LOOKING FOR GOLDIN: CAN ADOPTING STUDENT *ENGAGEMENT STRUCTURES* REVEAL ENGAGEMENT STRUCTURES FOR TEACHERS? THE CASE OF ADAM

Elizabeth Lake, Elena Nardi

University of East Anglia

Goldin et al. (2011) suggest nine 'engagement structures' for describing complex, 'in-the-moment' affective and social interactions as well as student beliefs. The study we report here examines the conjecture whether the 'engagement structures' construct can be appropriately adapted to allow such descriptions for secondary mathematics teachers. If this can be the case then linking teacher and student engagement structures could support detailed examination of classroom interactions. The aim of this paper is to consider one such adaptation and demonstrate some of its parts through the case of one teacher. We draw on this case study to indicate that such an approach has value, in particular in the ways in which it reveals relationships between engagement structures and norms in classroom interactions.

INTRODUCTION

There is a growing body of literature exploring affect in mathematics education (McLeod, 1992) and on the beliefs of mathematics teachers (Holm & Kajander, 2012). However there is less research on the complexity of teacher emotions as they engage in teaching mathematics (Hargreaves, 2000).

Goldin et al.'s *engagement structures* (2011) are designed as a tool for framing analysis of the complex nature of affect, and particularly the interaction between individual and social aspects of students' problem-solving experiences in mathematics. Goldin sees *engagement structures* as a useful, idealised multileveled hypothetical construct, one that covers a broader part of affect and more than emotions. He suggests that the construct of *engagement structures* can be used to describe complex "in-the-moment" (2011 p548) affective and social interactions for students by identifying positions that students can adopt when learning mathematics; and also locating the patterns which characterise individual behaviour, but are evoked in social situations.

In this paper, we draw on an ongoing study to propose that the construct of *engagement structures* can be adapted to apply also to teachers of mathematics. To this purpose, we first introduce *engagement structures* and then exemplify their use in a sample of our data. We conclude with an outline of where the larger study is currently heading.

ENGAGEMENT STRUCTURES AND THE AIMS OF THE STUDY

This paper aims to provide evidence that supports the existence of *engagement structures* (in the sense of Goldin et al.) for teachers of mathematics that are similar to

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those of students. This is potentially interesting as a position of power in the classroom means a teacher can manipulate the social situation and have a profound impact on the social dynamics of the classroom in a multitude of ways. For example, the teacher can, by condoning and modelling selected practices, through language and engaging in emotional interaction, act as gatekeeper to the community of practice of mathematics, establishing both 'norms' and 'endorsed narratives'(Sfard & Prusak, 2005).

Engagement structures are by no means fixed, but do emerge from common observable characteristics. Students can dip in and out of the positions suggested by these structures, sometimes showing characteristics of more than one structure, although at any one moment there will be a dominant structure, which directs their emotional reactions and hence their learning. Since Goldin et al. suggest that 'different motivating desires may result in similar behaviours' (2011 p550), this similarity implies there are a limited number of affective structures that encode current possibilities for the individual *engagement structures* for mathematics students. It also implies that, despite differing motivations for a mathematics teacher, the result may be similar structures. The nine original *engagement structures* that Goldin et al. (ibid.) suggest are: 'Get the job done'; 'Look how smart I am'; 'Check this out'; 'I'm really into this'; 'Don't disrespect me'; 'Stay out of trouble'; 'It's not fair'; 'Let me teach you'; and, 'Pseudo engagement' (p.553-557).

To illustrate one of these *engagement structures*, 'I'm really into this' is in evidence when a student's self concept appears to be that of a serious, involved thinker who values mathematical problem solving for its own sake, and is driven by an underlying mastery goal. This contrasts strongly with *engagement structures* such as 'Stay out of trouble' or 'It's not fair', both representing lower levels of engagement. We illustrate more *engagement structures* later in the paper, when we consider the case of Adam.

Goldin et al. (2011) mean to show patterns that are repeated or occur commonly; that are present in many different people and are therefore transferable. It seems reasonable to suggest that some recognisable patterns will also appear for mathematics teachers to form archetypal *engagement structures*. Here we examine this suggestion in the context of a study that involves secondary mathematics teachers in the UK.

If evidence of such structures emerges likewise for teachers, then we may have a unified language to examine complex classroom interactions, especially emotional interactions. This would allow a closer examination of how the teacher functions in guiding and supporting shifts in *engagement structures* for students, particularly in ways that support their learning. This may also mean that we can begin to examine how a teacher limits or encourages certain *engagement structures* in students, both through which *engagement structures* they themselves adopt, and through setting norms in a classroom context. We may also then be able to examine the place of beliefs within 'in-the-moment' interactions. Our experiences as teachers – and conversations with other teachers – suggest the viability of this plan and indicate a high degree of resonance and recognisability in these structures.

RESEARCH QUESTIONS, PARTICIPANTS AND DATA COLLECTION

This paper draws on a larger study which enquires into how mathematics teachers perceive and feel about their subject, and how they share their emotional engagement with mathematics, especially enjoyment, with their students.

The data collected for the full study comprises of three data sets for each participating teacher: data on their life history; lesson observations captured in video; and, post-observation discussions of video extracts where the teacher is asked to recall and articulate their emotions and thoughts during the incident presented in video extract. The selection of these extracts is guided by data collected through a galvanic skin sensor, worn by the teacher during the lessons, which records moisture changes in the teacher's skin. These changes are taken (van Dooren, de Vries, & Janssen, 2012) as indicators of emotional shifts and, in our study, as potential indicators of shifts in the intensity – or otherwise – of the teacher engagement at given points in the lesson. The sensor generates a timed graph of aforementioned shifts.

Participants to the study are UK secondary mathematics teachers who teach the age range 11 to 16 and are at various stages of their career, but not newly qualified. We have representatives from both urban and rural schools, and by gender and age. We are currently sampling across the school year, for example in early autumn, when norms are set with new classes. We expect to visit our teachers more than once. At the time of writing, data was being collected from twelve teachers.

In this paper, we exemplify the proposed use of Goldin's *engagement structures* in a small sample of our data, from one mathematics teacher, Adam. To this purpose we offer a snapshot of Adam's practice in a rural UK secondary school and of his talking about mathematics and his teaching. We heard the teacher relating his life history and talking about an observed lesson whilst watching a selected part of the video recording of the lesson. The transcriptions from the three phases of the data collection (life history, recorded lesson, post-lesson interview) is a rich source from which to construct a profile of this teacher's *engagement structures*, and to explore the place of his affect, as exemplified by the data, within his mathematical identity.

ADAM'S AFFECT: AN OVERVIEW

Adam, as evidenced from both interviews and observation of practice, values helping others, as he sees himself as being able to do mathematics when others cannot. He enjoyed his school work-experience helping primary children in mathematics:

> ...I used to help students with their homework in the mornings, on the bus, in payment, [laughs] give me like a can of coke or a chocolate bar and I'd help them with their maths homework...

Whilst training as a teacher, "...just having that opportunity to work with students and show them bits and pieces..." gave him a renewed enthusiasm for mathematics.

Adam may then experience discomfort if he feels he has not helped enough, for example if students were leaving without full understanding,

> ...and this is where...possible...I was thinking [groans] they didn't get this... so we thought, give them a bit to emphasise […]. So I don't like it when students don't get something.

He evidently finds pleasure and satisfaction in his interaction with students, especially students who are willing to engage in effortful learning of mathematics,

> and um...teaching at that level, at that kind of GCSE/A-level pitch [UK age equivalent: 15-19], I just get such a buzz […] when it starts to get a bit more um...like algebraic um....a bit more 'mathsy' and bits, when they get it, when they like it and love it like I do, it's brilliant, I love it...hmm [sound interpreted as strong satisfaction and contentment].

Yet particularly in the short video extract of Adam's teaching discussed during the interview, his motivation is primarily time, to cover the syllabus content quickly. He seems to value rapid pace, as in the utterance "I'll show you something quickly to help tie this together". The pace was clearly troubling him as he returned to this theme often, in the interview. For example: "I was talking quite a lot and we weren't getting through the content as quick as we should have done."

He possibly experienced some discomfort or perhaps frustration in that the students did not have enough consolidation time and there would not be enough time to round off the lesson properly:

> ...in the normal way...I think that I was also aware that again I hadn't […] kind of switch off and just sit and let them do something for a longer period of time...

There is evidence of competitiveness, which may be rooted in his stories about his early mathematical experiences. At about age 5, he says, in comparison to other children: "I was just able to do it...I just got any kind of numbers or anything."

Achievement was a repeating theme. At age 8, he was rewarded with early peer esteem for being good at mathematics. Adam's story is about who was top in a test, and his empowerment when he got recognition from peers.

However, vulnerability appears when Adam found university mathematics challenging. When other people were better at it, he "...lost the love a bit for mathematics."

A further thread in Adam's stories is the place of significant others, in his case a high school mathematics teacher. Adam experienced successful learning in a 'traditional' practice orientated way (and the observation showed Adam also teaching 'traditionally'). Yet we also find that he kept an open mind about not being concerned about any mistakes in his board work, modelling accepting error as normal, "Yeh...I'm not fussed with that. It happens quite a lot. I always say to the students...I'll make mistakes, and they'll make mistakes...and there it goes."

Although all of the above is merely a snapshot of our data, we suggest that it reveals much about Adam and his potential *engagement structures*. We illustrate some of these next.

GOLDIN'S *ENGAGEMENT STRUCTURES* IN THE CASE OF ADAM

Goldin et al. (2011) identifies for students 'Get the job done' through characteristics such as deference to establishment and following of the rules. In Adam's case, these are also often the expected behaviours for a mathematics teacher: a need satisfied by achievement of the perceived obligations and through task completion regardless of whether, or what type of, learning is achieved. Such a position sees school mathematics as procedural. A story Adam tells about when his school was short of mathematics specialists at one point illustrates his unease with this position, "Um...so you kind of lose some of the nice bits of the job, all the perks, all the nice feeling, you are just trying to get the job done."

One of the conventional 'expected' behaviour and social interaction rules for success in mathematics is quickness (Black, Mendick, & Solomon, 2009). This is illustrated here by how Adam fulfils an identified desire for timely completion. The lesson observation data suggest that he inhibits comments or questions from the students in order to complete a mathematical task quickly and promptly. Yet he is not entirely comfortable with this, since he simultaneously engages in 'in-the-moment' behaviour, acknowledging by eye contact, use of 'we', and facial expression some student contributions, thus maintaining his approachable style. So, although we have examples of engagement within the 'Get the job done' structure within the data, we simultaneously have evidence that this is not entirely satisfying for Adam.

A second *engagement structure* we have evidence for is 'Look how smart I am'. A teacher adopting such a structure, as in the case of a student, would try to impress with ability or knowledge, both highly valued, and would give value to where self-regard has been increased. They would respond to an admiring audience and may have a performance goal orientation that includes competitiveness. Adam's emphasis on pace and identified examples of competitiveness both in mathematics and in administration tasks places Adam within this structure at times. His losing some of his faith in mathematics, exactly when he was challenged at university and could not perform highly enough to meet the demands of this competitiveness, also reveals a perception of a need for affirmation that was unfulfilled, and the subsequent seeking of a new, more satisfying path.

Yet Adam also exhibits elements of another *engagement structure*, 'Check this out', where value is given to utility yet also to mathematics solely as an enjoyable experience motivated by intrinsic or extrinsic reward, and includes both conscientiousness and consideration for what benefits there are in the activity. He seems to feel the need for completion of the activity, even if it means de-prioritising other aspects of learning, thus perhaps valuing utility. He also appears to find personal satisfaction in his own successes, both intrinsic and extrinsic.

To a lesser degree there is some evidence of a further *engagement structure*, 'I'm really into this', in Adam's data. In the video he appeared able to focus single-mindedly on a task, exhibiting a desire to experience flow – complete

absorption in what one does and for tuning out of the rest of the world (Csikszentmihalyi, 1990). Goldin suggests that the underlying need within this *engagement structure* is for understanding i.e. a mastery/goal orientation. We would also suggest that Adam finds satisfaction in the experience of teaching itself, and in finding solutions to the challenges within his role. Both are strongly associated with this *engagement structure*. The satisfaction of mastery of teaching skills is perhaps illustrated through his use of idiosyncratic, observed yet subtle gesture and interjections, used to modify behaviour. These gestures were quick and clearly 'norms' for the group. For example, he used a rapid and directed 'Shh' for seeking the attention of the class, and he used the word 'travellate', which had meaning for this class (they were expected to assess their learning in the session) and the students immediately responded as expected.

Yet, of all the *engagement structures*, we would suggest that the strongest match, (unsurprisingly) is with 'let me teach you', the strong evidence of a desire to help others understand and adopting a position of nurturance. Adam shows that he finds satisfaction in fulfilling this desire, and that this belief that he will find gratification in a positive response or appreciation is well established. This well established belief is evidenced when Adam talks about his own achievements, in particular the frequent use of a contented 'hmm' when he is proud of a remembered experience. Other examples include his statement that the students liking mathematics because they also like him is rewarding: "I think um...students I teach get that enthusiasm from me, and they like the subject."

Adam also used vocal tone and emphasis to stress mathematical points, and his speaking pattern was different for this purpose than for other parts of the lesson: the pace in these parts of the recording became slower and more repetitive. His voice had contrasting volume, and became louder for significant junctures in mathematical explanation. We would suggest that students, exposed to this pattern regularly, would soon 'tune in' to what Adam intended to highlight as important.

TEACHER *ENGAGEMENT STRUCTURES*: AN EMERGING PERSPECTIVE

The preceding analysis sample, based on data from observation, life history interview and post-lesson interview with one participant in our study, reveals more about Adam's stable beliefs, as opposed to 'in-the-moment' emotional structures. This may be due to the broadness of the structures, especially what comprises 'Let me teach you', an issue which may later prove to limit the value of *engagement structures* for analysing interactions between teacher and student. Hannula (2012) also questions the stability issue, in that emotions are stable if the emotion patterns are similar in similar situations, becoming similar to beliefs which appear with particular triggers and this is what this analysis is revealing, and less about 'in-the-moment'. This needs further investigation.

Adam, experienced and comfortable in his role, very openly shows his shifting emotions in a classroom context. Therefore, his affective pathways (Gerald A. Goldin,

2000) are orientated into his beliefs and identity as a mathematics teacher. According to Hochschild (2003), emotions are generally managed according to organisational expectation rules, such as for display, framing and feeling. The role then becomes a baseline for appropriate emotional display, which we see as very much the case for a teacher of mathematics. Suppression may be evidence that the teacher is self-regulating his affect. We are not sure whether the teacher can, given role expectations, experience the meanings of a mathematics classroom as either emotionally engaged or disaffected in the same way as a student. We would, for example, suggest Adam appreciates and articulates times when he experiences class as pleasurable, yet is not so likely to reveal feeling bored, nervous, mean, mad or frustrated in class, as he may think that this would imply some valuing for unacceptable negative emotions.

Nevertheless, a key part of *engagement structures*, meta-affect, a strand which G.A. Goldin (2002) suggests is 'affect about affect', provides stronger evidence to establish any *engagement structures* in the case of a teacher. The teacher is more likely than a student to reflect emotionally on experienced emotions, including self-monitoring of their emotions (DeBellis & Goldin, 1997; DeBellis & Goldin, 2006). For example when, as discussed earlier, Adam adds a contented 'hmm', he seems to be assigning positive attributes to the described emotion. One could interpret this unconscious purr as the very act of internally experiencing affect as a transformative tool for converting the experienced affective pathway into a positive experience or a more permanent belief. If this interpretation is valid, then such a response indicates the presence of an *engagement structure* since, according to Gerald A. Goldin et al. (2011), it is the structure that evokes meta-affective responses.

So, to address our intended use of the model as a tool for analysis, there may also be new positions emerging as the research progresses and the model is applied to other teachers. However, we think at this stage that similar structures apply to teachers as well as to students, but with important provisos. *Engagement structures* for teachers cannot be divorced from the differentiated power relationship between teachers and students, and norms play a significant role as regulators of classroom behaviour management. For Adam, there seems to be a high level of norm setting in the relationship with students, which appears to facilitate the opportunities for learning in his classroom. Norm setting may therefore act in combination with Adam's beliefs, acting as both promoter and limiter of 'in-the moment' interactions. Approaching the data in this way has revealed this strong association.

To conclude, we would tentatively concur with Goldin's (2011) suggestion that the value of *engagement structures* lies in enabling practical access to the complexity of teacher emotions as they engage in teaching mathematics and that developing a deeper understanding of these structures could provide a unified tool towards deeper understanding of the interplay between teacher and student emotions.

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