

The role of affective work in Swedish preschool mathematics

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Research Article

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Title

The role of affective work in Swedish preschool mathematics

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Abstract

This study examined the role of affective work in everyday mathematical activities in a Swedish preschool. Affective practices play a central role for processes of socialization, relations and moral order in everyday preschool activities, but the knowledge about their role for preschool mathematics is yet scarce. Video recordings comprised both preplanned and emergent mathematical activities and were analyzed using multimodal Conversation Analysis. Affect was perceived as participants' stance toward the activity and each other, displayed by spoken and bodily resources that emerged in and through social interaction. In the analysis, we specifically looked at how teachers responded to children's affective stance displays and the role of affective practices for affiliation, engagement, and participation in mathematical activities. Results show that upgrading of affective involvement achieved alignment and affiliation and supported children's engagement, while downgrading and delaying responses indexed trouble and moral work. These results provide knowledge that is significant for the organization of emotionally attuned and engaging math learning environments in preschools.

Keywords

Affect; early childhood education; mathematics education; emotion work; interaction analysis

Competing Interests

The authors declare that they have no competing interests, either financial or non-financial, that are directly or indirectly related to the work submitted for publication.

Funding

This research was conducted as part of the first author's doctoral studies at Uppsala University. No specific external funding was received.

Data Availability

The data that support the findings of this study are not publicly available due to ethical and privacy considerations связанные with video-recorded interactions of children in a preschool setting but may be available from the corresponding author upon reasonable request and with appropriate ethical approval.

Code Availability

Not applicable.

Ethics Approval

This study was conducted in accordance with established ethical guidelines and was reviewed and approved by the Swedish Ethical Review Authority (Dnr 2023-03796-01)

Consent to Participate

Informed consent was obtained from all participants involved in the study. For child participants, written informed consent was obtained from their legal guardians. Participants were informed about the purpose of the study, the use of video recordings, and their right to withdraw at any time without consequences.

Authors' Contributions

Laura Galeano conceptualized the study, collected the data, conducted the analysis, and wrote the original draft of the manuscript.

Niklas Norén contributed to the conceptual development of the study, supported the analysis, and critically revised the manuscript.

All authors read and approved the final manuscript.

Additional Information

This manuscript is based on work conducted as part of the first author's doctoral studies at Uppsala University. A related version of the study was included in the printed version of the doctoral thesis; however, the manuscript in its present form is substantially revised and is not available in the publicly accessible online version of the thesis.

The manuscript has not been published elsewhere and is not under consideration by any other journal. A link to the thesis in the DiVA portal is provided here for transparency: <https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A2035871&dswid=914>

Introduction

This study investigated the interactional work achieved by affective practices in everyday mathematical activities in a Swedish preschool. In Swedish preschools, mathematics is embedded in everyday routines and playful activities in dyadic or small-group contexts (e.g., Björklund & Palmér, 2019; Gejard & Melander, 2018), as well as in more formal, goal-oriented instructional activities led by teachers (Björklund, 2014). Participants' multimodal performances (e.g., prosody, gaze, gesture, bodily orientation, and use of material artefacts) shape and organize children's participation, foster shared affective experiences, and co-construct the emotional and pedagogical environment in everyday preschool activities (Cekaite & Björk-Willén, 2018). While there is growing agreement on the relevance of teaching for children's learning of mathematics in early childhood settings (e.g., Björklund, van den Heuvel-Panhuizen & Kullberg, 2020), the affective dimensions of mathematical activities have received less attention, particularly from an interactional perspective. This study contributes to this research gap by examining how affective stances and practices shape engagement and mathematical activity in preschool settings.

Background

The Swedish preschool system reflects a play-based, child-centered approach that integrates learning within play, supported by policy promoting an intertwined model of play and education (Skolverket, 2018; Pramling Samuelsson & Johansson, 2006). Teachers subtly guide play toward mathematical learning while preserving spontaneity (Björklund, Magnusson, & Palmér, 2018), and mathematical activities can be flexibly organized as either incidental or pedagogical (Johansson et al., 2012). When authentic challenges are embedded in play, they support engagement, while mathematical tasks disconnected from children's interests have been found to be less effective (Björklund & Palmér, 2024). These studies have examined curriculum enactment and teacher strategies, but they show less about how affective interactional work shape everyday mathematics-rich preschool activities.

Research using dialogical perspectives (Ethno-Methodological Conversation Analysis, EMCA, Linguistic Anthropology) have explored affect and emotion studied in relation to socialization and moral behavior (e.g., Cekaite, 2012; Cekaite & Evaldsson, 2020; Holm Kvist, 2018, Cekaite & Bergnehr, 2018; Strid, 2024), but not specifically during mathematical activities. Cekaite (2012) shows how institutional and collective norms are co-constructed in everyday interaction, and that moral order is cooperatively restored in interaction when threatened by individual actions. Teachers' responses to children's emotional displays work to regulate affect and orient children toward institutional norms, prioritizing activity progression (Cekaite & Ekström, 2019). Their findings demonstrate the methodological potential of EMCA for analyzing affect in preschool everyday life, but do not investigate mathematics-related activities.

EMCA research on Swedish preschools that focus on mathematics demonstrate that preschool mathematical activities are a multimodal, interactional achievement (Gejard, 2018; Gejard & Melander, 2018). In Gejard and Melander's analyses of Geomag block play, children display mathematical understanding via pointing, deictic terms, response cries, and the coordinated handling of materials. They also co-construct mathematical discourse by naming shapes, reformulating peers, and challenging descriptions from different spatial perspectives. Gejard (2018) further shows how different activity ecologies (whole-group book-reading vs. individualistic/dyadic painting) create distinct participation frameworks in which teacher's goals and children's interests may align or not (ibid., p. 72). Teachers' multimodal uptake (e.g., verbal reformulations accompanied by embodied demonstration) converts material affordances into formal mathematical language and opens slots for further action. While these studies on occasion document evaluative displays and the multimodal procedures that make geometrical ideas public, they do not focus on the significance of affect and emotion for those procedures.

In a study of play-based mathematics activities in Australian preschool settings, Cohrssen, Church, and Tayler (2014a, 2014b) showed that teachers' responsive practices enhanced children's engagement in mathematical activities. The teachers delayed their responses (resulting in pauses) and oriented to the children's engagement through affective matching and prosodic involvement (e.g., lowered volume; 2014b). Through these practices, the teacher demonstrated attentiveness and responsiveness, and enabled children to participate meaningfully and collaboratively, which was found to foster a positive classroom climate. In a follow-up study, Cohrssen and Church (2017) analyzed the third turn as a site of instructional elaboration during play-based numeracy

activities. Their video analyses showed how teachers reformulated questions, introduced comparative terms, and incorporated gestures to build on children's prior responses. These turn-by-turn practices not only supported conceptual development in areas such as equivalence and numerosity but also highlighted how everyday dialogue can function as intentional teaching.

Tainio and Laine (2015) investigated emotional work in early mathematics education in Finnish grade 6 classrooms involving teachers and 12–13-year-old pupils. They showed that teachers' micro-practices (such as evaluative third turns, prosody, gaze, laughter, and timing) achieved emotion work in sensitive contexts where pupils had provided wrong answers to mathematical tasks. In these contexts, micro-practices could either mitigate or amplify the affective stakes of error and uncertainty. They demonstrated how teachers' third turns perform reassurance, humor, neutrality or silence, thereby performing affiliative work and shaping pupils' immediate and future willingness to participate. Across ten lessons, they identified a range of evaluative practices, from modified repetition and question reformulation to scaffolded follow-ups, which simultaneously addressed cognitive understanding and the affective threat of error. Their micro-analyses illustrated how stance is co-constructed multimodally (e.g., through prosody, gaze, facial expression, gesture, and posture) and how these affective stances can spread among participants, shaping classroom norms around mistakes and errors. While this work offers detailed insights into the emotional management of errors in Finnish middle-school mathematics, little is known about affective work in Swedish preschool mathematical education, where learning takes place in play-based contexts, and where formal mathematics instruction situations have just begun to become part of children's daily routines.

The present study contributes to the wider field of children's affective practices in mathematics-related interactions in school (Tainio & Laine, 2019). Our contribution is to begin to show how such practices are managed in social interaction already during preschool years. Affective practices are analyzed as participants' coordinated orientation to affect over time in terms of affect as stance. Affective stances refer to participants' emotional orientations in interaction that are publicly and multimodally displayed and negotiated (Ochs, 1996). When these stances are taken up, aligned with, and sustained across participants and sequences, they form shared affective practices: patterned, embodied, and socially situated forms of interaction (Wetherell, 2013) that shape engagement and participation in mathematical activities. This allows us to analyze both the moment-to-moment affective orientations and the emergent practices that support engagement and participation in mathematical activities in the preschool.

The aim of the study was to explore how affective work relates to participant's engagement and participation in mathematics-related activities in everyday Swedish preschool settings and the data was analyzed within the following research questions:

- How do preschool teachers respond to children's affective displays during mathematics-related activities?
- What do different responses to affective practices achieve or index in terms of children's engagement and participation in mathematics-related activities?

Method

Data was collected in an urban preschool that was in an area with predominantly Swedish-background families. 20 children (6 girls, 14 boys; ages 3–5) and 2 teachers participated. The data consists of ~6 hours of video recordings of daily activities, filmed during two weeks, using one handheld and one stationary camera. The recorded activities included mealtimes, indoor and outdoor free play, transitions from the outdoor playground to the preschool's indoor areas, as well as pre-planned math activities conducted in a designated teaching space.

The study was approved by the Swedish Ethics Review Authority (Dnr 2023-03796-01) and conducted in compliance with ethical standards outlined by the Swedish Research Council (2024) and Declaration of Helsinki (World Medical Association, 2024). Teachers and legal guardians provided informed consent. Throughout the data collection process, the researcher remained attentive to the reactions of teachers and children, continuously prepared to pause (pausing twice) if any signs of discomfort arose. Teachers and legal guardians received information about the researchers' overall interest in exploring the interplay between content goals and affect but were unaware that affective and math-related content was to be selected from the sampled material.

The analysis focused on everyday interactions involving both children and teachers. Mathematical activities were on the one hand child-initiated and emerged in any everyday activity (e.g., in free play, meals, putting on/taking off outdoor clothes). Mathematical activities were on the other hand pre-planned and teacher-led

lessons with specific learning objectives (e.g., practicing measurement skills). The teachers shared the day's lesson plans (also on other subject areas) with the researcher in advance. The recorded video data was screened independently by the two authors. Math-related and affect-laden activities were identified, and sequences in which both mathematical and affect-related features were apparent to both researchers were selected. In total, 17 sequences were selected, 6 from pre-planned activities and 11 from spontaneous activities. The selected sequences were then transcribed using multimodal CA conventions (a combination of Jefferson 2004 and Mondada 2019; 2024, Appendix 1).

When identifying mathematical activities, we drew on two complementary theoretical frameworks. The first frames mathematics as culturally embedded human practices (Bishop, 1988), while the second specifies core counting principles that organize early numerical activity (Gelman & Gallistel, 1978). Bishop's (1988, p. 20–59) six fundamental mathematical activities are counting, locating, measuring, designing, playing and explaining. Gelman and Gallistel's (1978, p. 47) five counting principles are one-to-one correspondence (assignment of exactly one number word to each object during counting), stable order (number words produced in a fixed sequence), cardinality (the final number word uttered representing the numerosity of the set), abstraction (any discrete entities can be counted), and order irrelevance (the order in which objects are counted does not affect the resulting cardinality). Among the 17 selected sequences, all activity types and counting principles are represented except for order irrelevance. An overview of activities and principles in the whole material is beyond the scope of the article. However, Table 1 provides an overview of the mathematical activity types and counting principles identified in the three selected extracts for the purpose of describing the analyzed material. Bishop's framework was used to identify the types of mathematical activities in which participants were engaged, while Gelman and Gallistel's principles were used to characterize how counting activities were organized. Extracts 1 and 3 were drawn from emergent play and Extract 2 was drawn from a planned lesson.

Table 1. Mathematical activity types and counting principles in Extracts 1–3.

Extract	1	2	3
Bishop's (1988) activity types			
Counting	x		x
Locating	x	x	x
Measuring		x	
Designing			
Playing	x		x
Explaining		x	
G&G's (1978) counting principles			
One-to-one correspondence	x	x	x
Stable order	x	x	x
Cardinality	x	x	x
Abstraction			x
Order irrelevance			

The interaction in the recordings was analyzed with multimodal video interaction analysis, (Garfinkel, 1967; Heritage, 1984; Sidnell, 2010) and Linguistic Anthropology (Goodwin, 2000; 2007). Key aspects are participants' sequential organization of social action and their use of language, bodily movements, gestures, gaze, and other multimodal resources to organize participation frameworks and co-construct meaning locally within those, in real-time (Schegloff, 2007; Goodwin, 1995). This allowed for a detailed examination of the emergent and sequential nature of affective stances (Ochs, 1996) and affective practices (Wetherell, 2013) in mathematical activities, and how responses to affective displays indexes or achieves engagement and participation.

Participation was analyzed using the notion of participation frameworks, a concept that accounts for how participants build concerted action in moment-by-moment orientation to each other, using an ecology of semiotic resources, such as speech, prosody (pitch, tempo, volume, etc.), gaze, gestures, mimics, bodily orientation and touch, manipulation of objects, and the use of physical space (Goodwin, 2000, 2017). Affect is perceived as participants stance (Ochs, 1996) or heightened involvement that achieves action within participation frameworks, and is displayed with various semiotic resources, but also with affective actions such as assessments, laughter and joking (Goodwin, 2000; Bateman, 2020; Cekaite & Ekström, 2019). Affective practices (Whetherell, 2013) are interactionally achieved and co-constructed by teachers and children and involves minimally a sequence where children display an affective stance initiative and the teacher(s) respond or

orient to that stance in subsequent turns. Responses to affective stance initiatives can align with the affective stance to a greater or lesser degree, which indexes or achieves different social actions.

The analysis focused on participant's orientation to affective practices in sequences of mathematical interaction and how affective practices contributed to shape engagement and participation within the mathematical activity. We used the notion of alignment to account for the sequence-sensitive, procedural work that organizes affective actions, and affiliation to account for the ways participants endorse or take up each other's affective stances and perspectives (see for example Stivers, 2008, p. 2). Alignment tends to operate at a structural level, e.g., through sequential organization, attentional displays, and bodily orientation and gaze, while affiliation operates at the level of affect and action, e.g., through affective displays, assessments, or play actions (Steensig, 2020; Pursi, Lipponen, & Sajaniemi, 2018, p. 31). Children and adults engage in activities by coordinating both the structural resources that make joint action possible (alignment) and the affective endorsements that sustain it (affiliation), which contribute to sustaining or re-structuring participation. Aligning practices are the observable interactional means through which affiliation, engagement and participation are realized. Therefore, nonalignment or different ways of aligning with affective stance initiatives has an impact on affiliation and engagement and participation in mathematical activities. Alignment and affiliation are also linked to preference organization (Pomerantz, 1985; Schegloff, 2007) in the sense that immediate, aligning, and affiliative teacher's responses are using preferred response formats, while delayed, disaligning and disaffiliative responses are using dispreferred response formats (Lee & Tanaka, 2016).

The analysis focused on how teachers responded to children's affective stance displays, and on the interaction following affective sequences to see what affective practices achieved or indexed in terms of participant's engagement and participation in mathematical activity.

Findings

The analysis identified three main ways of responding to affective stance displays, and they were found to index three different roles that affective work plays in mathematical preschool activities: supporting children's engagement, initiating the delicate task of embedded correction and contributing to moral work.

Upgrading the affective involvement supports children's engagement

The first example illustrates how upgrading the affective stance achieves re-engagement of a child into a play activity. Initially, a child disengages from a drawing activity, and the teacher responds with enacting an affect laden and multimodal counting sequence that upgrades the child's initial affective stance. This sequence also illustrates how affective work can make a playful mathematical activity meaningful within another everyday activity.

Extract 1 is drawn from an activity where five children and a teacher sit at a table drawing airplanes. Before the extract, the teacher just held up a tablet with images of airplanes. Agnes compares her own drawing of an airplane with the images in the tablet and seems to reject her work when turning her drawing upside down (lines 1–3). The teacher then objects and turns the drawing back up (lines 10–12) and begins to reengage Agnes in her drawing project by initiating a counting of the plane's many wings (lines 10–17). The counting evolves into a shared embodied affective practice (lines 19–23) and is successful in reengaging the girl into the drawing activity (line 36).

Extract 1. Drawing and counting wings

Helena = teacher. Agnes = child 5 yrs.

```
1    AGNES    [*ja vill ässå jag (.) ja behöver ( ɤ  
           I also want I          I need  
2    helena   *gazes twd drawing  
3    agnes                                         ɤflips drawing  
  
((4 lines omitted, teacher attends to another child's question))
```

8 helena >----->*gazes twd Agnes' blank paper--->
9 (1.0)
10 HELENA *men Agnes den här ↑>titta du hade ju gjort<↑ *här ju.
but Agnes this one look you had done here hadn't you
11 *puts down tablet with right hand----->*<↑
12 *picks up
drawing with left hand and flips it back
13 HELENA hur många vingar ska ren ha?
how many wings will it have
14 AGNES adär ([])
there ()
15 *points at drawing with pen
16 HELENA [ska vi räkna *hur många vingar.
shall we count how many wings
17 *points at drawing
18 (0.4)
19 HELENA (du har gjort) e:n, (2.2) [*två:, (1.0) t[re, [fyra,=
you have made one two three four
20 AGNES [*två, [tre [fyra=
two three four
*follows Helena's pointing-->
21 HELENA =[°fem [sex [sju [åtta [nio [tio° [ELVA
five six seven eight nine ten eleven
22 >--at wings with her hand--(#1)----->*<↑
23 AGNES =[°fem [sex [sju [åtta [nio [tio [elva°
five six seven eight nine ten eleven
24 >----->*(#1)----->*<↑
25 helena *turns towards Agnes
26 AGNES a.h[:
*face away from camera
27 HELENA [*.HH:: SKA VI SKRIVA >såhär< elva=
shall we write like this eleven
28 *opening eyes and mouth wide (#2)
29 HELENA =vingar så att *vi kommer ihåg.=
wings so that we remember
30 *takes pen from Agnes
((2 lines omitted: teacher attends to another child's question))
33 * (3.0)
34 helena *picks up another pen, writes on drawing
35 * (3.0)
36 agnes *picks up the first pen again and draws on the airplane
37 HELENA TITTA AGNES då vet vi ju: hur du >t↑änker att du
look Agnes then we know how you think that you
38 vill< göra ett superhjälteflygplan med elva vingar
want to make a superhero airplane with eleven wings



Figure 1. Teacher and Agnes point together.



Figure 2. Teacher's response face.

When comparing her airplane drawing with the images in the tablet, Agnes displays an affective stance toward her drawing, saying with a concerned voice “I also want to (.) I need ()” (line 1). At the end of her turn, she turns her drawing upside down (lines 1–2), indicating to disengage from drawing. The ending of the utterance is inaudible, but the turn seems to identify something in the tablet images that renders her own drawing inadequate. However, after attending to another girl’s needs, the teacher objects to her move, saying “*but Agnes this one look you had done here hadn’t you*” (line 10), with an engaging pitch raise, an affective stance that upgrades the affective stance in Agnes’ embodied turn. The turn is a positive assessment of the drawing and marks or registers the drawing as noticeable (Sacks, 1995). The teacher then follows up on her noticing with attempts to reengage Agnes, beginning with counting the wings in the drawing. The child gets involved in the verbal counting when the teacher grabs her hand (which is holding the pen) and moves the pen from wing to wing (lines 20–23, Figure 1). Thereby, the joint verbal counting is achieved with multimodal means that create an affective embodied (re)engagement of Agnes throughout the sequence. Agnes’ initial affective stance of de-engagement changes into a shared embodied affective counting practice with heightened, shared affective involvement.

The affective counting practice also develops with further playful affective stances in the position after the finished counting, when the teacher combines voice quality with an exaggerated facial expression in the evaluative comment that follows the counting. The teacher builds an engaging, affect-laden post-expansion (lines 27–29) that highlights the joint identification of the total sum of wings. She is doing that with an animated question (“*HH::: SHALL WE WRITE like this eleven*”, line 27), featuring a sharp inbreath, increased volume, and a playful staging of exaggerated surprise with her face (opening eyes and mouth wide and freezing the face, Figure 2). Following this affective peak, the teacher writes on the drawing (line 34), and Agnes continues to work on her drawing, showing reengagement with her project (line 36). The teacher closes the sequence with an affect laden appreciative evaluation (lines 37–38).

The child’s initial negative affective stance towards her drawing is responded to by the teacher with affiliative attempts at making the child appreciate her work again, to change her perspective on her work. Their bodies become entangled through the teacher’s shepherding (Cekaite, 2010) of Agnes’ hand, achieving a shared embodied affective practice (Wetherell, 2013) that has consequences for the child’s engagement in the drawing. The mathematical counting activity is embedded within the teacher’s response to the girl’s initial affective stance of disengagement. Through the affiliative counting activity, the participants establish a heightened affective stance that matches (Cohrssen et al., 2014b) or inverts the girl’s de-engagement and reengages the child in the drawing activity.

The counting activity is enacted as a multimodal narrative that rhythmically builds up to an affective peak when reaching the sum *eleven*, partly by way of saying *eleven* together (lines 21 and 23), partly by assessing the number as a noteworthy achievement with expressive mimics (lines 27–28), partly by writing *eleven* on the drawing (line 34), and closing the sequence with naming the drawing “*superhjälteflygplan*” (*super hero airplane*, lines 37–38). The mathematical counting activity is embedded within a playful and joyful affective practice where upgrading the affective intensity is part of a positive assessment of the child’s drawing work.

Downgrading the affective involvement indexes trouble and delicate repair work

The next example is drawn from a preplanned mathematics teaching setting, focusing on measuring. Here, children’s heightened affective involvement in a series of incorrect answers are responded to with actions that downgrade the affective involvement, thereby indicating a problem and projecting the delicate task of remedying the problem while keeping the children engaged in the activity.

In Extract 2, children and teachers collaboratively explore how to use a measuring tape, with the didactic aim of identifying the length of the tape as well as the relevant measuring unit (centimeters). In the beginning, teacher Helena asks a question about the length of the tape, which is answered by two children. Peter says “*de står ett*” (*it says one*, line 5), and then Sara says “*TVÅ*” (*two*, line 9) with an upgraded affective involvement, referring to a reading of the number 22 on the middle of the tape. In line 14, Sara changes her answer into “*TJUGETVÅ står’e här*” (*twenty-two it says here*), as a possible self-correction. Sara thereby demonstrates affective engagement with the activity as well as competence in reading from the tape; despite not orienting to the question as such (the tape is 200 cm long).

Extract 2. The measuring tape

Helena and Stefan = teachers. Eva, Sara, Lena, Peter, Henry and Anton = children 5 yrs.
Anton sits slightly away from the group.

- 1 PETER %de står--
it says
- 2 %holding end of the measuring tape---->
- 3 HELENA vet du €hur lång mätstickan e Anton
do you know how long the measuring tape is Anton
- 4 €turns head and gaze twd Anton---->
- 5 STEFAN [[den borde ju va:::
it should be
- 6 PETER [[<de står e[tt>
it says one
- 7 HELENA [vill [du komma å kolla,
do you wanna come and check
- 8 >----->
- 9 SARA [TVÅ:.
two
- 10 *(0.4)
- 11 anton *Anton shakes his head
- 12 HELENA [[€°nej°°
€.....---turns head and gaze twd Sara---->
- 14 SARA [[*TJUGETVÅ står'e här.
twentytwo it says here
- 15 ¢holding tape about 50cm from Stefan's end
- 16 HELENA &tju↑TVÅ cen- e're centimeter eller meter.
twenty-two cen- is it centimetre or meter
- 17 eva &moves from Helena's lap to the tape
- 18 ANTON [[°meter°
- 19 EVA [[TJUTRE:::
twenty-three
- 20 LENA [[@<tre fyra>
three four
- 21 gz @gazes at middle of tape
- 22 HENRY här STÅR' *E ETT (där vid) oss.
here it says one (there at) us
- 23 *#3 points at his end of the measuring tape
- 24 HELENA €hm:. >nu måste vi kolla här.<
hm we got to check this
- 25 €raising from the floor (#4)
- 26 EVA &€jag ska sitta här



Figure 3. Henry points at his end of the measuring tape.



- i will sit here*
- 27 &moves to sit by Stefan
- 28 helena €walks twds Henry and Eva-->
- 29 STEFAN °nittonhundra° >man ska kolla på re (här) *nineteen hundred you should look at this*
- 30 helena >--- walks twds Henry and Eva -----€
- 31 [som e här< nere. *that is down here*
- 32 HELENA [€här börjar ju (.) >stickan<, då e're ett, *here begins the tape then it's one*
- 33 bd €leans in close to Henry & Eva----->
- 34 eller hur, de börjar på ett, €och €va står'e= *right, it starts at one, and what does it say*
- 35 bd >-----€turns tow Stefan->
- 36 pt €points at other-->
- 37 =borta vi Stefan.€ *over at Stefan*
- 38 bd >----->€
- 39 pt --end of tape--->€ (#5)
- 40 STEFAN här stå're hundraNITTI:, *here it says hundred and ninety*
- 41 (0.6)
- 42 STEFAN [hundranittinie *hundred and ninety-nine*
- 43 PETER [HUNDRA- *hundred*
- 44 (1.0)
- 45 STEFAN två (0.6) >ska're väl va'rå<. *two should it be I think*
- 46 HELENA två (1.0) h↑undra. *two hundred*
- 47 STEFAN tvåhundra *two hundred*

Figure 4. Teacher Helena raises from the floor and moves towards the standing children.



Figure 5. Teacher Helena points at Stefan's end of the measuring tape.

Sara's turn in line 9 is the first affective stance display in the extract, and teacher Helena responds to Sara's suggestion *twenty-two* in the next turn (line 16) with a repetition "tju↑TVÅ" (*twenty-two*) that replicates Sara's emphatic volume (*format tying*, Goodwin, M. H., 2007), acknowledging her answer. However, Helena adds a pitch rise to the prosodic contour that indicates a possible problem with the number (*repair initiation*, Schegloff et al., 1977). She cuts the response short (before fully disclosing the correct measurement unit), and immediately requests a clarification of the unit, asking everyone to choose between meter and centimeter (line 16). However, instead of answering, Eva just continues with a reading of the next number on the tape, providing "TJUTRE::" (*twenty-three*, line 19), tying her contribution to Sara's with an equally engaged volume. Eva's turn is immediately followed by Lena who reads aloud the subsequent numbers "tre, fyra" (*three, four*, line 20) on the tape. Henry follows up with "här STÅ'RE ETT (därvid) oss." (*here it says one (there at) us*, line 22) also tying

his contribution to Sara and Eva's with a similar format, but breaking the reading of consecutive numbers, and instead pointing at the number on the end of the tape near to him (Figure 3). With reference to Helena's initial question, these are all wrong but affectively produced answers, but Henry seems to be the only one on the right track, demonstrating some knowledge about where to look on the tape (at its ends).

The engaged affective stance in the sequence of answers is acknowledged by teacher Helena when she says "hm:. >nu måste vi kolla här.<" (*hm we got to check this*) (line 24). The turn initial response particle "hm:" is emphasized and the whole turn indicates a problem with the answers and projects nonalignment (Lindström, 2009) and upcoming repair work (Drew, 1997). Helena raises from the floor (line 25, Figure 4) and walks to the children that stand holding the measuring tape (lines 28, 30). Compared to the children's answers and compared to her initial response to Sara's first answer, Helena's response turn is more low-keyed, without pitch variation and with a more subdued intonation.

The teacher's change of position in the room changes the participation framework in the mathematical activity. Helena leaves her peripheral place on the floor at the wall and moves into the center stage of the measuring activities. The change of physical position provides her with an opportunity to participate differently from mainly asking questions from the side. She is now in a better position to explain the basic design of the measuring tape (lines 32-39), and the move achieves embodied affiliative work when leaning in close to the children and pointing to the tape (line 33). Hence, the affective practice initiated by the engaged (but wrong) answers achieves a change in teacher engagement and affiliation in the mathematical activity, but with a more low-keyed verbal affective involvement as compared to the affective stance in the children's preceding turns.

After Helena's move from the floor, both teachers get involved in explaining where to look at the tape, thereby remedying the children's demonstrated difficulties with finding the right place to look for the tape length. In addition to verbally explaining, Helena also points at the correct end of the tape (line 36+39, Figure 5). The teachers even follow up with providing the correct length answer (*two hundred*, lines 40-47). Their joint efforts to repair the incorrect answers are not produced explicitly: neither of the teacher explicitly identifies what the problem with the children's affect laden contributions are but they indicate the trouble sources when directing their focus to the correct end of the tape and when providing the solution (see embedded repair, Jeffersson, 1983). In this way, the teachers jointly progress the mathematical meaning-making process (with explaining) and demonstrate one of the goals with the pre-planned mathematical task (by providing the solution). The affective practices in the activity become consequential for the teacher's changed participation and engagement as well as for the subsequent progression of the mathematical activity. A difference from the previous extract, however, is that the children's bodily engagement decreases rather than increases when the teacher shifts into teaching mode. From being actively bodily involved in exploring the tape (holding, pointing at and gazing toward different parts), the children become more passive listeners to the teachers' explanations and solutions. Another difference from Extract 1 is that the responses replicate and downgrade the children's level of affective stance involvement rather than upgrading it, which can be associated with the dual and delicate task of on the one side disaligning with and repairing the inaccurate answers verbally, and on the other side achieving embodied affiliative work to keep the children engaged in the mathematical activity.

Delaying the response indexes moral work

The last example is drawn from an outdoor counting activity where a child initiates a playful and rather silly word game, resembling a teasing, that disaligns slightly with the ongoing counting. The teacher initially just continues with the counting, without explicitly responding to the word game, but then finally, several turns later, responds by re-inviting the child back to the group activity. We analyze this as a serious, *po-faced* response (Drew, 1987) as the child's word game mildly mocks the teacher's counting activity. We also argue that avoiding dealing directly (or explicitly) with the child's affective stance achieves moral work (Cekaite & Ekström, 2019) in the sense of directing the child towards more appropriate ways of participating in an emerging mathematical activity.

In extract 3, a group of children and one teacher gathered around seashells with different colors that are scattered in the snow on a wooden table. The counting emerged during the gathering and was not a preplanned mathematical activity. Noteworthy for the analysis is that some shells are white on the outside and brown on the inside. The teacher instructs the children to gather white shells, and starts to count the gathered shells, arriving at "sex" (*six*, lines 9-15).

Extract 3. Counting shells

Helena = Teacher. Rasmus, Erik, Alva, Sara, Åsa = Children 5 yrs. Gazes are mostly unavailable during this sequence due to the camera angle.

- 1 HELENA **men den ↑här va väl ändå vit.**
but this is white, right
- 2 RASMUS **å den [härä.**
and this
- 3 HELENA **[*e den vit?**
is that white
- 4 **picks up a shell and shows it to Erik*
- 5 gz **.....----> gazes tow Erik*
- 6 *α (1.0)*
- 7 erik *αnods*
- 8 gz *α---α meets Helena's gaze and looks down*
- 9 HELENA ***okej, då har vi *↑e:n två tre fyra (.) fem?***
okay, then we have one two three four five
- 10 gz **----looks down on table and shells-->*
- 11 pt **points at each shell----->**
- 12 *(1.0)*
- 13 ALVA **€()**
- 14 rasmus **€.....----> picks up brown shell (#6)**
- 15 HELENA **€>titta där-< €se:x?**
look there six
- 16 rasmus **€>-----€---->moving shell**
tow camera
- 17 RASMUS **€SEX €BAJS**
six poop
- 18 bd **€turns tow camera/away from Helena**
- 19 **€----€showing shell f. camera (#7)**
- 20 **€dropping shell on table**
- 21 HELENA **sju::?**
seven
- 22 RASMUS **€sju bajs.€**
seven poop
- 23 **€.....----€pushing shell into pile of large**
brown and white shells
- 24 *(1.4)*
- 25 HELENA **sju::?**
seven
- 26 ERIK **åtta=**
eight
- 27 HELENA **=+åtta:+**
eight
- 28 *(0.8)*
- 29 RASMUS **< N I:[E €B A: J S, >**
nine poop
- 30 **€placing hand beside pile**
- 31 HELENA **[>de va väldigt-<**
that was very
- 32 *(0.4)*
- 33 HELENA **>Rasmus,< kan du hitta vi↑ta↑ snäck*skal.**
Rasmus can you find white shells

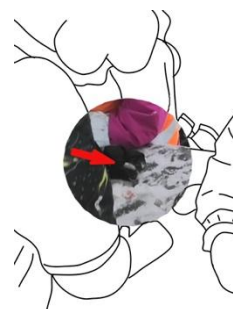


Figure 6. Rasmus picks up a light brown shell with his glove.

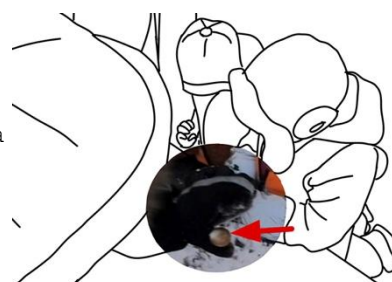


Figure 7. Rasmus displays the brown shell in his glove.

34 *picks up white shell
 35 HELENA [[**Esom ser ut *såhär,**
 that looks like this
 36 *shows white shell in palm (#8)
 37 RASMUS [[**Ja ja ska-**
 yes I will
 38 **Eleans forward**
 39 ÅSA **HE[:LE:N**
 40 SARA **[ni:e,**
 nine
 41 (0.6)



Figure 8. Teacher shows a white shell in her palm.

At this point, Rasmus has just picked up a small shell from the table (line 14), and shouts out “SEX BAJJS” (*six poop*, line 17), while turning towards the camera, balancing the shell on his glove, and displaying its brown inside to the camera operator (CO). Rasmus shifts the word ‘shell’ for ‘poop’ in a playful and silly word game addressed to the CO but probably also to the peers to invite laughter (Cekaite & Andrén, 2019). The bodily shift in orientation towards the CO initiates a change in the participation framework (Goodwin, 2000) where the teacher’s role of leading the counting is challenged. The playful word shift also marks or registers (Fasulo, Nomiko & Nye, 2021; Pillet-Shore, 2021) the displayed shell’s brown inside as a publicly perceptible and noteworthy referent (Strid & Cekaite, 2022), which also challenges the counting activity’s sole focus on white shells. Despite dropping the shell on the table (line 20), and because not receiving a response, Rasmus makes a second registering simultaneously as pushing the shell into the pile of shells on the table (lines 22-23). This time he says “sju bajs” (*seven poop*), demonstrating that he is still aligning with the joint counting activity, but still claims the right to lead the count. The third word joke “<NI:E BA:JS>” (*nine poop*, line 29) is louder and prosodically more elongated than the first two, demonstrating a heightened affective involvement. He is not displaying the shell anymore (it’s on the table) so the registering has turned into a more general action bid (Fasulo et al., 2021). Worth noting is that Rasmus is continually attentive to Helena’s public counting progression through the sequence and produces his joke counts in close proximity to them. However, still nobody picks up the jokes, not even the other children, so Rasmus’ affective initiative is not responded to directly. In terms of action alignment, the others are disaligning with Rasmus affective stance initiatives.

After the first joke in line 17 (*six*), teacher Helena just goes on with the next item in the ongoing counting of white shells (*seven*). After the second joke in line 22, the teacher just repeats “seven”, as if insisting on staying withing the group’s counting progress and defending the right to lead the group counting. After the third upgraded joke in line 29-30, the teacher acknowledges Rasmus and addresses him with a question about finding white shells (line 33). The choice of a question as response format demonstrably avoids responding to Rasmus’ silly joke, and functions as a serious invitation back into the play, but is also a *delayed response* that orients implicitly to the inappropriateness of not engaging with the group’s shell search, and perhaps also to the mocking aspect of calling the teacher’s counted items *poop*. The joke and its serious response have some similarities with a teasing (Drew, 1987), in the sense that Rasmus draws on and challenges the power relations between teachers and children’s institutional roles in preschool settings, rendering the joke as possibly subversive in this setting.

The delayed re-invitation demonstrates a task-focused alignment with the ongoing mathematical activity and a gentle redirection of the child back to counting shells, without upgrading the affective involvement of the sequence. The indirect addressing of the joke indexes local norms of proper behavior in the setting of group play activities (Cekaite & Evaldsson, 2020). The ongoing counting and talk about finding additional shells are here prioritized over acknowledging an inappropriate word play that possibly challenges the institutional roles of the preschool and works to keep Rasmus involved in the white shell counting.

This sequence shows how teachers can manage affective stance initiatives that slightly disalign with or are mildly subversive to an already ongoing emerging mathematical activity. The teacher gently redirects the child into the already established participation framework and thereby maintains the group’s alignment and engagement with the emergent mathematical activity.

Discussion

The analyses show that the role of affective work varies with different local sequential contexts and local activity types, and that the type of response to an affective stance initiative achieves or indexes different actions: reengagement, nonalignment/repair, and moral work. Upgrading the affective involvement while counting achieved a reengagement of a child into an ongoing emergent mathematical play activity (Extr. 1). Downgrading the affective involvement projected upcoming repair of wrong answers and a shift into a teaching mode (instructing and explaining) in a preplanned mathematical lesson (Extr. 2). Finally, a delayed response indexed moral work regarding a joke or tease that mildly challenged moral norms on how to participate appropriately in an emergent mathematical group activity (Extr. 3).

Context sensitive responses to children's affective displays

Teachers' responses to children's affective displays in preschool mathematics are context sensitive, in the sense that the role of affect for mathematical activities emerge from the local sequential context. Extract 1 exemplifies how the teacher responds to a child's affective disengagement with an *upgrading of affective stance* that works to reengage the child. Extract 2, on the other hand, exemplifies how the teacher responds to the children's heightened affective involvement with a *lowering of affective stance* and change in her own participation, towards a more factual stance that works to provide the children with the knowledge they need to solve the mathematical problem, but also decreasing the opportunities for children's own embodied exploration of the material. And Extract 3 exemplifies how the teacher *delays her response* to a child's silly joke during a mathematical activity, which achieves moral work in the sense of indicating, but not explicitly addressing, appropriate participation in a group play activity, when inviting the child to rejoin the activity.

The role of affective practices in shaping engagement and participation

One central way by which affective practices shape engagement in the analyzed preschool context is using structural alignment/nonalignment, which in turn provides the interactional basis for doing affiliative, repair and moral work. Our findings are in line with Cohrssen et al.'s (2014a, 2014b) and Cohrssen and Church's (2017) findings in that teachers' responsive practices foster engagement in play-based mathematics and add knowledge about the role of affect in these processes. Responses that upgrade the affective stance in the children's actions are affiliative, responses that downgrade the affective stance are projecting repair while sustaining an affiliative stance, and delayed responses disalign with an affective action bid while reengaging the child, all depending on what is at stake in local sequential context. The resources for displaying alignment with a preceding affective stance initiative were found to be *verbal actions* such as questions, assessments, marking/registering, and invitations, *prosodic actions* such as replicating the volume or pitch in preceding turns (format tying), *embodied actions* such as shepherding, expressive gazing, and pointing, as well as moving closer in physical space, *handling objects* such as pens and tapes, and *marking/registering objects* such as drawings and shells. Aligning responses to affective stance displays achieved affiliation with the child, which contributed to engagement and participation.

Tainio and Laine's (2015) showed that primary school teachers' sequential responses to incorrect student answers shape students' participation. They conclude that given the affective stakes of incorrect answers, it is pedagogically important for teachers to communicate that such answers are normal and appropriate contributions (Tainio & Laine 2015, p. 85). Our findings also show that preschool teachers avoid overt marking of answers as wrong and teasings as morally problematic, and handle these delicate situations with affiliative multimodal practices, while simultaneously marking the children's actions as dispreferred within that local sequential context. Teachers in institutional settings often prioritize collective norms over individual children's emotional stances (Cekaite & Ekström, 2019). The teacher's delayed response to the teasing can thus be interpreted as an implicit socialization move, enforcing the non-negotiability of how the mathematical activity is to proceed, while maintaining institutional moral order through redirecting rather than overt confrontation, similar to what Cekaite (2012) shows in preschool peer's dispute resolution.

Our findings show how affective work shapes engagement in different ways depending on the local sequential context. Upgrading the affective stance successfully re-engaged a disengaging child with playful counting, while orienting to the child's drawing as preferred within the local play context. Children's heightened affective involvement when providing incorrect answers to a mathematical question was handled with a complex mix of explanatory repair work that marked the answers as dispreferred in the situation, with a downplaying of the

affectual stance that worked to mitigate the critical stance. These actions, however, also reduced the children's embodied engagement with the mathematical task. And finally, delaying the response to a child's playful, mildly subversive joke oriented to the joke as dispreferred within the ongoing counting play, avoiding endorsing the inappropriate wordplay, and simultaneously accomplishing moral work by implicitly reinforcing norms for appropriate participation. This makes visible that mathematics teaching in play-based preschool settings is continuously shaped through locally situated, cooperative interactional work.

In these settings, affect is multimodally and sequentially organized, and crucially dependent on how teachers and children orient to and build on affective initiatives in situ. This positions affective work as a central resource in the enactment of play-based mathematics pedagogy. At the same time, teachers' responses involve ongoing choices. For example, prioritizing the progression of a shared activity may sustain collective focus but limit responsiveness to individual affective initiatives, whereas orienting to children's local affective contributions may support engagement but redirect or transform the trajectory of the activity. By showing how such choices are interactionally accomplished, this study brings together research on participation and engagement in preschool interaction with research on early mathematics education. It contributes new knowledge about how affective relations to mathematics are constituted in everyday practice, addressing a gap in the literature on play-based mathematics didactics. Finally, this study highlights the importance of supporting preschool teachers in making context-sensitive decisions about how to balance engagement, participation, and mathematical progression in interactions with young children.

Appendix 1. Transcription conventions

HELENA	Speaker reference for spoken actions.
helena	Speaker reference for embodied actions.
pt	Pointing gesture.
bd	Body movement (e.g., wiggling, leaning, posture shifts).
gz	Gaze direction.
prs	Prosodic or rhythmic performance (e.g., singing, rapping).
()	Unhearable speech.
(text)	Speech that is difficult to hear.
text-	Cut-off speech.
text	Speech in original language.
text	English translation.
((text))	Transcriber's comments.
>text</<text>	Faster / slower tempo.
TEXT	Higher volume.
°text°	Lower volume.
(.)	Minimal pause (less than 0.2 sec).
(0.4)	Pause length.
:	Sound stretch.
t(e)xt	Laughing voice.
<u>text</u>	Emphasis.
.	Falling final intonation.
,	Slightly rising or continuing final intonation.
?	High final rise.
↑	Pitch rise during utterances.
text alignment	Speech and bodily actions are temporally aligned.
[	Overlapping talk.

=	Turn latching.
* ✕ € % & @	Marks onset/offset of embodied actions, assigned to specific persons.
.....	Small dots indicate that an embodied action is emerging.
-----	Hyphens indicate that an embodied action has reached a recognizable shape and is maintained.
, , , , , , , ,	Commas indicate that an embodied action is withdrawing, retracting.
-->	Arrows indicate that actions continue across subsequent lines.
#1, #2, #3	References to images, inserted where they are captured.

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