MOTIVATIONAL CLASSROOM CLIMATE FOR LEARNING MATHEMATICS: A REVERSAL THEORY PERSPECTIVE

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The 2011 TIMSS report provides evidence for a relationship between negative affect and achievement in mathematics (Mullis, Martin, Foy & Arora, 2012). It notes a continuing trend for measures of affect to consistently decline between the ages of 9 and 13 years. The report documents the large numbers of pupils who do not like mathematics, are not confident in their ability, and do not engage with the subject.

The problem of students' *disaffection* with school mathematics is unsustainable in economic, social and personal terms. It is a key factor in disengagement from school mathematics, lack of participation, progression and attainment. In this way, large numbers of students are effectively becoming "lost" to mathematics, with the result that too many are leaving education without the competence in mathematics that they require for a successful career, or the personal competences needed to function as citizens.

In looking at the influence of aspects of affect on learning and achievement in mathematics, a range of constructs has been proposed. Examples include anxiety (Hembree, 1990), attitude (Zan & Di Martino, 2007), motivation (Patrick, Ryan & Kaplan, 2007) and goal orientation (Dweck, 2000). Much of this work has provided evidence of the multi-directional relationships between affect, cognition and learning. However, despite its importance, and with some notable exceptions (see Hidi & Harackiewicz, 2000; Nardi & Steward, 2003; Skinner *et al.,* 2008), disaffection has been too little studied.

Much of the research on disaffection, and on affect generally, is dominated by the quantitative study of cognitively focussed constructs such as attitudes and beliefs. While such studies have made important contributions to our understanding of the incidence of negative affect, the limitations of these constructs have been widely noted (Ruffell, Mason & Allen, 1998; Zan & Di Martino, 2007; Hannula, 2012). Hannula (2012), in a review of theoretical approaches in mathematics education research, for example, has commented "Almost all work on attitudes missed important distinctions regarding its quality, simply focussing on the direction and magnitude of attitude" (p. 141). Indeed, as Turner, Meyer & Schweinle (2003) have pointed out, cognitive conceptions of affective constructs (including motivation) represent a "dominant paradigm", which has led to emotion, in particular, being backgrounded. As Turner, Meyer & Schweinle (2003) state, "Comprehensive theoretical work that articulates how emotion, motivation, and cognition interact within classroom contexts is needed if understanding learning is to move forward" (p. 112). The centrality of motivation and emotion, together with cognition, in the learning process is also reflected in the work of Schutz and DeCuir (2002) and Hannula (2012), and is an emerging theme in mathematics education research.

In this article, I show how reversal theory (Apter, 2001), and particularly its taxonomy of motivations and emotions, provides a basis for a thick description of students' experiences of learning in a mathematics classroom. Using data from an earlier ethnographic study (Lewis, 2013), I show how reversal theory can be used to examine the landscape of disaffection from the point of view of students' subjective experience of mathematics in school. This approach highlights the significance of classroom climate in students' experience of disaffection.

Reversal theory

Reversal theory is a comprehensive account of personality that integrates motivation and emotion, and that enables an investigation of the experience of learning mathematics beyond quantitative descriptions of attitude. The theory originated in the UK in the 1970s, in a child guidance context. A key insight was that the same presenting problem could represent different and opposite meanings for different children. In the case of school avoidance, for instance, one child could truant because they were afraid of school, while another child could avoid school because they were bored, and needed stimulation. This distinction between a nervous, troubled response and a boisterous, troublesome response later crystalised into the serious-playful dichotomy, as described below. Research also demonstrated that, at different times and in different circumstances, children were able to express both of these styles, and thus the concept of reversal between states was introduced. The theory has been developed and elaborated theoretically and empirically over the years, and has been used in fields as diverse as psychotherapy; sport; smoking cessation and design (Apter 2001).

The basic principles of reversal theory are:

- There are eight motivational states (Apter, 2001, p. 13), arranged in binary oppositional pairs.
- The four pairs are: serious (telic) versus playful (paratelic); conforming versus rebellious (negativistic); mastery versus sympathy; self (autic) versus other orientation (alloic).

- We are in one of each pair of states at any one time (*i.e.*, 4 states).
- One (or possibly two) of these four states will be focal at any one moment. That is, it (they) will operate at the forefront of our phenomenal field, and thus will be more influential in driving our experience of the world at that moment. This focus can change.
- We will reverse between states frequently. Indeed, it is known to be psychologically dysfunctional to be stuck in a state, and unable to reverse.
- Motivational states (or combination of states) combine with our temporal experience and interpretation of events to determine a range of 16 primary emotions, thus providing a theoretical foundation for emotions.

The theory offers a number of advantages for research of a psychological nature. Firstly, the theory accounts for a range of motivational states (often referred to as styles) and their associated emotions, and the ways that these are induced and expressed in behaviour allows for richer descriptions of everyday experiences and choices than, for instance, the notion of fixed traits. The concept of reversal between states is new to psychology, and, together with the concept of change of focus, enables an account of the dynamic, in-the-moment flow of experiences, that can be observed in typical classrooms. In this way, motivational states can be seen, not as peripheral to our everyday experiences, but as central organising structures of experience.

The theory has been shown to have explanatory value in understanding complex behaviour. For example, Mullet (2014) describes a series of studies that systematically inventoried complex motivational structures to perform or not perform given health-related behaviours seen to be socially relevant in the European or African cultures in which they were studied, such as elective surgery, organ donation and aesthetic issues. Using exploratory and confirmatory factor analyses, the studies tested the capacity of the reversal theory model of the four domains of experience to account for these complex motives. In an educational context, Svebak (1993) demonstrated the predictive value of the theory by examining the relationship between student self-scores on an emotion-related scale and performance in academic tests.

This is not to say that reversal theory is free from criticism or challenge. Cramer (2011) has offered a comparative evaluation of the theory that acknowledges both its strengths and limitations. However, my position is that reversal theory at the moment is an adequately robust theory, which is well evidenced and has proven research utility, but that is subject to challenge and amendment over time.

In a mathematics education context, the theory, and the taxonomy of motivational states and their related emotions can help us to understand more deeply the reasons why students might engage or not engage with mathematics. Using reversal theory, I have been able to interpret classroom episodes as sequences of experiences (including reversals) through the lens of the motivational states (see Lewis, 2013, for examples). This focus on motivational state is valuable, since it is under-researched and offers new perspectives for research in mathematics education. Hannula (2012) has stated:

> There is a clear imbalance in favour of studies that focus on traits over studies that focus on states, and a similar imbalance favouring a psychological approach over others. In particular, studies that focus on the dynamics of emotional or motivational states in a classroom or other learning community are still rare. (p. 155)

More salient in the present case is that the theory can be used to offer new perspectives and insights into current concepts of interest such as classroom climate.

Classroom climate

Classroom climate is important since it influences students' experiences of the mathematics classroom. It also influences engagement or disengagement. Skovsmose (2005), for instance, talks about barriers to learning: "a particular situation or a particular way of organising teaching-learning processes can prevent students from acting as learners" (p. 7). He goes on to describe climate as "the opportunities which the social, political and cultural situation provides for the person" (p. 6). Skovsmose notes the influence not just of the past (*e.g.,* inherited culture), but also of intention, or the individual's interpretation of current and future opportunities, which he terms foreground. So, whilst acknowledging the influence of policy, physical environment, resources and socio-cultural issues, it also seems clear that the psychosocial and socio-emotional (*i.e.,* the affective) climate within a classroom is important in determining an individual's response.

Goh *et al.* (1995) also talk about the influence of psychosocial climate on student outcomes in mathematics classrooms. They report:

> Research using student perceptions of classroom environment tends to support the contention that classroom learning environment could be an important variable accounting for variance in student outcomes. (p. 29)

Classroom climate is also important when accounting for wide variations in measures of affect and attainment between groups in the same institution. Noyes (2012) has noted significant within-school variation in teacher quality, student engagement and learning outcomes. In Lewis (2014), I presented evidence from a survey of a whole school year 9 (aged 13-14 years) cohort in the UK. The survey echoed the findings of Noyes, since parallel groups at the same attainment level varied strongly on measures of affect, suggesting that it is the classroom or group itself that is the major determinant of pupils' affective experience of mathematics. That study also showed how widespread the experience of negative affect is, with boredom being particularly prevalent in the experience of students.

Motivational classroom climate

If classroom climate can vary significantly, when school climate can be said to apply and influence equally across those classrooms, then the individual teacher can be seen to be the primary architect of classroom climate. Evidence suggests that as well as pedagogical and teaching practices, the personality of the teacher, and the nature of the interpersonal dynamics of the classroom are also relevant (Gossman, 2011). Turner, Meyer and Schweinle (2003) show that students' involvement in instructional discourse is socially constructed, both motivationally and emotionally. They see affective support from the teacher as a key variable in classroom climate and learning. Middleton and Spanias (1999) argue that: "the ways in which teachers structure classroom inquiry can greatly influence students' views of mathematics and can lead students to develop more powerful conceptual structures" (p. 73). That students need to feel supported has also been examined in the classroom environment literature. Patrick, Ryan and Kaplan (2007) suggest that the association between perceived classroom environment and student engagement is mediated by students' motivational beliefs.

Watson and de Geest (2005) suggest that a range of beliefs and commitments that underpin teacher choices are more important than individual pedagogical practices in fostering learning. The valuing of students both as learners and as individuals seems to be important. Watson and de Geest (2005) talk of "togetherness" and "humane attitudes", emphasising the social and human aspects of the classroom environment. These studies show how students are sensitive to the motivational affordances of the classroom and the emotional component of teacher-student interaction.

Motivational classroom climate for learning mathematics

The argument has been advanced, then, that students' perceptions of the opportunities and affordances for learning (or lack of learning) in a classroom are based on individual need and, as such, are motivational in character. These affordances influence students' emotional and behavioural responses to the climate in the classroom. Since reversal theory provides a comprehensive taxonomy of motivational states, and their related emotions, it can be used as a means of providing structure to students' reported experience of classroom climate, and sequences of events can be described and explained using the lens of motivational states.

To be in a motivational state (or a combination of states) is to experience the classroom in a particular way. The motivational state colours every aspect of a student's life at that moment, from what they pay attention to, to how they interpret lessons as they unfold. By its nature, state determines what the student needs and wants at that moment, which provides a benchmark against which they can interpret events, and evaluate them against their needs. It also determines their emotional response to events. Thus they are sensitive to what is happening in their phenomenal frame, the affordances provided by the classroom climate, and by the relationship with the teacher.

By analysing the complex and dynamic interactions between aspects of affect and how these aspects influence how students do or do not learn mathematics, motivational classroom climate for learning mathematics is best characterised as an intersubjective space (Walshaw, 2004) with psychosocial, individual and educational aspects, where the influence of classroom practices and conditions are brought to bear on learning. By understanding how the experience of learning mathematics for the student can be influenced by the way that teachers create a positive climate for learning, it is possible to understand how the decline into disaffection might be alleviated or even reversed.

Whilst mathematics classrooms are often described in terms of goal structures, with the focus on "cold" cognition, or as social systems based on power, motivational classroom climate for learning mathematics also includes the sympathetic motivational states, in which students and teachers bring their more human and emotional selves to bear.

Evidence further shows that the narrative of students' disaffection is expressed in relation to specific states, and that disaffection represents frustration and unsatisfied needs in relation to those states (Lewis, 2013). I argue that the degree to which a classroom climate provides affordances for the satisfaction of the motivational and emotional needs of students determines the affective response of those students, which in turn influences the degree to which they learn or do not learn mathematics. Disaffection occurs when meaningful engagement and satisfaction is unavailable in some or all motivational states. The opportunity to become motivationally connected to tasks and activities is denied. Individual case studies which illustrate this point can be found in Lewis (2013).

Motivational states in UK mathematics classrooms

In this section, I illustrate and elaborate, with evidence from a study of further education college students, how individual motivational states feature in the context of classroom climate. The data referred to come from an investigation into the nature of disaffection with school mathematics (Lewis, 2013). The study was primarily qualitative in nature and the main body of evidence was obtained from individual interviews conducted with school pupils in year 9 (aged 13-14) and in two UK further education colleges with students aged 16-18 years who were deemed to have "failed" in national examinations [1]. Prior to interview, students in groups supervised by me completed a simple questionnaire based on reversal theory concepts, identifying their current emotional dispositions to mathematics (Svebak, 1993). During the interviews, students were invited to illustrate graphically their changing relationship to mathematics over their school career. Students' responses to these instruments were discussed in the interviews, along with further questions about their experiences of school mathematics. The methods and instruments are described in more detail in Lewis (2011). In this article, I refer to data from students aged 16-18, unless otherwise stated.

The need for significance

A great deal of the evidence of the experience of disaffection relates to the serious (telic) state. The serious state is about purpose or significance. A student will be motivationally connected (willing to engage) with a task or activity if it has some personal meaning for them, such as: to appear clever; to please the teacher; to pass an exam; to become a lawyer. Teachers can help to make tasks motivationally significant by providing an intra-mathematical rationale, such as the notion of utility, real life relevance or the exchange value of qualifications:

> She had a unique way of relating all the topics she taught to real life situations. She always made the lessons very relevant by explaining clearly why we were learning to do certain problems and why it would help in real life. (S, female student, aged 21, quoted in Lewis & Forsyth, 2012)

Where a student lacks such purpose or where the teacher has not helped them to create it, a sense of meaningless or hopelessness follows. Meaninglessness comes about because the student has no sense of significance attached to learning mathematics (or at least to a particular topic or task):

> If you know how to count what's the use of doing big maths an' that? (Helen)

Hopelessness is an expression of feeling unable to achieve the desired goal:

> because I feel […] because I found every time I failed year 6, year 9 […] all the years I failing [...] like if I flop this year what's the point waking up early every morning to learn and then every time you fail. (Masud)

When engaged in an activity in the serious state, it is important that students feel they are making progress towards a valued outcome, or that they succeed at assigned tasks. Being able to perform certain tasks successfully is highly satisfying when it does happen:

> I like to know I've achieved something today. If I leave the classroom and I think I've not really learned anything today, I wouldn't like maths in that way. I wanna leave that classroom and feel I've learnt something today. I like to feel that a lot of the times. (Adnan)

If the likely or actual outcome is unwanted (*e.g.,* failure) or if students are unable to make progress towards a favourable outcome, then negative affect follows.

Emotions in the serious state relate to the experience of arousal. High arousal will induce negative emotions, including fear (or anxiety, panic) when in combination with the conforming state. Not being able to do a task successfully, or not understanding, is often the starting point of a sequence of changes in motivational state that can be interpreted using reversal theory, and that often result in anger. For instance, when Masud gets stuck, he notices that others are not, and this negative comparison with others leads to a shift in focus to self-mastery (losing). This in turn triggers a reversal from the conforming to the rebellious state, leading to anger. Since all people will experience frustrations and negative affect when undertaking mathematical tasks, it is vital that students learn to deal with them and overcome them through developing a willingness to persist. These self-regulatory and metacognitive skills are as necessary as cognitive and analytic skills in learning mathematics.

There is ample evidence in these accounts that students can be sustained in the longer term to achieve a goal, even when the experience of doing it is unpleasant, if that goal is seen to be valuable enough in itself. Classrooms described and observed in the study were imbalanced and strongly dominated by a motivational climate of serious-conformity. Such a climate emphasises duty and obligation (conformity), and will be productive only if tasks are perceived to be both achievable and meaningful. Where this is not the case, and where the climate is dominated by perceived meaningless "drill and practice" in repetitive, procedural tasks, the result is disaffection.

The need for fun

The paratelic or playful state is opposite to the serious state. The value of this state is enjoyment and having fun: doing things for the pleasure of the activity itself. In this state, a person is more likely to be spontaneous and creative. The willingness to engage in this state will only happen in a climate where there is little perceived risk of failure or mistakes, and where a tolerance of uncertainty and ambiguity is encouraged.

Attention in the paratelic state is in the here-and-now and students will be arousal-seeking, since high arousal is perceived as being pleasant (excitement), and satisfaction in this state will be akin to the state of flow described by Csikszentmihali (1996). If arousal is low, the situation will result in boredom (when combined with the conforming state) or sullenness (when combined with the rebellious state). There is more evidence in the study for boredom than for any other negative feeling or emotion related to school mathematics.

When teachers do not "feed" students' need for positive arousal when they are in the playful state, the students will get bored. The two most cited reasons for this boredom are lecturing (listening to boring or bored teachers) and repetition:

> cos once you know it, you can't be bothered to keep doing it again and again (*laughs*). (Pat)

> Boredom? I tend to switch off a lot. I need a break. In fashion you're doing stuff, music, time flies. In maths you're trying to listen to the teacher. (Dena)

The importance of the paratelic state in learning mathematics has not been highlighted enough in the research literature, which focusses more on outcomes, results and goals, which in turn trigger a serious state of mind. However, students in my study consistently talked about the need for fun, and the value of enjoyment as a motivating factor in their engagement with school mathematics. Classroom climates that make available opportunities for playful engagement, by introducing elements of humour, curiosity, gaming, unfamiliarity, intrigue or something out of the ordinary to increase arousal in a positive way, are thus able to engage the interest and participation of the students. Open-ended tasks and problem solving contexts provide elements of uncertainty and cognitive challenge that can be immersive and exciting.

It should be emphasised that paratelic engagement is a qualitatively different way to experience mathematics learning compared to serious engagement, and while both are necessary and complementary in supporting learning, the opportunity for playful engagement is a condition of genuine affection, and not just "the sugar that makes the pill go down".

Students in the study by Lewis and Forsythe (2012) describe the benefits of teacher enthusiasm, passion, positivity and energy, which clearly induce the playful state:

> I really liked her optimistic attitude to life. Every time I came to a lesson she would be happy and smiling, full of energy and enthusiasm. (K, female student aged 21)

By framing activities as a game, the playful state can also be encouraged:

> Miss B she taught it as a game. For different people she put it in different contexts. Like for me it was always football, like angles and stuff. She used football to help me understand it. (Harry)

It is perhaps no coincidence that students' accounts of disaffection make it clear that paratelic activity and pleasure is so often unavailable in those classrooms that represent the most negative experiences for students.

The need for conformity versus the need for negativism

The motivational state of conformity brings with it the need to fit in, and to do what is expected, and the associated feelings of a sense of duty or obligation, bounded by the tacit rules and norms, which are, in turn, determined by the individual teacher. This state is contrasted by the opposite state of rebelliousness (negativism), where the value is freedom, and the need is to assert one's individuality and separateness from "the other".

When the need for conformity operates in "fail" mode, students feel excluded from the community of "people who can do maths". Other researchers have commented on this identity of students as excluded, whether it be by virtue of gender, or social class, for instance, or because of the perceived elitist nature of mathematics (Nardi & Steward, 2003). Another way of excluding people is for teachers to pay attention only to those perceived as "clever".

The logic of reversal theory suggests that whilst students have a need to fit in, they also have the need to express their rebelliousness. It is, perhaps, unnecessary and all too easy to recount the many and varied ways in which they are capable of expressing rebelliousness in behaviourally dysfunctional or unwanted ways. However, the notion of autonomy and the need for a sense of individuality is well documented (see, for example, Patrick, Ryan & Kaplan, 2007, among others). Evidence from my study suggests that students can express rebelliousness in a functional way by asserting the ability to challenge, choose, or even develop, their own methods for solving problems, or performing procedures:

> I just wanna find my own method and I feel freedom, doing it my own way. (Alan)

> Let's say I've learnt something, and I figured out my own way to do it, a technique or something, anything, randomly looking at patterns and stuff and figuring out things my own way. I wouldn't keep it to myself. I'm not that type of guy. I'll literally put my hands up and I'll scream out to the teacher I've figured another way to do it. I'll tell the whole class. I wouldn't keep it to myself. (Adnan)

The playful-rebellious state combination can be a source of highly effective and creative problem-solving behaviour, if the context of the mathematical task or challenge is pitched correctly.

The need for mastery

In the mastery state, the operative value is power and control. Students need to be able to *do*. In the context of a mathematics classroom, they need to feel that they can perform the tasks set successfully. For many in this study, and also pointed out by others, such as Boaler (2010), performative mastery (being able to do) is often predicated on cognitive mastery (being able to understand).

When students are able to perform tasks, the emotion is pride, and the feeling is confidence and being in control. In a competitive frame, being able to do better than others feels like winning. When they are unsuccessful, they feel powerless and helpless. The associated emotion is humiliation:

> it makes me feel like I'm dumb and stupid because of my grade and I feel like, feel like, when people go […] ah, what you doin' at college and you go maths GCSE or whatever. I'm ashamed to say I'm doing it because maths is like very important, and I just feel dumb and stupid. And if someone else knows more or got a better grade. I just feel like ohmigod I don't want to say mine. (Meena)

Classroom climates in which competitivity and peer group comparisons are over-emphasised can have damaging consequences for students who feel they lose in such circumstances.

One of the more surprising findings was the motivational richness of the notion of helping others. In such circumstances, the active motivational state combination will be other-mastery. It is mentioned often in the narratives, as a source of pleasure and satisfaction:

> I won't let them just copy my work. I'll explain it to them in a different way which makes me feel happy, that also it's helping someone. It makes me feel happy (*laughs*). It also makes me feel quite important as well that she'd rather ask me for help and to explain it more, rather than the teacher. (Meena)

Meena's account shows that she not only gets pleasure from helping someone else, but that there is a collateral benefit for her: in this case, she feels important. Helping others is clearly a motivationally rich activity, by which is meant that the activity offers the possibility of satisfying motivational needs in multiple states.

The need for self-sympathy

In the self-sympathy state combination, a person wants to feel that they are loveable and that they are cared for. In a classroom context, students can be highly sensitive to the perceived empathetic behaviour of teachers. When this human caring is not apparent, students can feel unloved or not cared for. The emotion is resentment:

> I felt like I just got dumped on somebody else because the actual teacher didn't want to help and wanted to push the other students further. (Eve)

This human aspect is an important part of a positive and motivationally rich climate for the learning of mathematics. Evidence from the literature (Ryan & Patrick, 2001; Lewis & Forsythe, 2013) suggests that students are more engaged when they perceive their teachers as supportive. Worryingly, Hargreaves (2000) points to a neglect of the emotional dimension of relationships in classrooms in the increasingly rationalised and performative educational environment that currently exists in the UK.

Conclusion

Some interesting and unexpected themes emerged from my study, including the volatility of students' relationship with school mathematics, suggesting that affect cannot be described simply as trait, since the subjective reality is more complex than such a judgement allows.

The data from the graphic histories, together with the interview narratives, shows that this volatility happens at every level of granularity. Minute-to-minute changes during a lesson can be described and accounted for by reversals and changes of motivational state, as predicted by reversal theory. Year-on-year variations in dispositions imply shifts in cognitively-mediated structures such as attitudes and beliefs, which in turn implies that they are malleable rather than fixed.

The evidence from the study shows that different motivational states weave in and out of students' experiences in mathematics classrooms, and that students' perceptions of the degree to which their in-the-moment needs are satisfied influences their engagement and learning. A positive motivational classroom climate for learning mathematics is one in which the teacher creates the conditions for student engagement and satisfaction across a range of needs. Affection and disaffection are determined by the degree to which opportunities are available for positive engagement in the whole range of motivational states.

The findings reported here demonstrate that using reversal theory to provide an account of students' experiences of motivational classroom climate can contribute to the development of new perspectives for research in mathematics education. Students' relationships to mathematics are complex and ambiguous, comprising both positive and negative aspects, and their engagement is often qualified by coercion, duty or instrumentality—"reluctant engagement" or utilitarian accommodation. However, the evidence shows that even students who could be considered disaffected were, in fact, often quite motivated to achieve, and will apply effort and persistence when the satisfaction of motivational needs is available.

Notes

[1] Since the sample interviewed can be said to be an opportunity sample, not all of the students interviewed were disaffected. A discussion of the nature of disaffection, how it is characterised in the study, and how it manifests in the experience of these students can be found in Lewis (2013).

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