control of negative emotional responses to math stimuli (rather than merely additional math training) will be most effective in revealing a population of mathematically competent individuals, who might otherwise go undiscovered" (p. 2102). Thus, there is a need to test these suggestions more widely with a view that they become embedded in policy directives, to help meet the need for more people to be able to think and reason with mathematics.

To date, not enough emphasis is placed in mathematics-specialist teacher training on mathematics wellbeing and the affective domain as it relates to teaching mathematics. We therefore suggest that as part of training, and in continuing professional development, mathematics teachers should be familiarized with these three tools, and their uses and benefits, in the context of learning how to develop loving kindness through unconditional positive regard. Mathematics anxiety can be debilitating but it can be addressed.

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