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Contradiction and conflict between 'leading identities': becoming an engineer versus becoming a 'good muslim' woman

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Abstract This paper builds on previous work (Black et al., Educational Studies in Mathematics 73(1):55-72, 2010) which developed the notion of a *leading identity* (derived from Leont'ev's concept of 'leading activity') which, we argued, defined students' motive for studying during late adolescence. We presented two case studies of students in post-compulsory education (Mary and Lee) and highlighted how the concept of a leading identity might be relevant to understanding motivation in mathematics education and particularly the 'exchange value' or 'use value' of mathematics for these students. (Lee's identity was mediated by mathematics' potential exchange value in becoming a university student, and Mary's more by its perceived use value to her leading identity as an engineer.) In this paper, we follow up Mary's story as she progresses to university, and we see how she is now 'led' by contradictory motives and identities: Mary's aspirations and decisions seem to be now as much related to her identity as a Muslim woman as to her identity as an engineer. Therefore, we argue that more than one identity/activity may be considered as 'leading' at this point in time—e.g. work versus motherhood/parenting, for instance—and this raises conflicts and tensions. We conclude with a more reflexive account of leading identity which recognises the adolescent's developing awareness of self—an ongoing process of organisation as they experience contradictions in managing their education, work, domestic, community and other lives.

Keywords Leading identity · Leading activity · Self · Development · Motives · Activity

1 Introduction

Mathematics education has long been concerned with how to construct mathematics activity which engages with students' developing motives, particularly adolescents'. (See Williams & Goos, 2013). The fact is that most adolescents drop mathematics as soon as it is no longer compulsory, while even those who choose to study mathematics may have little interest in the subject per se and pursue it for other reasons (e.g. Williams, Black, Davis, Pepin &

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Wake, 2011). One might argue that the majority of mathematics curricula, because they focus on intra-mathematics educational concerns, do not engage many adolescents whose motives for studying (amongst other activities) typically begin outside mathematics. This is not to say that mathematics cannot be made engaging, but it does raise concerns and suggests all mathematics educators need to consider what motivates adolescent students in our classrooms: the subject of this paper.

In a previous paper (Black, Williams, Hernandez-Martines, Davis & Wake, 2010) we developed the notion of leading identity using Leont'ev's (1981) concept of leading activity in order to address this issue. We drew on interview data with post-compulsory mathematics students to argue that the notion of 'leading identity' can be used to unpack the student's motive for study and as such can shape their relationship with mathematics. We argued that whilst some students might focus on a leading identity of 'being a student' and engage with the leading activity of 'studying' to gain qualifications, others focus upon 'studying' with a vocational future in mind and thus attend to the 'use value' of mathematical knowledge beyond schooling (i.e. the leading activity provides an aspiration for further growth into a particular vocation). We concluded that understanding developing motives for study in adolescence is complex, yet crucial, if we are to design a curriculum that enables students to engage and subsequently persist with mathematics when they may otherwise lose interest and drop out.

This paper seeks to add complexity to this argument in that we consider the various competing identities students negotiate as they progress into adulthood. We take up the story of Mary who appeared in the first paper and, using narrative analysis, we highlight the multiplicity of motives she engages with as she experiences transition to university and consequently, the complex relations between identities which may emerge through such engagement. We suggest such an analysis requires us to re-consider the notion of 'leading' in line with more recent debates in Cultural Historical Activity Theory (CHAT) whereby the possibility of multiple identities (Holland, Lachicotte, Skinner & Cain, 1998) has emerged. The implication of this argument is that such multiplicity may make constructing mathematics activities which engage with such diverse motives even more complex than we previously suggested.

As such, we add to a body of research which utilises CHAT to examine the interplay of identity and learning in adolescence (Nasir & Hand, 2008; Hegedus & Penuel, 2008) and more specifically, how relations and conflict between different identities (e.g. academic and peer group) can be manifest in learning activities (Wortham, 2004; Nasir & Saxe, 2003). Vianna and Stetsenko's (2011) account of Jay—an adolescent resident in a group home—is of particular relevance to this paper because they connect conflict and contradiction between identities to transformative development both individually and socially.

2 Leading activity and leading identity

The CHAT theoretical framework which underpins our analysis was discussed in detail in our previous paper (Black et al., 2010). Utilising this framework we provided an account of Leont'ev's notion of leading activity and our derivative concept of leading identity with an explanation as to how the two concepts were connected. What follows is a summary of the key points of this framework in order to illustrate how our present discussion builds on our previous analysis. However, the reader may find it useful to refer back to the original paper for a fuller account.

2.1 Leading activity

According to Cole and Gajdamaschko (2010), the notion of a leading activity which can be seen to serve a significant developmental purpose and which corresponds loosely to a child's age was introduced in Russian CHAT in response to 'internal' stage theories of development (such as Piaget) which located developmental change essentially inside the head. Leont'ev defines a leading activity as one that plays a particular role in shaping psychic processes to the extent that development is dependent on them. So whilst we engage in a variety of activities on an everyday basis, some of these are more important than others in shaping our development and the structure of the psyche. We highlighted Leont'ev's example of 'rule based play' which he presents as a leading activity for the pre-school child because the motive and structure of the activity mediates a significant shift in the child's awareness of social relations and interactions, which paves the way for future 'non-play' rule bound activities (e.g. schooling, sport). Thus, the leading activity at any one particular stage in a person's life is not defined in terms of dominance or salience to the individual at a given moment in time but rather its significance in developing one's capacity to engage in new, more advanced levels of activity in the future. As Leont'ev (1981) states, human life:

> is not built up mechanically … from separate types of activity. Some types of activity are leading ones at a given stage and are of greater significance for the individual's subsequent development, and other types are less important. Some play the main role in development and others a subsidiary one. (1981, p. 95).

Leont'ev states that a leading activity can be identified where we see a shift in the child's motive to engage with a particular activity so that the original motive is surpassed by a new motive and thus generates a new activity. Our previous paper outlined his example of a student engaging with the activity of homework study with an original motive to please her parents. Through engagement a new motive is generated (e.g. she sees that it pleases her teacher) and consequently, homework becomes part of the new activity of schooling for the child. The outcome of the activity (getting good grades, pleasing the teacher) becomes more important for the individual than the original intended motive and so a new 'objectivisation of needs' emerges. Similarly, we might argue that school mathematics activity(ies) could be developmentally significant (thus, leading) if there is a shift in motive, whereby the original motive (e,g. achieving a high grade in an exam) is replaced by the realization of a new motive (e.g. providing useful knowledge for future studies at university or work) through engagement with the production of the activity's outcome.

It is also important to point out at this stage, that what counts as 'significant' or leading is not merely defined in terms of the individual but "is as much to do with whether it is leading or not as the societal sequence of activities." (Beach, 1999, p.125). Therefore, our analysis of the leading activity must pay attention to the sequence of leading activities society offers the individual. Beach (1999) argues that in most westernized societies this follows the pattern of play—school—work—retirement. As we previously stated, the students we are working with are at the cusp of transition from education to the adult world of work and as such, we can view this particular post-compulsory phase of education as a leading activity if it offers a new, adult motive relating to this next developmental stage.

2.2 Leading identity

Using Leont'ev's concept of leading activity, we developed the notion of 'leading identity' in our previous paper. Here, we drew on Leont'ev's (1981) account of the development of

the personality (or 'self' as others have referred to it e.g. Stetsenko & Arievitch, 2004). Leont'ev argued that through engagement with many different cultural activities, we experience a diverse range of motives and subjectivities during the course of the lifespan. Over time, when our subjectivities are reflected upon, some may become crystallised as social identities and used as 'tools' to understand ourselves. Thus, like Holland et al. (1998) we see a distinction between subjectivity and identity with the latter viewed as symbolic markers defined by specific, historically constituted 'figured worlds'.

Our previous paper defines leading identity as the social identity made available through conscious reflection in relation to one's subjectivity in doing a leading activity. Furthermore, we argued it is this which provides hierarchical structure to the developing self (or personality) in that it shapes which identities are more or less 'significant'. For instance, Vygotsky (1986) tells us that instructional activities (pertaining to scientific concepts) for the school aged child can 'lead' development in that they foster higher mental functions such as voluntary attention, logical remembering and ultimately reflective awareness. Such activities may be considered leading, since they encompass new 'scientific' motives which are distinct (in terms of their social roots in academic activity) but firmly rooted in the 'everyday' activities encountered in the pre-school years (and outside the school walls)—i.e. they engender a new relationship between the child and the object of study including new attitudes towards such objects and new ways of representing them in consciousness. We might suppose, therefore, that the identity which emerges out of engagement in instructional activity (e.g. as a learner) during the school years gradually gives hierarchical structure to the other identities children negotiate at this time (e.g. as friends, sons/daughters etc.), although this clearly depends on the degree to which the motive offered by schooling activities 'marches ahead' of the child's development. N.B., we have noted elsewhere (Williams, 2012) reasons why this may not happen, citing for instance, the detachment of school activity from those deemed as 'experientially real' or meaningful to the learner.

It is the notion of 'hierarchy' that we seek to unpack in this paper—whilst the child's engagement in one, culturally defined yet developmentally significant, sequence of leading activities may make sense in terms of organising the development of higher mental functions and concept formation (Vygotsky, 1986), to what extent can we apply this notion of hierarchy to adolescents? Vygotsky (1998) tells us that development in adolescence is essentially 'a problem of interests' (or motives[1]). During adolescence a multiplicity of interests unfolds which are gradually whittled down to 'a basic nucleus of interests' as the adolescent grows into the life of the community that surrounds him/her. As we have noted, such interests are not intrinsic but rooted in the structure of the activities with which one engages and provide for the possibility of multiple identities.

> Unlike the development of instincts, thinking and behaviour of adolescents are prompted not from within but from without, by the social mileu. The tasks with which society confronts an adolescent as he [sic] enters the cultural, professional and civic world of adults undoubtedbly become an important factor in the emergence of conceptual thinking. (Vygotsky, 1986, p.108)

[1] Since Vygotsky places emphasis on 'interests' as deeply rooted in the structure of the activity we might equate this notion with Leont'ev's notion of 'motive'. For instance, of activity Vygotsky (1998) comments "Human activity is not simply the sum of unregulated working habits; it is structurally encompassed and regulated by integral dynamic tendencies—strivings and interests." (1998, p.8) This aligns with Leont'ev's notion that motive is rooted in the structure of an activity and mediated through the dialectic relationship between the individual mind and the activity bringing about a specific 'objectivsation of needs' .

Therefore, we might argue that development in adolescence is about a growing awareness of our place in the adult world and the increasingly conscious process of structuring our personality (i.e. providing order to the multiple social identities we draw on to understand ourselves) within the frame provided by society (complete with regulative structures which make specific positions available). As Holland and Lachicotte (2007) argue, the reflexive nature of this process means we exert some sense of agency over the ordering of the personality (i.e. working out which identities are a priority for our own development etc.). This developing process of self management and reflexivity is, according to Vygotsky, crucial to the development of the adult personality.

In our previous paper, we focused on students' work/career aspirations as new, emerging interests or motives for studying mathematics which were derived from certain school or workplace experiences and upon reflection, invoked a student identity which was orientated towards an adult future in the workplace. Thus, a shifting motive towards taking up one's place in the workforce was seen as crucial to the identification of the leading activity/identity for some adolescents (not all) and the subsequent 'hierarchical' organisation of other identities with which they might engage. Yet Vygotsky's focus on the multiplicity of interests/motives facing adolescents (and their subsequent identities), which are mediated not only through work-focused activities but those pertaining to wider social, cultural and civic duties also, raises the possibility of several leading activities emerging during the adolescent phase. Thus, we might suggest that the reflexive process involved in structuring the personality may be complex and riven with conflicts and contradictions rather than organised (and re-organised) in a linear hierarchical fashion towards psychological maturity. It is this organisation of our multiple interests, activities and identities that we now consider in respect of our data—however, it remains the case that to be classified as 'leading' in this developmental sense, such activities must involve some shifting motives (change) for the student in relation to future adult activity (in the social sense) and therefore, some remain more significant than others.

3 The data

In our previous paper (Black et al., 2010) we presented the story of Mary,—an Asian female student in her late teens, who, we argued, told of a leading identity of 'wanting to become an engineer'. We argued that this leading identity gave her enough motive to persist in studying mathematics in the face of certain troubles—(e.g. being placed in a low set for mathematics, failing specific exams etc.). In this paper, we re-visit Mary's story in light of new interview data which we obtained after her transition to university.

The data come from two research projects which investigated student participation in mathematically demanding programmes/courses at post-compulsory level (aged 16–17 years) and at university (17–19 years) (see www.transmaths.org for more detail[2]). This involved interviews with approximately 40 students focusing on their background history, their experiences with mathematics, career aspirations and disposition towards future study. Mary was a participant in both of the above projects so we have 6 interviews with her—the first of which was conducted at the age of 16 when she began post-compulsory education

[2] We acknowledge the support of the ESRC-TLRP programme for "Keeping Open the Door to Mathematically-Demanding Further and Higher Education Programmes" (RES-139-25-0241) and the support of the ESRC for the "Transmaths" project "Mathematics Learning, Identity and Educational Practice: the Transition into Higher Education" RES-062-23-1213.

and the last took place at the beginning of her first year of undergraduate study at university (aged 19) having already completed a supplementary Foundation Year (see below).

Using a CHAT perspective, we recognise the interview activity as a space where students (and interviewer) are encouraged to reflect on the many subjectivities the interviewee has experienced and which pertain to the activities in focus (e.g. mathematics for engineering workshops). In this sense, we recognise the interview situation as an identity-forming activity of its own—whereby a particular identity may be narrated or become crystallised in the course of constructing some kind of discursive 'object' with the interviewer. As we have argued elsewhere (Black et al., 2010), we view the student as a boundary crosser—transiting between their subjective experience of the activities in focus (e.g. those relating to their university degree programme) and the interview activity. Thus, we recognise the interview data as permeated by subjectivities experienced outside of the interview activity, which are then reflected upon within the interview.

4 Analytical framework

The framework for analysing Mary's interviews remains the same as before (see Black et al., 2010). We use narrative analysis to explore the identities students' constructed as they engaged in the reflective activity of being interviewed and how these may relate to each other. The framework we have employed combines discourse analysis (following Gee, 1999) with a CHAT approach. In terms of discourse analysis, our students' interviews are viewed as biographical narratives which are made up of inter-connecting sub-stories which can then be connected (or disconnected) through the analysis process. This involves the identification of a central 'plot' within or across a number of interviews and recognition of sub-stories (as told by the student) which are then considered in terms of their proximity to this (Goodson & Sikes, 2001). We have used the constructs of leading activity and leading identity as the central plot. The operationalisation of these and other CHAT constructs (and others) is outlined in Table 1 below.

The use of leading activity and leading identity to formulate a central plot means that our analysis connects the sub-stories students tell to present the 'whole story'—i.e. what students tell us across the interview(s). Inevitably, some sub-stories told within the interviews are not included in this paper; we have selected data that are of significance to the overall plot (i.e. the student's leading identity).

4.1 Mary's story: prior to university

In our previous paper, we presented Mary's earlier experiences and attitudes towards education and mathematics as a 'canonical' story, which was shared amongst a small number of students in our sample (5 out of 40 students). This story was identified as 'when troubles come, aspirations remain the same' and in Mary's case, we told of her leading identity of becoming an engineer which enabled her to persist with studying mathematics despite being placed in a low GCSE set and dropping statistics at post-compulsory level (due to likely failure). We argued that this leading identity emerged out of Mary's engagement with her GCSE Engineering programme (Double Award) during which she undertook various design projects (the leading activity). Mary, herself, identified such projects as crucial in shaping her aspiration to become an engineer and spoke of how this experience developed an awareness of her 'needs' as a student ('I like hands on stuff') and her future potential self.

Table 1 Constructs used to read the data (taken from Black et al., 2010)

Construct	Operationalisation
Leading Activity	Used to identify an activity which involves a significant shift in the student's motive to engage with that activity or others like it. This may relate to a particular sub-story the student recounts or may refer to shifts in motive which are apparent when comparing the sub-stories told at different points in time (i.e. between the first and second interviews).
Leading Identity	Identity statements pertaining to the new relations between motives, emerging through the student's engagement in leading activity. Identity statements may refer to either their state of being (in the past, present or future) (e.g. I am, I will be, I was etc.) or themselves in action (e.g. I do, I got, I will do). The intention is to establish if/when one particular significant identity acts as a driver to both the student's sub-stories and our subsequent interpretation of the data.
Cultural Models	The identification of cultural models is thematic focusing on beliefs, propositions or value statements, e.g. those made about mathematics and learning mathematics. Central to the identification of such statements as cultural models is establishing them as socially shared (or culturally derived). This was achieved through an empirically grounded cross-sectional analysis of the whole interview data set which highlighted beliefs as common amongst the whole sample or specific clusters of students. Additionally, some of the cultural models we refer to, such as 'maths is hard', also draw on wider discourses about maths and have been identified in previous research (Mendick, 2006; Solomon, 2007).
Troubles/Obstacles	Drawing on Bruner (1996) we sought to identify sub-stories where the student recounted 'troubles'—problems or challenging events in their experience of being in college which may bring about a shift in motive/identity for the student through reaching some kind of resolution or rationalization (not always positive). We are particularly interested in those 'troubles' which may signify some kind of 'crisis' for the student—Leont'ev notes that a 'crisis' may occur when a youngster's 'potentialities' are not matched to their social reality (the activities they engage in).

> That whole process [making something from scratch] and that accomplishment and that feeling I got, I loved it and I just thought I really want to keep that and be part of it. One of my dreams is to do something massive, and be like, "Yes, I did that." (cited in Black et al., 2010)

We classified this as a leading activity for Mary since it appeared to involve a shift in her motive for 'studying' which was linked to her future self in the workplace—thus she spoke of the knowledge she acquired on her course as having 'use value' in terms of its eventual consumption (i.e. being of use to her future labour power and position in the workplace) which was over and above its 'exchange value' (i.e. for grades, qualifications etc., Williams, 2012).

4.2 The possibility of competing and conflicting leading identities

When we interviewed Mary at university she was still studying to become an engineer through undertaking a Foundation Degree in Mechanical Engineering at "X" University. This was not her original first choice of institution or course that she could have attended after obtaining the required grades through her A-level results but instead was an alternative option she had taken up because she wished to remain living at home (her first choice was approximately 200 miles from home and would have required moving away). However, this decision had come at a cost; it had necessitated that she take an additional Foundation Year because university X would not allow her direct entrance on to their undergraduate degree programme in Mechanical Engineering.[3]

[3] In England, students can take a Foundation year at university in certain vocational subjects (e.g. engineering, art & design) prior to starting their undergraduate degree programme if they have not obtained sufficient qualifications for direct entry.

Nevertheless, the two interviews we have with Mary at university suggest 'becoming an engineer' is still very much a leading identity for her, although her aspirations have shifted a little towards aeronautical engineering.

> You know maybe do aeronautical. I wasn't, I'm still not 100 % sure because there's a lot of choice in the stuff— […] But I think what I was going to do was stay with mechanical engineering and do maybe a Masters in aeronautical aerospace you know, something like that.

She described her experience of studying engineering on the Foundation Course course at university in fairly positive terms (e.g. performing well in assessments, positive peer group relations etc.) and suggested this was a constructive turn in her story given prior troubles with her studies (particularly mathematics) in the past:

> I think it [recent success on her course] was just because I finally knew what I wanted to do. […] I've always wanted to do a sort of Maths and I knew I liked making things […] I can't wait to get my job and you know, call myself an engineer. It'll be such a great moment in my life I think.

Thus, as in our previous paper Mary continues to speak of a motive for studying and 'doing well' at university as driven by her leading identity of becoming an engineer in her future. Indeed, she asserts an alignment between the motive offered by her university engineering course and her own goals (leading identity) as responsible for her positive engagement with her studies. Further, we see a sense of consistency in these goals as rooted in her previous educational experience ("I've always wanted to do maths…I knew I liked making things") and, as before, Mary continues to perceive a certain synthesis between her education and future labour which engages her interest as she progresses to adulthood ("I can't wait to get my job … and call myself an engineer").

However, this was not the only identity that Mary spoke of in her later interviews. There were repeated references to other identities, particularly her identity as an Asian female. For instance, she told of a family narrative regarding her 'designated future' and the activities which this might implicate: "we have a very backwards sort of family. It's a very Asian sort of, you know, girls should stay at home to do the cooking— […]Where the guys go out and work." Thus she draws on an identity of being an Asian female which implicates a different developmental sequence of activities to that of becoming an engineer—this development may be seen as 'schooling followed by motherhood/domestic work' and would perhaps engender a very different motive for 'studying'. Whilst this was not an identity she was keen to subscribe to in this quote (hence the reference to "a very backwards sort of family"), in other parts of her interviews she did utilise her Asian female identity more readily.

Furthermore, her interview data suggested that being an Asian female created tension with her apparent leading identity of 'becoming an engineer'. Mary spoke of this tension in describing her developing relations with her peers on her engineering course and how this was perceived by some members of her community:

> I think they were just worried about me being a girl, erm, because I'm a Muslim girl. […] Erm, and obviously in Islam … you shouldn't really, .. let men touch you [..] because … all my friends are really guys, … sitting next to them, …to most people that would look quite bad… a lot of people think I'm doing it for silly reasons, but……in my heart I know I'm not doing it for silly reasons, … I'm here for me, I'm doing my work, I'm not messing around. So there's, there's been a lot of that happening.

Further evidence of tensions between these two identities (becoming an engineer and being a Muslim girl) emerged when Mary spoke of her decision making in relation to studying engineering at university. She spoke of having to convince her parents and her sister that "Engineering was something I've always wanted to do" and informed us that "my step-granddad he doesn't agree with it still." But she tells us "… I've just started to ignore him now because it is just, I'm so happy doing this course…" So Mary tells us that her trajectory of "becoming an engineer" has implicated some resistance to the identity laid out in her family narrative. However, a sub-story regarding why she chose to go to X university suggests her identity as an Asian female has to some extent informed her transition into university. As mentioned previously, Mary has opted to take an additional Foundation Year in order to attend a university near her family home (important to her as a Muslim girl) rather than an institution which, according to her earlier interviews, offered better prospects for her future career as an engineer but required that she live away.

> **I**: And you said that you'd chosen to go to X university which meant that you had to do an extra year. […] What would you say was the main reason behind that choice that you made?
>
> **M:** There was a lot of reasons kind of behind that choice. When I got home from going out with my friends saying, 'yeah I finally got into university', and they were all kind of jokingly laughing about a lot of things, after I came home, my family were home and I sat down to them and I said to them, 'obviously I got these grades' and I said, 'I got accepted into both universities but I kind of want your help to kind of choose'. […] They all wanted me initially to go to X university cos they wanted me to stay close to home and stuff like that. And I said to them that, well it's not really about that, and then when I thought about it more. I thought X university was actually a very good university. I mean it does, it is made, it's for Engineering—[…] I didn't go Y univeristy cos it is very far away.

The extent to which this is linked to her identity as an Asian female is more clearly articulated when Mary discusses how the need to live at or near home might be a key hindrance to her future career development:

> **M:**…I think, the thing that will probably stop me from going all the way to the top of engineering, because … I've been warned, erm, a few times that if you are going to the top of engineering you do have to make a lot of sacrifices when it comes to family and friends. […] I think when it comes to my family it's really… because I'm quite, it's quite a strong Asian family, so…[…] it can be difficult
>
> **I:** Yeah, so, how would they kind of stop you getting from going right to the top of engineering?
>
> **M:** Erm, I think, to get to the top you need to travel a lot. …there's obviously my parents and my sisters and my cousins that live here, I think, to kind of leave the country, or something like that for a long period of time it's quite difficult for them. […] I might find a job here and I might love it around the corner…or something. […] Come home every night and have dinner, yeah.

So whilst Mary continued to tell us of her commitment to a future in engineering, her comments here implicate another future trajectory associated with her identity as an Asian female. Rather than talk only of her engagement in the activities which constitute her engineering course, she also appears to place emphasis on the activities which constitute family and domestic life (maintaining relationships, sharing meals … and maybe making sacrifices of these etc.). Furthermore, she had begun to perceive a conflict between this

future and a 'successful' career in engineering—a conflict which she describes as a challenge (although not an insurmountable one)—"But I think, cos my challenge is, it's [becoming an engineer] gonna be a bit harder, because I'm from the family I am and because of the religion I believe in…"

5 Discussion

In conclusion, Mary's new story encourages us to believe that for her 'becoming an engineer' may still be a leading identity in the sense we previously argued, but her story has now developed complexity and her identity as a Muslim woman is a major additional factor in her identifications and reported decision-making regarding her development. Whether the engineering identity is now 'leading' in any sense of 'dominant' must be questioned. But as we noted earlier, the concept of 'leading identity' (and leading activity) is not about dominance in the present but rather the identity's significance in terms of adolescent development and the emergence of new, adult motives. Some social identities may go nowhere significant developmentally even though they seem important to the adolescent in the present. Consequently, the question should be: where is the activity/identity leading?

So now we must consider how being/becoming a 'Muslim woman' can be seen as another contender for a leading adolescent identity, one that prepares for a particular, future adult self. In this case, the social relations and activities of the family and community could come to play an important role in development, encompassing new motives which serve functionally in a sense akin to the instructional activities that prepare for university. As woman-hood and marriage approaches, such motives/identities might be considered as leading there, and so as leading the social development of the personality towards a certain kind of woman- or mother-hood. In this analysis 'mothering' might be seen as being as much an essential social (adult) activity as 'work', and should perhaps be included in the typical, westernised, sequence of leading activities identified by Beach (1999). In the particular cultural, ethnic, gender, and class context which Mary comes from, the activity of 'mothering' would seem to be one of nurturing family and community relations, of making 'sacrifices' of contradictory ambitions, and being home 'every night' for dinner.

As such, we claim that it is not just possible to acquire more than one social identity through discursive identification with various social groups (e.g. I am a goth/hockey player/violinist) but, there may also be plural and contradictory leading identities preparing for distinct adult identities. Such a proposal cuts to the heart of our focus on adolescence in terms of considering how multiple social identities may be implicated in development in this phase. We are now challenging Leont'ev's view (and others within this theoretical framework) on the social structure of the personality/self which appears 'linear' and hierarchical because the activities that these authors were concerned with were those thought to be psychologically 'developmental'—and the notion of development or growth of the child into the adult adhered to is thought of as normatively 'upwards' towards psychological maturity. So in Leont'ev's account pre-school 'play' serves the social function that it prepares the child developmentally for schooling, the normatively 'next' social stage in societies that prepare and socialise this way.

Here we are suggesting that in the adolescent phase a kind of branching begins to appear in the structure of the personality/self whereby several identities can now become 'leading' in their own right and begin to enact diverse developmental pathways (akin to Lave's (1996) notion of 'telos'). This is concurrent with Vygostky (1998) who suggests a lack of

uniformity in development during adolescence which is deeply embedded in the increasing influence of the social environment and the adolescents' social position mediating their multiple interests and identities.

As such, schooling may prepare for adulthood, social maturity and work through various means, including 'scientific', humanities and other studies, but also through learning to negotiate assessments, deadlines, and conflicting expectations, and to handle peer and sexual relations. In this paper we have suggested two branches within the structure of one student's social personality/self (i.e. becoming an engineer in the adult world of work and becoming 'a good Muslim girl' in the community/family/domestic world involved in being a mature adult). Furthermore, our data indicate that such partial ordering can potentially afford a complex structure that individuals may have to negotiate, with all kinds of latent contradictions surfacing in conflicts. Considering the two 'leading identities' of which Mary speaks, we can see them as contradictory in the sense that they offer two distinct futures which are in opposition and are potentially incompatible. So we could conceive of a scenario where the leading identity derived from family activities (which forms a particular developmental pathway) hinders an educational/vocational leading identity (as in Mary's account of not being able to travel extensively which she perceives important to being an engineer). Looking across our data set, we find many similar stories of students experiencing such contradictions in adolescence, and often these relate to students' emerging adult responsibilities as carers in their communities, reflecting ethnic, gendered, and class relations.

The issue then arises as to how contradictions and conflicts between leading identities can be resolved (or produce change). As we noted earlier, the adolescent phase is characterised by Vygotsky and Leontiev as the stage when reflection on the self(ves) in practice produces self-regulation and agency: the adult can, in the right circumstances, come to see these selves and contradictions, and through semiotic action (i.e. discourse with others and self-reflection), come to have some degree of control over them. Vianna and Stetsenko (2011) also make this point by showing how Jay (mentioned earlier) adopted a new agentive identity involving 'a meaningful life agenda' borne out of the contradiction between his identification with the macho culture of his 'group home' but simultaneous resistance to its oppressive regime. Similarly, we argue that the resolution of the contradiction between being 'a good Muslim girl' and 'a top engineer' involves progressive action and world-making by Mary and her allies, the making of new kinds of engineers, new kinds of good Muslim girls that overcome the contradiction she experiences. Furthermore, a Vygotskian approach suggests that such contradictions do not simply arise inside Mary's head but exist first on the social plane. They are deeply rooted in social, cultural and historical activities and the structural relations between these within the social system, and so we argue this work is not merely a discursive reconstruction or work of imagination, but the outcome of struggle in practice, a struggle that is not necessarily going to be successful, even in Mary's lifetime.[4]

It is at this point where we diverge from others who have discussed multiple identities/subjectivities within the mathematics education literature. Particularly those within the post-structuralist camp who have highlighted the multiplicity of positions or subjectivities which are made available through different and diverse discourses (Mendick, 2006; Evans, Morgan and Tsatsorini, 2006). For instance, Walkerdine argues that since subjectivities are produced in specific locations and are continually in contradiction and conflict with each other there can be no unified 'developing' self—this is merely an illusion or fiction. (Walkerdine, 1993). In contrast, whilst our account (along with Holland et al., 1998)

[4] This stance is not too distant from the revolutionary Vygotsky who, among others, would perhaps have argued for the emancipation of women being a clear 'progression' in humanity's forward development.

recognises that there is a multiplicity of identities which are located within the array of historically constituted activities with which we engage (or have engaged), this does not mean that we should abandon the concept of 'development' or progress through activity (i.e. it is feasible to theorise a non-uniform pattern of development). Rather we would support Gullestad's (2003) emphasis "on the reflexive efforts of the individual of bringing together their various performances and experiences in a unified conception of the self." (2003, p. 531). So whilst we can accept Walkerdine's (1993) critique that some notions of development within psychology are predicated upon a white, westernised, masculine and rational view of the self (and we even recognise some elements of this in Vygotsky's or Leontiev's writing) we would not wish to abandon the concept of development per se. As we mentioned above, development(s) may take the form of diverse pathways which are enacted through the 'self making' process through which we construct and order our various identities (Stetsenko & Arievitch, 2004). From adolescence this becomes gradually more self-regulated—and requires reflection about what's important to 'me'. For instance, one might become gradually aware of oneself as a particular kind of person which is at odds with another, perhaps more prioritised, identity. The outcome of such conflict might perhaps be resistance to or suppression of the former or alternatively transformation of both. This kind of reflexive process is about partial ordering of the self/personality—we tell ourselves who we are and presumably who we are not, and who we might be a little bit—we prioritise and decide what's important within the framework of identities we have constructed and reflected upon already.

To summarise, this paper builds on our previous argument regarding 'leading identity' in that we now seek to recognise a more reflective aspect to the self as a process. This advances Leont'ev's ideas on leading activity since we can recognise that whilst his use of this concept is not always part of a conscious re-structuring process in childhood (i.e. an activity can be developmentally significant for the child without their conscious awareness) it becomes more so in adolescence and in to adulthood. Further we recognise that whilst such reflection is mediated by cultural narratives (discourses) we are not constructed by them, we are more than this—hence agency. Thus we subscribe to Vygotsky's notion that the capacity for semiotic regulation of one another and of oneself makes it possible to transcend a present situated activity context and create a new one. As Vianna and Stetsenko (2011) note, in Vygotsky's account 'development' is not solely about individual progress but about changing oneself, gaining knowledge of oneself and of the world whilst engaging in transformative collaborative practices with others (Vygotsky & Luria, 1994). So we argue there is a way out or a possibility of change which is achieved through engagement with/reflection on the contradictions between our identities in this process of organising.

6 What are the implications for mathematics education?

We suggest these findings have implications for those interested in deepening engagement with mathematics and increasing participation in mathematically-demanding programmes and careers. This is particularly significant in the adolescent phase: mathematics curricula and pedagogy rarely take the diverse motives and identities of learners seriously, and this may be the most significant reason why mathematics education alienates the majority during this phase.

In particular the industrialisation and uniformity of mathematics educational curricula and pedagogy, particularly in its assessment and accreditation processes, works against the growing diversity of interests in adolescence. Taking seriously the complexity of students' formation of identity would surely involve a personalisation of the curriculum in which

individual students and groups of students explore questions and problems of interest to them, including the kinds of structural and political questions posed by ethnic, gendered, and classed presumptions of engineering professions and the like. A personalisation of mathematics education might then also become a radical and critical mathematics education (c.f. Skovsmose, 1994) in which pedagogy becomes expert facilitation, and schools become well-networked centres of research and inquiry, and students' learning outcomes are self- and peer group assessed.

While asserting the validity of this somewhat radical approach to a critical mathematics education, we also recognise the powerful stakes this can challenge, and many will argue that this is somewhat ideal and even impractical. Taking Bourdieu's point that education-as-reproduction is as much about failure as success, in practice it may prove to be a good deal easier to take these implications to elite institutions than to mass education where alienation on class lines (inter alia) becomes most obvious (see Bourdieu & Passeron, 1977/1990; Williams, 2012). Recognising that contradictions in society at large necessarily come to be reflected in educational activity, and internalised in identities, personality and motives should be no surprise. This suggests that working through these contradictions and conflicts is part of the critical educational enterprise, and that the object of a critical education needs to include the examination of these social conflicts.

From a CHAT perspective, research has highlighted how bringing community and classroom activities together to form new, 'hybrid' activities can foster productive contexts of development (Gutierrez et al., 1999). We would take this further to suggest the need to embed longer term social motives into such activities/programmes where the 'use value' of what is learnt is made 'experientially real' for students. We argue that the logic is to break out of the confines of schooling, engaging in social activity that aims at collective advancements in culture and social practice (see also Vianna & Stetsenko, 2011).

For Mary, working with the social contradictions involved in her striving to become a Muslim woman AND a top engineer involves becoming socially and politically conscious of what is involved, of getting organised with others, and making new worlds (Holland et al., 1998). The question is, can a critical mathematics education help her and her like in such tasks? In principle the answer must be yes: mathematics and mathematical modelling is surely about imagining new worlds (Skovsmose, 1994).

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