The issue of 'proudliness': Primary students' motivation towards mathematics

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In this paper, we study year 2 and year 5 students' expressed motivations for doing mathematics. The responses were analysed using thematic analysis; first with a deductive approach using themes from previous research, and then an additional inductive analysis searching for new themes. The results show that the children express both intrinsic motivation (cognitive-oriented and emotional-oriented), as well as extrinsic motivation (including outward and compensation). Two new categories of cognitive intrinsic motivation were found—normative and personal. The results also indicated an interplay not only between the different categories but also within categories, signalling that expressed motivation is double-layered. Some implications are discussed.

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1 Introduction

Motivation is a central component of learning, including mathematics learning (Gerholm, 2016; Schukajlow, Rakoczy, & Pekrun, 2017). Simply put, "to understand students' behaviour we need to know their motives" (Hannula, 2006, p. 165). A reduced description is that if learning is to take place, we need some incentive (Ryan & Deci, 2000a), and this incentive is pivotal if students are to direct their behaviour towards learning (Radford, 2015). Therefore, it is relevant to investigate individuals' expressed motivations if we want to understand why, for instance, some students are positively or negatively disposed towards mathematics, or understand the differences in performance in mathematical tests. One possible consequence of students' perceiving maths to be hard, boring and useless is students' choosing not to continue studying mathematics as soon as they are given a chance to opt out (e.g. Brown, Brown, & Bibby, 2008).

Even though there has been much research in psychology and general education generating several theories aiming to support explanations about motivation and learning, such as Bandura's (1977) theory about self-efficacy or Wigfield and Eccles' (2000) expectancy-value theory, the topic has not received much attention in mathematics education (Hannula, 2006; Schukajlow et al., 2017). Two relatively recent studies that focus on younger students' motivation for learning mathematics—year 2 (age 8) and year 5 (age 11)—both report that most students in year 2 express

mainly positive motivation towards mathematics whereas students in year 5 express significantly more negative motivation, such as stress (Blomqvist, Elamari & Sumpter, 2012; Dahlgren, Johansson & Sumpter, 2010). This contrasted with an earlier Swedish report that found interests and positive emotions peaked in grade 5 (Skolverket, 2003). Such results, potentially indicating a rather rapid change in expressed motivations and emotions, signal the need to know more about young students' motivations and other affective constructs. Therefore, the aim of this paper is to explore a qualitatively nuanced understanding of expressed motivation and potential relationships between different affect-related constructs. The following research questions are posed: (1) "What different types of motivation do primary school students express?" and (2) "How are these different types of motivation interrelated in the students' responses?"

2 Theoretical background

As stated earlier, motivation has been of academic interest for decades, and we can only give a limited background. Motivation can be understood as 'the engine that keeps us going', the drive to accomplish things that in one way or another are of some importance to us. More specifically, one definition is: when a person "is energized or activated toward an end" (Ryan & Deci, 2000b, p. 54) and inversely, when you feel no drive or inspiration to act you are considered unmotivated. Another definition:

> "Motivation is the process whereby goal-directed activity is instigated and sustained." (Schunk, Pintrich, & Meece, 2010, p. 4).

Both definitions relate motivation to a goal or an end which implies it to be understood as conscious, although not necessarily positive, since a goal can be either positive—striving for attainment, or negative—seeking to avoid. The word 'activity', also used in both definitions, connects the concept of motivation to a starting point, meaning that motivation needs to be triggered somewhere and somehow (c.f. Ryan & Deci, 2000b; Schunk et al., 2010). One explanation for the origin of these triggers and the energy of driving forces is the concept of need (Hannula, 2006; Ryan & Deci, 2000a), and more specifically the need for relatedness, autonomy and competence as inherent driving forces for human motivation.

In Deci and Ryan's (1985) theory of self-determination the notions of extrinsic and intrinsic motivation are considered as parts of the same motivational spectrum that

range from amotivated, where a person has neither positive nor negative motivation, to extrinsically motivated, to intrinsically motivated. What distinguishes between these levels are the levels and origin of self-regulation, a construct primarily linked to autonomy, but also to competence in the form of self-efficacy. When we see people doing something for the pure satisfaction of doing it, because it is fun or challenging and not because it renders you any type of external consequence, this person is considered intrinsically motivated, as opposed to an extrinsically motivated person being active in order to attain a certain outcome (Ryan & Deci, 2000a). However, in the way most schools are organised, factors such as grades and exams are linked to extrinsic motivation. This means that teachers also need to regard extrinsic motivation as an influence on learning. It has been suggested that intrinsic and extrinsic motivation should not be perceived as a bipolar construct, at least not in classroom situations (Harter, 1981), and research has shown that elementary school children express both intrinsic and extrinsic motivation when asked about their motives for studying (Lepper, Corpus & Iyengar, 2005). In relation to achievement, Hattie (2009) establishes a link between motivation and achievement but without potential direction differentiation. Further work on the relation between motivation and achievement is done by Garon-Carrier et al. (2016). Their results indicate that there is no correlation between motivation and achievement, but that the correlation exists in the opposite direction—from achievement to motivation—and they discuss both temporal links as well as linkage to academic self-concept in relation to this result (Skaalvik, 1994). Hence the importance of understanding the various levels of both intrinsic and extrinsic motivation (Ryan & Deci, 2000a) as well as the potential interplay between the two alongside other factors (Hannula 2006, 2012; Prat-Sala & Redford, 2010).

Both intrinsic and extrinsic motivation can be further divided into subthemes (Amabile, Tighe, Hill & Hennessy, 1994) with the two main themes falling into two subscales each: extrinsic motivation is split between Compensation (e.g. personal gain such as grades) and Outward (e.g. personal appearance such as status). Further, Intrinsic motivation is divided between Challenge (e.g. trying to solve problems) and Enjoyment (e.g. positive feelings). However, when applying these subthemes to the study of upper secondary school students' indicated beliefs, Sumpter (2013) saw the need for an expansion of the intrinsic motivation subthemes. The subthemes were called Cognitive and Emotional respectively, allowing for more cognitive-linked

motivation such as wanting to learn and an expansion of the emotional spectrum to include the negative.

Also, studies focusing on students' motivation point towards constructs being intertwined or in some sort of interplay (e.g. Gerholm, 2016; Jansen, 2006). One example is the longitudinal case study of Rita, reported by Hannula (2002, 2006). Rita's comments concern emotions, beliefs and motivation in such an intertwined way that it seems impossible to separate them. Other research concludes that the constructs in themselves can be internally intertwined with their sub-constructs and hence difficult to separate. The case of Sam, an upper secondary school student reported by Sumpter (2013), illustrates how negative cognitive intrinsic motivation appears to be compensated by extrinsic motivation. Another study, focusing on high achieving students in upper secondary school, stresses that the feeling of joy that comes from being socially accepted has a pivotal motivational aspect (Gerholm, 2016). But the very opposite can also be true: students can actively avoid participating in social classroom activities for fear of producing a socially stigmatising image to peers or appear to the teacher to be a poor student (Jansen, 2006). This behaviour was linked to acting on negative compensational motivation, meaning that emotions and beliefs linked to motivation could be both negative and positive. Studies like these can illustrate how social factors are at play in school-related situations and activities, both perceived (Sumpter & Sternevik, 2013) and expressed in task-solving sessions (Sumpter, 2013). According to Radford (2015), understanding the connection between the individual and socio-cultural realm is of value:

> "/.../ the affective domain in general and motives and motivation in particular are not only subjective but also sociocultural phenomena. They are subjective and sociocultural in the sense that on the one hand, motives are the motives of a concrete and unique person but, on the other hand, they relate to a sociocultural and historical world that transcends the individual. In its transcendence, the sociocultural historical world indirectly – albeit in a decisive manner – shapes and organises the individual's motives and emotions. "(Radford, 2015, p. 26).

In this way, motivation can be considered an individual-based construct as well as something that is shaped and organised in interplay with the cultural and social environment where the individual exists and acts.

2.1 Methods

The present study seeks to build on the results from Blomqvist et al. (2012) and Dahlgren et al. (2010) where students in years 2 and 5 answered a seven-item questionnaire (for a complete list of the questions see end notes) and the data was analysed using mainly quantitative methods. This meant that the results were limited: both studies only reported generally using a positive/negative scale while nuances or other aspects of motivation were not explored and no possible explanation for the reported differences was offered. In this study we used Blomqvist et al.'s questions for semi-structured interviews in search of a qualitatively nuanced understanding of the motivational construct. Thus, we collected students' descriptions of their mathematics education experiences and of mathematics in general. The data consist of transcripts of interviews containing the respondents' explicit utterances. In addition, their implicit communication, including exclamations, sighs and pauses have been taken into account since this taps into a person's possibly subconscious driving forces (Bryman, 2016; Kvale & Brinkmann, 2014). As this study focusses on motivation, responses in relation to Blomqvist et al.'s question number four, "Why do you do maths?", will be discussed here. Our decision to use students from year 2 and year 5 enabled comparison between our results and those of Blomqvist et al. (2012) and Dahlgren et al. (2010).

2.2 Participants

Three schools were sampled for this study in a way that captured the distribution between city and suburban as well as the socio-economic settings of the urban area where this data was collected. At each school, teachers teaching the intended grades were asked to participate, their pupils were informed, and consent was obtained from parents. Shortly before each interview, the teachers were asked to pick out, from the group of volunteering pupils, individuals that they considered to be neither particularly good nor particularly poor at mathematics so we could get a large and diverse group that lay between the two extremes. The teachers were also asked to consider whether pupils would react well in the interview situation, to avoid some of the common difficulties associated with interviewing children (Hritz, Royer, Helm, Burd, Ojeda & Ceci, 2015). Prior to the present study a pilot study was conducted with six students from year 2, four students from year 4 and five students from year 6. The pilot study indicated that the questions worked on a general level but follow up

questions were needed especially when the respondents started talking about other subjects such as Star Wars or computer games.

All the interviews were conducted by the first author of this article over a period of four weeks in the participating schools during lesson time and in a separate room close to the classroom. In total 19 students participated—ten girls (four in year 2 and six in year 5) and nine boys (six in year 2 and three in year 5) were interviewed. Each interview lasted for about 25 minutes, including time for a drawing task (item number seven), and was audio-recorded. This limited sample size does not allow for any general conclusions, but it will be sufficient to see nuances in how students describe their experience of mathematics and their emotional and motivational relation to it (e.f. Guest, Bunce, & Johnson, 2006).

The ethical considerations stipulated by the Swedish Research Council through Codex (Vetenskapsrådet, 2017) were followed, meaning that all respondents had written parental consent and were informed that they were participating voluntarily and at any moment could stop the interview without having to provide any explanation. The Council also stipulates how data is managed and reported, and therefore all names have been changed.

2.3 Interviews

Semi-structured interviews allow follow up questions to be posed, providing the respondent with opportunities to provide richer detail (Bryman, 2016). The follow up questions were mainly of the "please expand" type, for instance "could you explain a bit further?" or "can you give an example?" but questioning also facilitated following a respondent's line of thought. This technique also allows the intended meaning of questions to be reciprocally verified; either the respondent asks the interviewer back, "[H]mm, what do you mean…?" or the interviewer rephrases the question when the response reveals a misunderstanding of the question. In addition to revealing nuances the follow up/please expand questions provide the interviewer with a method for triangulation through a set of responses around one topic, thus a means of countering common methodological issues associated with interviewing children, e.g. neutrality issues, interviewees feeling intimidated, etc. (Hritz et al., 2015; Talmy, 2011).

2.4 Methods of analysis

The interviews were transcribed verbatim, including non-verbal communication such as exclamations or stresses of words, as well as sighs and extended pauses. Instances where the respondent highlighted and stressed a word were marked with italics. Non-verbal instances of a more temporal nature such as pausing were marked with (...) when the pause was short, approximately less than two seconds, and with rectangular brackets ([thinks]) if the pause was longer. For readability the transcripts followed standard spelling conventions, for example, an utterance like: "ifju-no-wadda-meen" was transcribed as: "if you know what I mean". In this paper, when sections are omitted to shorten excerpts these places are marked with (/.../).

In the complete transcripts, responses to a selected question were marked and the analysis was subsequently carried out in three steps, the first two deductively and the third inductively (e.g Braun & Clarke, 2006). A first categorisation was made by connecting responses to either of the two main themes, extrinsic or intrinsic motivation (e.g. Ryan & Deci, 2000a). Coding for extrinsic motivation focussed on answers connected to the outside world, like: "you[everybody] have to know", or more explicitly connected with reward or punishment: "if I get a job as a cashier when I grow up" or "[if I can't do it] it will be embarrassing", respectively. The second theme was intrinsic motivation—interest, enjoyment and satisfaction for instance, where one example of a response could have been: "it feels good when I do it".

The second, deductive analytical phase used a four-part mapping scheme: first, data connected to the Extrinsic motivation category were mapped against the sub-themes Outward and Compensatory, here understood as social-gain values (e.g. "I'm concerned about what other people think of me.") and personal-gain values (e.g. "I'm motivated by what I can earn.") respectively, as described in Amabile et al. (1994). Second, data connected to the Intrinsic motivation category were mapped using the same subscales as described by Sumpter (2013) as linked to intrinsic motivation: Cognitive and Emotional. The subtheme Cognitive frames issues of knowledge and personal development, and Emotional contains statements like "I think it's fun doing it". In the third and last step of the analysis we followed the inductive thematic analysis as described by Braun and Clarke (2006), searching the total wealth of the data for recurring themes that captured "something important about the data /.../ and represent[ed] some level of *patterned* response ..." (Braun & Clarke, 2006, pp 82, italics original). One example was various references to "the future". However, further

analyses of the data reveal variations, like explicit mentions of "a job" or making "calculations", that contribute to form a larger and more nuanced pattern. This phase of the analysis is an iteration where potentially enhanced variation is balanced by a condensation of themes, looking for the point where the themes are still coherent and descriptive, but not overlapping. In the cases where a respondent's utterance contained more than one theme, the utterance was split.

The analysis was made primarily by the first author, and any unclear responses were analysed by the two authors separately before being discussed to increase the reliability of the analysis.

4 Results

First, as an overview and a guide for the reader, we present in the form of a table (Table 1), the different themes that resulted from the analysis, including the different subscales which informed the deductive analysis, and the subthemes which came out of the inductive analysis. Below, the contents of this table are discussed.

Table 1. Explicit motivation expressed by students in years 2 and 5. Outward to be interpreted as social-gain values and Compensation as personal-gain values. (Total number of instances within brackets).

Main themes	Subscales	Subthemes
Extrinsic Motivation	Outward (27)	Important for the future (12)
		To be able to calculate things (8)
		To get/manage a job (6)
		To produce an 'answer' (explicit) (1)
	Compensation (5)	Not to make calculation errors (3)
		You succeed if you make an effort (2)
Intrinsic motivation	Cognitive (15)	To learn (13)
		Want to try new things (1)
		Maths makes you better (1)
	Emotional (9)	Fun/I like it (7)
		Exciting (1)
		No-stress (double negative) (1)

Looking at Table 1, we see that the most common response (n=27) was regarding extrinsic motivation with the Outward subscale. These subthemes, including similarities and differences, will be discussed in three themes that reflect the result of the study. The aim of this paper is not to study differences between the two age groups.

However, because we believe that the respondents' age is an important part of the context, we have chosen to include this in the excerpts below.

4.1 Future needs—important but often vague

Most responses were about a specific work task or a profession in the future and were analysed under the Extrinsic motivation Outward scale. Louise uses the example of working at the till in a supermarket/shop:

> "I should learn so if I work at the till when I'm grown up for instance and there is a fruit that cost 20 crowns, and the person gives perhaps 40 crowns, then I should be able to calculate how much he/she should get in return." [Louise, Y2]

Here, it is about a specific situation (being able to calculate change at the till) more than it is about the profession 'shop assistant'. Anton, also year 2, talks about both the situation and the profession; here civil engineer:

> "To me it's like that you should learn for the future, if you will for instance have a job as … an engineer or something because then you need to know a lot of maths; you need lengths and all. Shapes and figures."
> **Interviewer**: "…mm, and what do you need to use it for?"
> **Anton**: "To construct blueprints. And it's important to know mathematics." [Anton, Y2]

Anton not only states the profession but also gives examples of what types of mathematics (e.g. 'lengths') and why you need it (constructing blueprints). Often the responses are related to professions connected to being able to calculate things, for instance Melker (Y2) thinking about becoming a doctor: he "must know all the calculations" and it "has to be easy when you are grown up." The ability to calculate is also mentioned without links to any profession:

> "To be able to learn and so on. Because for example if it's your birthday and you made a cake and have invited seven people you must be able to split the cake in eight pieces and then you need the maths where you learnt to know how to split the cake." [Frida, Y5]

Minna has a very vague idea of any links at all, but nonetheless has a strong sense of necessity:

> "Because you have to learn. When you're grown up and you must pay, and if you work in a food store then you don't know how much money you should give

> back or how little. So, you have to know, anyway, to also know … you have to have maths." [Minna, Y2]

The situations described by Frida and Minna are more about everyday situations, but what these four examples (including Louise and Anton) have in common is the conviction that mathematics is very important for managing situations connected to adult life and responsibility. The statements above serve as examples of the Compensation category. A further analysis shows that some statements contain indications of a social rather than a personal reference, here illustrated by the following response:

> **Interviewer**: "Why do you do maths?"
> **Samira**: "What? Why I do maths?"
> **Interviewer**: "Yes, why do you do maths?"
> **Samira**: "At school?"
> **Interviewer**: "Yes, we can start there, why do you do maths at school?"
> **Samira**: "To learn. And you're going to have knowledge, it's good if you have it later in the future if you're going to buy stuff it's good to be able."
> **Interviewer**: "Ok. And why is it so good to be able?"
> **Samira**: "Because otherwise you can't know. For example, if I have a one-hundred bill and take more stuff than I can buy it'll be embarrassing at the till." [Samira, Y5]

In Samira's response, two matters are indicated. The first is the importance of knowing some mathematics in order to avoid embarrassing situations. The second is that due to this embarrassment, there is a risk that others might view you as a less knowledgeable person. In her response, there are traces of intrinsic motivation, negative emotions connected to avoidance, and outward extrinsic motivation.

4.2 "To learn" — of normative or personal origin

One common reason that pupils give for why they do mathematics, with slight variations, is 'to learn'. It could be an indication of extrinsic motivation such as you need to learn to be able to calculate, such as Frida's response above with an example of when and why, or it could be given without any further explanation. But it could also be about the individual's own wish, thus indicating a more intrinsic motivation. Comparing Pakisa's with Christopher's statements illustrates a delicate but important difference in their responses:

> **Pakisa**: "To learn how you calculate … and … I don't really know … you know, you learn maths and you need it in the future sometimes.
> **Interviewer**: "Why do you need it in the future?"
> **Pakisa**: [Thinks] "I don't know … "[Pakisa, Y5].
>
> **Christopher**: "I want to learn things. Try new things … and stuff." [Christopher, Y2]

Both statements reveal a connection to a cognitive dimension, but at the same time a subtle difference regarding intrinsic motivation; Pakisa's response is neither typically extrinsic, nor does it show the same intrinsic qualities as Christopher's does. In order to capture these slight differences in their expressed motivation, we chose to divide the subtheme 'To Learn' that is sorted under Intrinsic motivation and the subscale Cognitive (i.e. Intrinsic Motivation-Cognitive-To-Learn, shortened: ICL), into two: ICL-Personal and ICL-Normative. ICL-Personal is then defined as Intrinsic motivation with linkage to personal desires or issues of self-fulfillment whereas ICL-Normative is considered as Intrinsic motivation linked to convictions of right and wrong. In the above examples, Pakisa's statement is considered ICL-Normative based on "you need it in the future sometimes", implying that her driving force is based on complying with a norm, whereas Christopher's is considered ICL-Personal due to his "wanting" to learn. Here, the ICL-Normative group is dominant among the respondents. Some students offered both arguments when asked to differentiate between personal and normative and some stuck to one (either ICL-Personal or ICL-Normative), regardless of the way the questions were posed or whether the follow-up question took a slightly different track.

4.3 Interplay

Another result is the interplay of factors that can be interpreted as Intrinsic motivation with a mix of Cognitive and Emotional origin, here illustrated by Matteus and Casper:

> **Interviewer**: "Can you explain why you do math?"
> **Matteus**: "I think it … is because it's fun to calculate. You can take your time and calculate, it's no rush. You have the time."
> **Interviewer**: "Is that the *reason why* you do maths?"
> **Matteus**: [nods]
> **Interviewer**: "… because it's fun …?"
> **Matteus**: "Yes, it's also exciting."
> **Interviewer**: "How is it exciting?"
> **Matteus**: "… umm … if there's a task that is rather difficult, you don't think you're going to make it, but when you try you *do* make it." [Matteus, Y5]

In the above example Matteus' feeling of contentment is not explicitly expressed, but we sense it implicitly in his emphasis on the word '*do*'. The interplay is confirmed by Casper, from grade 2, who gives a similar but more explicit description:

> **Interviewer**: "Why do you do maths?"
> **Casper**: "Why I do maths?"
> **Interviewer**: "Mm?"
> **Casper**: "Because I like it very much … and it just feels good when I do maths."
> **Interviewer**: "Aha, does it?"
> **Casper**: "Mm …"
> **Interviewer**: "Can you try to describe that feeling of 'good'?"
> **Casper**: "It feels warming. Proudliness [Swedish: 'stoltlighet']. And it feels like you're going to make it." [Casper, Y2]

Here the motivation for doing maths is the "warming" feeling of pride when you manage to complete a (difficult) task. This is indicating an interplay between motivation and emotion.

Both Casper and Matteus express a similar motivational combination: one part being a positive and Emotion-driven motivation linked to Cognitive aspects: "it just feels good" and "it's fun" respectively, and the other part expressed as Extrinsic motivation—that there are tasks that require calculation and you have time to do this. But the last quote, from Matteus: "because it's fun to calculate, you can take your time and calculate, it's no rush. You have the time" at the same time reflects a third and temporal type of motivation: that if you do not have the time and you have to rush when calculating the tasks, then different emotions, most likely negative ones, also come into play. This positively expressed type of interplay consists of missing a negative emotion, borrowing from the arithmetic rule of thumb: "two minuses make a plus", we termed this category 'double negative'.

Figure 1 summarises the relationships between the different constructs in Table 1.

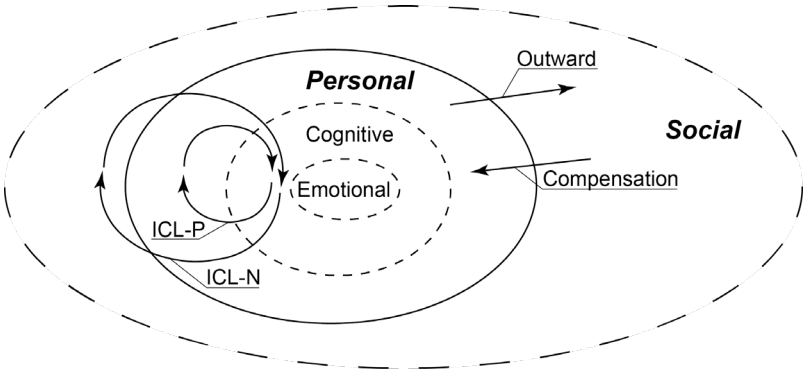

Figure 1. the relationships between the different constructs.

Figure 1 illustrates how the three Emotional and the three Cognitive components are located within the personal where the Emotional dimensions could be seen as part of a core concept. The two new constructs ICL-Personal and ICL-Normative both connect the cognitive components with the other components, here seen as an interplay. The two constructs related to extrinsic motivation, Outward and Compensation, can also be understood as an interplay between the personal and the social levels and with the two constructs working in opposite direction as each other. The Outward theme is the persons' motive to make social gains, and the Compensation theme is the person's motive to make some personal gain from the social or outside world.

5 Discussion

The aim of this paper was to study younger students' expressed motivation for doing mathematics. Looking at the main motivations that these students expressed, the responses are about future needs associated with the responsibilities of adulthood, some explicitly in connection with a profession or job, some in relation to shopping and some in very general terms, expressed as "I need it". While all respondents communicated the innate importance of mathematics, they sometimes struggled to give examples. This is somewhat different to previous studies where the most common response was mainly intrinsic motivation (Blomquist et al., 2012; Dahlgren Johansson & Sumpter, 2010). One explanation for this difference could be attributed to different research methods. In this study, the interview format and the possibility that the posing of follow-up questions allowed the respondents to offer several answers which deepened their explanations, thereby giving multiple motives for action. In some cases, this led to a seeming ambiguity in the responses, as illustrated with Samira's explanation about shopping. This ambiguity indicated that the categories Outward and Compensation could either be expanded in their definitions to include social situations or be expanded with a third category that focusses on social situations (c.f. Amabile et al., 1994). Here, based on our limited results, we cannot make any definitive conclusions. It would require additional investigations in order to determine whether it is different from the previous two categories or a refinement of the definitions. The result—that students in this study assign personal as well as social components to mathematical skills—is interesting given it has been noted in previous studies, both with prospective teachers (Sumpter & Sternevik, 2013) and upper-secondary school students (Sumpter, 2013), and it could be seen as a

confirmation of Radford's (2015) conclusion about the importance of social and cultural environments in motivation to study. Also, the findings of two new subthemes, ICL-Personal and ICL-Normative, means that a further investigation of sub-constructs could lead to a better understanding of what motivation is and how it can be expressed.

When looking at the Intrinsic category, we see that the subthemes Cognitive and Emotional were present just as in Sumpter (2013). In the present paper, the results also reveal nuances within each category. One example is the difference between joy and excitement. Both could be considered emotionally positive, but there is a difference between enjoying a mathematical problem and being excited and challenged by problem solving. Some students describe finding the working situation enjoyable because it is nicely framed, which is different to being excited by the prospect of winning a multiplication game or challenged by solving a tricky problem. Another, and perhaps complex, example from the Intrinsic category is the subtheme No-stress. This can be considered a double negative; the first negative being the absence of stress, and then, defining stress itself as a negative emotion, hence double negative. It should be emphasised that this No-stress theme is something other than the other two: the first two are clearly positive, albeit for different reasons, but this third theme is an interpretation of positive because it lacks negative loading. Given that the No-stress theme is linked to a comparison of previous mathematics schooling, it could be interesting to study older students' expressed motivation since they would have more experience to draw upon.

The combined conclusions around intrinsic and extrinsic motivational factors, as discussed above, is that even though they are very helpful in providing a tool for separating the inner from the outer sources of motivation, these concepts do not seem as separable and linear as those presented by Ryan and Deci (2000a; 2000b). Rather, the results from this study support the idea that the intrinsic/extrinsic constructs are intertwined and "messy", both in relation to each other and also to other affective constructs like emotion (c.f. Hannula, 2006, 2012; Radford, 2015).

When analysing the relationship between different types of motivation in the students' responses we found instances of interplay, such as being proud (i.e. Emotional) when solving a very difficult problem (i.e. Cognitive) or feeling embarrassed (i.e. Emotional) when being in a social situation (here Outward Extrinsic motivation). Our results support research that has looked at the interplay between intrinsic and extrinsic motivation (e.g. Lepper et al., 2005; Prat-Sala & Redford,

2010). But the link between other affective constructs such as emotions are also present, and just as Hannula (2012) concluded, it can be hard to separate them. Here it is illustrated by Casper's own invented word 'proudliness' ('Stoltlighet'). His strong feeling of pride when completing a challenging task appears to be so important to him that he invents a word appropriate for the occasion. This could be seen as a confirmation of Emotional being a subtheme under Intrinsic motivation, but also that emotions are an integral part of motivation, making interplay between affective constructs a probable by-product (c.f. Hannula 2012; Prat-Sala & Redford, 2010; Sumpter, 2013). One conclusion is that students' expressed motivation seldom appears to be one-dimensional, and one possible implication could then be that mathematics teaching cannot approach students' motivation in a one-dimensional way. Based on the qualitative differences themes within the Extrinsic category, we then suggest that researchers and teachers might need to reevaluate the role of motivation in mathematics education—that extrinsic motivation is also important, and constantly striving for students' positive intrinsic motivation could result in missing out on other motives and needs that are important.

Note

The questions in the questionnaire from Blomqvist et al. (2012) were:

1. What do you think about maths?
2. How do you feel before a maths lesson?
3. How do you feel before a Swedish lesson?
4. Why do you do maths?
5. How do you feel when you do maths?
6. What do you do when you do maths?
7. Please draw a picture of yourself when doing maths.

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