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Exploring participatory dynamics in conversational argumentation: Operationalizations, visualizations, and cooccurrences[1]

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English abstract
Children's discursive participation in conversational argumentation is crucial both for learning to argue and for arguing to learn. Yet, conversation analysts have rarely applied quantitative methods to systematically investigate the dynamics and conditions of participation in conversational argumentation. This paper addresses that desideratum by conceptualizing discursive participation in argumentative activity as the share of interactants in the joint processing of argumentative jobs. It demonstrates how CA-based operationalizations can be used for quantification and visualization – tools that, in turn, offer powerful means for uncovering participatory structures and generating new hypotheses for qualitative analysis. By systematically operationalizing and normalizing participation, the approach enables comparisons of participatory dynamics across conversations and school grades. Using the example of accumulations of disagreement and overlap events that cooccur with a sudden drop in one interactant's participation, the paper illustrates how explorative visualizations serve as a useful impulse. They help narrow down collections and identify relevant cases for sequential analysis of the complex interplay between such interactional events and argumentative participation.

Keywords: discursive participation – conversational argumentation skills – operationalization – visualization – interactional trajectories – disagreement – overlap

German abstract
Diskursive Partizipation von Kindern an mündlichen Argumentationen ist zentral für diverse Lernprozesse. Dennoch hat die Gesprächsforschung bisher nur selten quantitative Methoden angewandt, um partizipatorische Dynamiken und die Bedingungen von Partizipation in mündlicher Argumentation systematisch zu untersuchen. Dieses Desiderat wird hier angegangen, indem diskursive Partizipation als Anteil an der gemeinsamen Prozessierung argumentativer Jobs konzeptualisiert wird. Der Artikel zeigt auf, wie gesprächsanalytisch basierte Operationalisierungen für Quantifizierungen und Visualisierungen genutzt werden können, die dann wiederum ein wertvolles Instrument für die Exploration von Partizipationsstrukturen und die Hypothesengenerierung für weitere qualitative Analysen sind. Die systematische Operationalisierung und Normalisierung von Partizipation ermöglicht einen Vergleich partizipatorischer Dynamiken über Gespräche und Klassenstufen hinweg. Am Beispiel gehäufter Ereignisse von *Disagreements* und Überlappungen, die mit einer plötzlichen Verminderung von Partizipation kookkurrieren, wird demonstriert, wie solche Visualisierungen wertvolle Impulse darstellen. Sie helfen dabei, Kollektionen auf relevante Fälle für die sequenzielle Analyse des komplexen

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Wechselspiels zwischen solchen interaktionalen Ereignissen und argumentativer Partizipation herunterzubrechen.

Keywords: diskursive Partizipation – mündliche Argumentationskompetenzen – Operationalisierung – Visualisierung – interaktionale Verläufe – *Disagreement* – Überlappung

1. Introduction

The anthology title *Arguing to Learn* (Andriessen et al. 2003) programmatically represents a focus of recent learning research: the pedagogical value of *collaborative argumentation*. A growing number of studies shows that students simultaneously develop both subject-matter knowledge and practical argumentation skills through engaging in argumentation (Iordanou et al. 2019:9). Collaborative argumentation fosters the use of evidence in constructing arguments (Hemberger et al. 2017:33) and encourages multi-perspective thinking (Kuhn/Crowell 2011:549-551). It also helps students develop an awareness of the effectiveness of different argumentative strategies and the conversational norms that guide discussions (Kuhn et al. 2013:480).

This article focuses specifically on *peer conversations* – that is, conversations between schoolchildren in the absence of adults. Such interactions are seen as especially conducive to the benefits of collaborative argumentation (Zillmer/Kuhn 2018:73). Important skills like leadership can only be practiced and acquired in peer settings (Certo 2011:64), where the flattened conversational hierarchy enables children to adopt expert roles (Blum-Kulka/Snow 2004:295).

However, realizing these learning gains depends on students' *discursive participation* in globally organized argumentative activity (Quasthoff et al. 2021:14). And from a conversation-analytical (CA) perspective, a striking research gap remains in this field: despite the "substantial growth in the application of quantitative and statistical resources […] in CA work on data from so-called institutional contexts" (Schegloff 2009:404), there is still a lack of studies that attempt to quantify participation in argumentative-discursive activity. Specifically, no research to date has grounded such measurements in CA-based operationalizations to explore the interactionally constructed conditions and consequences of participating in conversational argumentation.

This article aims to address that gap by exploring two guiding questions:

(1) How can CA-based coding of actions be used to operationalize discursive participation in conversational argumentation?

(2) What impulses for the further analysis of participatory dynamics can be gained through exploratory visualizations based on these operationalizations?

To illustrate our approach, Section 2 introduces some of the tensions between CA and quantification. Section 3 outlines our framework for a CA-based operationalization of participation and reviews earlier findings on its relation with disagreement and overlap. Section 4 presents the data and operationalizations used, while Section 5 demonstrates the analytical potential of quantification and visualization for CA. We present a case study showing how visual methods can reveal moments in a conversation where accumulations of disagreement and overlaps cooccur with shifts in participation – moments that can then be examined in greater depth through sequential analysis. This post-analysis is provided to assess the hypothesis-like operationalizations and to reflect on the potential pitfalls of reducing interactional phenomena to codes and visualizations. Finally, Section 6 offers a critical evaluation of the quantitative methods employed and considers directions for future applications.

2. Challenges and potentials of CA-informed visualizations

Although the microanalytical orientation of CA may initially seem incompatible with quantitative approaches, coding and quantification have become increasingly common in CA research (see, for example, the extensive coding schemes in Dingemanse et al. 2016; Floyd et al. 2020; Stivers/Enfield 2010). In fact, it has been argued that CA's methodological principles may be particularly well suited to providing a robust empirical foundation for coding (Stivers 2015:3). This is closely tied to the practice of building collections – one of the core procedures in CA (Drew 2024:253). After assembling an initial, 'generous' collection of instances, both the refinement of the collection and the evolving "idea of what one is collecting" must be grounded in the explicit identification of the features that define the phenomenon in question (Schegloff 1997:502). Developing such operationalizations for coding can, in turn, lead to a more methodologically rigorous specification of the categories and collections involved (Steensig/Heinemann 2015:21-22). In this sense, the final formation of a collection presupposes that the phenomenon has already been identified *as a member of a particular category* (Luginbühl et al. 2021:180).

However, there is also a conceptual justification for coding interactional actions: for a stretch of conduct to be recognizable to other participants *as a* specific action with a specific meaning, speakers must necessarily rely on practices that can be categorized as *known* interactional patterns with conventionalized meanings (Spiess 2025a:171-172). For purposes of quantification, it is therefore not only the frequency of such patterns that matters, but also their relevance as perceived by the interactants themselves (Schegloff 1993:110).

Burch (2014:660) outlines three challenges related to coding conversational data. First, interactions cannot be reduced to tables or visualizations without also transparently indicating which observed interactional details the quantifications are based on (Foster/Snyder Ohta 2005:403). This issue is addressed here by ensuring data transparency and offering a detailed and critical methodological discussion of the operationalizations in Section 4. Second, the "radically emic" (Markee 2000:48) perspective of CA requires that categories be developed inductively from the data itself (Burch 2014:660). This paper meets that requirement by strictly adhering to CA-established principles when creating categories. Third, any differentiation into unambiguous, clearly delimited categories inevitably involves reduction (Burch 2014:660). However, such reduction can be mitigated through 'non-essentialist coding' (Spiess 2025b:8), which avoids assigning actions to a single, fixed category (for example, labeling something solely as a 'request'). Instead, it employs multiple, non-exclusive labels, allowing a single action to be categorized, for example, as both 'requesting' and 'affiliating'. Moreover, some degree of reduction is justifiable if the application of quantitative methods yields insights that would otherwise remain inaccessible (Luginbühl et al. 2021:182; Stivers 2015:12). In this way, quantification becomes not only compatible with CA, but necessary in many applied CA studies, where interactional phenomena are analyzed in relation to social or psychological categories (Heritage 1995:405).

An additional benefit of quantification is that it "opens up to new qualitative analytic possibilities" (Steensig/Heinemann 2015:23), particularly when viewed as a process rather than a product. It can help isolate phenomena of interest (Heritage 1995:404), for example by specifying and narrowing down relevant cases within a collection (Deppermann/Schmidt 2014:9). This is especially true for inherently explorative methods such as visualizations, which render conversational patterns visible and can spark new questions for further qualitative analysis (Luginbühl et al. 2021:221).

In recent years, visualizations have become increasingly common for exploring conversational dynamics and presenting findings. Examples include visualizations of turn lengths and frequency (Bubenhofer 2020:291), the synchronization of vocal resources in story-telling (Rühlemann 2020:175), argumentative actions (Luginbühl et al. 2021:223), temporal alignment in dancers' body movements (Krug 2022:7), disalignment through hand movement (Klatt/Krug 2023:52), gaze (Rühlemann/Ptak 2023:22), multimodal annotations (Liebers et al. 2023), and turn transitions (Kelterer/Schuppler 2025:30-32; see also the overview in Spiess et al. in press).

In this sense, the present article falls within the 'less controversial' domain of quantifying CA, as the visualizations produced are intended only as hypothesis-generating tools, which will be tested and elaborated upon through subsequent qualitative analyses.

The next section introduces the concept of participation used in this paper, in order to lay a solid conceptual foundation for the operationalizations that follow.

3. Conceptualizing participation in conversational argumentation

The notion of participation as developed in CA offers a highly valuable lens for describing and understanding the fine-grained ways in which participants co-constitute a conversation as social reality. However, this conceptualization differs slightly from the perspective and interests often involved in applied CA studies. In basic CA approaches, participation is understood as "intrinsically a situated, multi-party accomplishment" (Goodwin/Goodwin 2005:231), emphasizing the emergent and distributed nature of interactional contributions. In contrast, applied studies on conversational skills often pursue a different analytical aim: they seek to describe what *individuals* contribute to the constitution of a conversation (Deppermann 2004:18).

These two conceptualizations of participation will be discussed in more detail in the following two subsections.

3.1. Basic CA approaches to participation

In CA, participation refers to a far more fundamental aspect of interaction than simply 'contributing turns'. It encompasses the interactional work that interactants engage in to orient to the joint interactional projects they pursue with their co-participants and to achieve social order (Goodwin 1999:177-178). Participation is thus understood as "a temporally unfolding process through which separate parties demonstrate to each other their ongoing understanding of the events they are engaged in", accomplished "by building actions and stances that contribute to the further progression of these same events" (Goodwin 2006a:24-25). Central to this conceptualization is the role of embodied behavior (Goodwin/Goodwin 2005:222-223). The multimodal synchronization of interactants – through facing formations, joint attention, or affective stance-taking – is crucial for enabling participation to emerge in the first place (Pfänder et al. 2024b:1689-1690).

While this conceptualization acknowledges that even a hearer's continuers during another speaker's monologue count as participation (Sacks 1992:311), the idea of "participation as action" (Goodwin/Goodwin 2005:225) still suggests a continuum, with some forms of participation regarded as more engaged than others (see also Peräkylä et al. 2022:267). In line with this gradient view, Sacks (1992:707) noted that it is interactionally relevant whether co-participants "voluntarily participate" – that is, mere compliance with sequential expectations, such as answering questions or producing backchannels, is often not treated by participants themselves as 'real' or full participation (Sacks 1992:707). Crucially, what counts as participation is context-dependent. Since participation always takes place *within a particular contextual frame* and projected line of action established through prior interaction (Goodwin 2007:63-64), its local definition is shaped by the type of conversational system and the interactional roles participants adopt within it (Peräkylä et al. 2022:292-293). For instance, the requirements for participating as a co-arguer in an argumentative sequence differ significantly from those for participating as a listener in a narrative sequence.

In argumentative discursive activity, non-participating may manifest as the failure to respond to an argument with a relevant counter or follow-up, thereby avoiding the next locally relevant move (Goodwin 2006b:456). Such disalignment with the ongoing activity may escalate, at the extreme end of the participation continuum, into full *disengagement* (Klatt/Krug 2023:58; following Goffman 1963:58). While enduring disengagement appears rare, participants often exhibit temporary "moments of disengagement" (Peräkylä et al. 2022:271), marked by the absence of three core components of engagement: (i) collaboration in joint action, (ii) embodied orientation to the co-participants, and (iii) alignment with a shared local moral order (Peräkylä et al. 2022:259-260). Klatt and Krug (2023:58) point out that some disaligning actions – particularly in conversations involving children interacting with their parents – can reflect highly cooperative and engaged forms of participation, as children assert agency and help shape the direction of interaction.

To contrast the conceptualization of participation in basic CA approaches, the next subsection addresses the specific form of discursive participation examined in this paper.

3.2. Applied CA approaches to discursive participation

The concept of participation used in this paper builds on and aligns with the conversation-analytically informed approach to analyzing the interactional acquisition of discourse competence (Hausendorf/Quasthoff 2005:586-587), as introduced in Section 1. We prefer to use the term *skills* rather than *competence* to emphasize the analytic focus on what participants *actually* do in conversations – *interactionally* and *demonstrably* – while avoiding implications of cognitive categories. Discourse skills are thus defined as the interactional contribution participants make to discourse units typical of a particular joint activity (Quasthoff 2009:92). Within this framework, argumentation skills are a subcategory describing more specifically the ability to participate in co-constructing argumentative discourse units (Quasthoff/Kluger 2020:109).

A key assumption underlying this research is that these skills both form the foundation for – and are developed through – argumentative-discursive participation. In other words, participants display their argumentative skills by co-producing argumentative sequences, while simultaneously acquiring and practicing these skills through participation in argumentative interactions (Quasthoff et al. 2021:22). In summary, argumentative-discursive participation can be defined (following Quasthoff et al. 2021:22; translation by the author) as "participating in globally organized, that is, discursive, practices according to genre-specific demands [here: of argumentation] through interactive and linguistic contextualization".

An important distinction for conceptualizing participation here is offered by Klatt (2024:24-28): on the one hand, *interactional projects* (Schegloff 2007b:244) refer to lines of actions that participants locally make relevant and negotiate, setting them as the joint focus of the ongoing interaction (Klatt 2024:27). In the conversations analyzed here – where children must reach a joint decision about which objects to take on a desert island or which donation project to support (see Subsection 4.1) – interactional projects correspond to single argumentative episodes where children discuss their preferences about a particular object/project previously established as relevant.

On the other hand, there is a more global level of *activity* that refers to the "work that is achieved across a sequence or series of sequences as a unit or course of action" (Heritage/Sorjonen 1994:4). This higher-level activity functions as a context above the sequential level, characterized by participants orienting themselves to normative patterns provided by this contextual frame (Klatt 2024:29). Such activities can also be externally motivated by task introduction (Pfänder et al. 2024a:6) or instructions, which shape how interactants orient toward the shared activity (Klatt 2024:43). Including this factor is analytically essential because it influences participants' orientation to a joint goal and helps explain their behavior when displaying goal-related interactional expectations, such as normatively sanctioned steps within typical courses of action (Klatt 2024:29).

In the conversations examined here, the instructive goal of reaching a joint agreement constitutes the relevant activity. Achieving agreement first requires participants to express preferences, which are either aligned or in conflict. In cases of disagreement, the 'argumentative machinery' provides conventionalized interactional means and strategies to resolve conflicts and reach a joint conclusion. Examining how this argumentative process toward a shared goal is initiated and participated in provides a basis for assessing discursive participation in the activity at hand.

There is an ongoing interest in children's socialization through interactional participation – see, for example, the recent special section on *Doing participation in child talk and interactional synchronicity* by Arendt et al. (2024), as well as studies by Jacknick (2021) and Preston (2016). Yet, a notable research gap remains in CA-informed research that attempts to quantitatively assess discursive participation. A step in this direction is Erath et al. (2018:163-168), who both counted discursive practices in a mathematics classroom and approximated participation quantitatively by measuring the time students spent contributing. However, this quantification remains fairly basic and does not explore the participatory dynamics over time. Moreover, simply counting the number of words or length of turns falls short of the relevance principle discussed in Section 2, which argues that frequency alone does not necessarily indicate importance – some communicative practices naturally occur more often than others (Robinson 2007:73).

This highlights a fundamental tension in *quantitatively* assessing the extent of *relevant* contributions. To address this gap, this study focuses on participants' *factual competence* – that is, what they actually do in conversation, observable through conversation-analytical methods (Deppermann 2004:20; Luginbühl et al. 2021:182). One promising approach is to conceptualize participation as "social actions in alignment with both the ongoing interaction and the *pedagogical goals* [emphasis added] of the moment" (Jacknick 2021:48). The notion of conversational skills – here, the ability to participate in conversational argumentation – must always be specified and analyzed according to the particular research interest (Deppermann 2004:20-21). In this context, conversational skills are thus understood as the share that individual interactants contribute to the joint production of meaning in relation to the specific conversational activity and setting (Quasthoff 2009:86).

Therefore, if we want to measure discursive participation in conversational argumentation, it should be defined as the quantitative contribution to the shared creation of *argumentation-related* meaning. Before outlining how this can be further operationalized by considering the argumentation-related actions participants use to engage in conversational argumentation (see Subsection 4.2.1), we first provide an overview of research on the relation between participation and disagreement and overlap.

3.3. The relevance of disagreement and overlap for participation

To illustrate the potential of visual approaches to participation in Section 5, we will focus on how interactional events like disagreement and overlap cooccur with changes in participatory dynamics. This subsection thus lies the groundwork by summarizing previous findings that will later be tested in the analysis.

3.3.1. Disagreement

The relation between participation and disagreement described in previous CA studies appears somehow ambivalent. On the one hand, disagreement – defined as expressing an opinion contrary to that of a previous speaker (Klatt 2024:36) – can actually foster participation and make relevant particular ways of contributing to the conversation. As Sacks (1992:707) noted, being in an argument can sometimes "make for 'the best conversations.'" One example is other-corrections, which typically indicate some kind of disagreement but simultaneously make relevant an account or follow-up response from the 'corrected' speaker (Schegloff et al. 1977: 380). When disagreement continues – for example, by contesting an other-correction – it can lead to extended sequences of recycled positions, which eventually evolve into justifications of those positions (Goodwin/Goodwin 1987b:212-213). Such oppositional interactions provide excellent opportunities for participants to display character and position themselves (Goodwin/Goodwin 1987b:215).

In fact, sequences featuring a disagreeing second pair part can be seen as particularly expansion-relevant (Schegloff 2007b:117), because the challenge effectively selects the prior speaker as the next speaker, thus making their participation (that is, defending themselves) relevant (Sacks et al. 1974:704). In conflict talk, disagreeing turns may even be viewed as actions that align with the ongoing activity and actively contribute to its progression (Morek 2016:151). Supporting this, there appears to be a specialized interactional machinery that maintains oppositional talk while simultaneously signaling that previous turns are taken as valid (Goodwin/Goodwin 1990:98). Disagreeing turns often create and rely on linking points to prior or subsequent turns through format-tying (Goodwin 2006b:449), and speakers may even modify their turns mid-delivery in response to noticing disagreement "in the works" (Schegloff 2007b:70).

Arguments tend to follow an orderly and describable structure, often broadening or shifting to related topics over time (Goodwin/Goodwin 1990:97), which can sustain or even enhance continued contributions to the conversation. In some contexts, the typical preference for agreement may even shift to a preference for disagreement based on institutional and genre-specific norms (Kotthoff 1993a:195; Sacks 1992:708). This structural preference for disagreement is especially common in conversational arguments and among children (Glenn 2019:230). Goodwin (1983: 675) observed that in children's argumentation, repeated recycling of positions without justifications – or even aggravated disagreement – is more common and often sustained longer than in adult conversations.

When participants work toward a joint goal, rejections and dispreferred actions are often cooperative (Klatt 2024:171). This pattern also appears in the data analyzed here: to achieve joint agreement, opinions that differ from the preceding turn must be expressed, so they can be negotiated and eventually lead to a shared conclusion.

Despite disagreement often fostering further participation, it can also carry clear interactional risks. When disagreement is expressed without affording the co-participant the interactional space to remedy it, they are "not portrayed as having the competence to remedy the error himself or herself" (Goodwin/Goodwin 1987b: 208), thus constituting an interactional face-threat. Similar negative effects on cooperative participation have been observed in cases such as excluding a present third party by complaining about them to a co-participant (Heinemann 2009:2449), opposing single participants in alliances (Kangasharju 2002:1468), or through violent actions (Klatt/Krug 2023:59).

An additional risk arises from the nature of the data analyzed here, which concerns children becoming competent members of an argumentative-discursive community. As noted above, disagreement usually selects the disagreed-with as the next speaker, placing the obligation on them to take the next turn (Sacks et al. 1974:704). In argumentative exchanges, participants are then expected by co-participants to defend their positions (Kotthoff 1993a:209). However, meeting these expectations presupposes having relevant interactional skills, as argumentative settings often require quick and coherent contradictions (Kotthoff 1993a:203). Adults conversing with children frequently prioritize the children's participation over the usual conversational preference for progressivity by reformulating questions or scaffolding children's turns (Liu 2022:192-193). In peer interactions among children, however, such attention to acquiring pragmatic interactional skills cannot be assumed (Liu 2022:187).

Pfänder et al. (2024b:1689-1690) have shown that the display of empathy through affective stance-taking is crucial to enabling children's participation in conversation. Given this, the question arises whether an extreme accumulation of disagreement – especially when paired with a temporary lack of skill to defend one's position – may reduce participation by leading to dismissal as an equal co-participant, and thus exclusion from the argument. Section 5 will demonstrate how visualizations can help examine these questions.

3.3.2. Overlap

Overlapping talk has been a much-debated research topic since the inception of CA. Building on the early foundational observation by Sacks et al. (1974:704) that participants generally aim to minimize overlap, many studies have attempted for a long time (Youngquist 2009) to operationalize problematic overlaps – understood as interruptions that may be complainable (see, for example, Beattie 1981; Ferguson 1975; Roger et al. 1988; Rogers/Jones 1975; Smith-Lovin/Brody 1989; Zimmerman/West 1975). At the same time, numerous scholars have challenged these operationalizations by highlighting the often cooperative nature of overlapping talk in supporting conversational progressivity (see, for example, Drew 2009; Drummond 1989; Goldberg 1990; James/Clark 1993; Schegloff 2001). This subsection briefly summarizes this research by first outlining the many forms of unproblematic overlapping and then discussing uses that may be seen as uncooperative or even risky for further participation.

As early as 1973, Jefferson began publishing on the orderliness and cooperativeness of overlaps in conversation. She described most overlaps as displays of fine-grained attention and synchronization (Jefferson 1984:1), especially at transition-relevance places, where orientation to the projectability of possible completions allows interactants to begin their turn before the previous one has ended (Sacks et al. 1974:707). In this way, overlaps often display engagement and orientation toward the co-participants (Sacks 1992:643): "We shall see that overlapping is frequently (I might say overwhelmingly, but I haven't done the statistics) co-operative, affiliative, supportive" (Drew 2009:72). Drew (2009:82) further argued, on structural grounds, that overlapping talk has a systematic tendency to be affiliative, noting that dispreferred responses tend to be delayed rather than overlapping.

One particular cooperative form of overlapping is *continuers* (or *backchanneling*), which support the ongoing activity by marking agreement with the speaker's stance (Stivers 2008:46) and displaying understanding (Gardner 1998:206). These are also described as *supportive minimal responses* (Holmes/Stubbe 1997:11), *convergence tokens,* or *engagement tokens* (O'Keeffe/Adolphs 2008:84). Their use during narrative sequences correlates with increased turn sizes (Peters/Wong 2014: 424) and longer stories (Rühlemann 2013:177-178), whereas complete silence in place of backchanneling is often seen as problematic and marked (Bosch et al. 2005:81; Sacks 1992:684).

Besides terminal overlaps and continuers, Schegloff (2000:5-6) mentioned two additional types of unproblematic overlapping in ordinary conversation (as opposed to other speech exchange systems such as singing or protesting): conditional access to the ongoing turn (for example, supporting word search or collaboratively constructing utterances) and choral talk (for example, collective greetings or simultaneous laughing). Studies on such practices of turn-sharing further demonstrate the precise multimodal synchronization and cooperative nature of such overlaps (Hayashi 2005; Pfänder/Couper-Kuhlen 2019:38). Other common sites for overlap include, but are not limited to (see for an overview: Drew 2009), joint disagreements within oppositional alliances (Kangasharju 2002:1452), closing together (Jefferson 1986:173), or moments of self-selection (Sacks et al. 1974:706).

Quantitative studies attempting to operationalize problematic overlaps (that is, interruptions; see, for example, Ferguson 1975:16) often refer to the well-established CA finding that, generally, "one party talks at a time" (Sacks et al. 1974:700). When this order is breached, participants typically attempt to quickly re-establish it (Oloff 2013:208): accordingly, short overlaps are quite common, while long-lasting overlaps are rare (Sacks et al. 1974:706-708). Since turns grant the exclusive right to speak until the first possible completion (Sacks et al. 1974:15), and interactants generally pursue interactional goals, interruptions can be seen as an obstacle to achieving these goals (Smith-Lovin/Brody 1989:425). This association has a long tradition (Youngquist 2009:147), but the relationship is more complex than often assumed. Identifying interruptions requires considering contextual and conversation-specific features (Tannen 1993:176).

Schegloff (2000:23-24) noted that while most overlaps last no longer than three beats, longer overlaps often indicate interests other than turn-taking – for example, a departure from the current interactional project. However, the 'normal' length of overlaps at transition-relevance places depends heavily on contextual and cultural factors (Bonacchi 2020:47-48). Importantly, overlap length alone is not a sufficient criterion for identifying interruptions: cooperative terminal overlaps can last considerably when participants have sufficient cues to anticipate turn completion early (Drew 2009:83). Moreover, extended simultaneous talk producing agreeing assessments is often linked to a particularly affiliative stance (Goodwin/Goodwin 1987a: 26).

Consequently, a distinction between *disruptive* and *cooperative* overlaps has emerged, where the former are characterized as interruptions (see, for example, Cafaro et al. 2016:911-914; Murata 1994:387-388). Cooperative overlaps support the project of the ongoing turn, while disruptive interruptions disturb these processes (Cafaro et al. 2016:912). Similarly, Kotthoff (1993b:167-170) differentiates simultaneous speaking that does not interfere with another's right to speak from interruptions accompanied by turn takeovers. Yet, the competitiveness of overlapping talk does not reliably indicate interruptions, as turn-competitive overlaps may also involve agreeing actions (French/Local 1983:35). While they can indeed serve subversive completions that depart from intended turn completions (Bolden et al. 2019:156), they often enhance conversational progressivity by displaying affiliation (Schwitalla 1993:89) or expressing understanding via conjoined actions (Lerner 2002:250).

Therefore, Schegloff (2001:301) cautions that the concept of "'interruption' is not only an analysis of its target occurrence but a complaint about it". He emphasizes that the complaint aspect must be demonstrated through the interactants' own displays (Schegloff 2001:305-306). According to Schegloff (2001:313), the goal is thus "to treat 'interruption' not as a transparent tool of analysis but as a problematic component of the object of analysis".

Nonetheless, it is undisputed that overlapping talk *can* be used non-cooperatively to shut down fellow participants. Qualitative studies have documented cases where overlapping leads to drastic exclusion and consequent reduction in participation (see, for example, Debray/Spencer-Oatey 2019:21-22; Pierce/Gilles 2022:6). Accordingly, the present paper follows Schegloff's (2001:313) approach by making the concept of interruption "a component of the object of analysis". Specifically, we demonstrate how visualizations can be used to identify moments in conversations where significant accumulations of overlaps cooccur with decreases in participation, thus helping pinpoint relevant conversations for further analysis.

4. Data and operationalization

Before detailing the operationalization process, Subsection 4.1 offers an overview of the analyzed corpus and the coding scheme applied to this data in an earlier project.

4.1. Argumentative peer discussions among schoolchildren

This study examines 180 argumentative conversations among groups of four Swiss German schoolchildren, aged 7-12. All parents or legal guardians of the subjects involved in the study gave their written informed consent for the anonymized video data and transcripts to be used and published for research purposes (for a detailed overview, see Luginbühl et al. 2021).[2] The conversations are peer interactions and thus characterized by an interactional symmetry, which encourages students to openly express (sometimes incomplete) ideas and to experiment with different roles, such as that of the expert (Blum-Kulka/Snow 2004:298-299).

The data were collected from 60 groups performing three distinct tasks: in the 'Robinson setting' (Ro), children imagined being stranded on a desert island and had to agree on three out of twelve items to retrieve from the seabed (Luginbühl et al. 2021:185). The second task ('donation setting') required them to rank four potential donation projects according to their personal priorities (Luginbühl et al. 2021:185): a project for brown bears in Switzerland, wild bees in Switzerland, vacations for children from financially disadvantaged families, or their own class fund (Luginbühl et al. 2021:185). The third task was similar to the second task but had real consequences, as the children's choice determined where actual money was donated.

The conversations were transcribed following the GAT-2 standards (Selting et al. 2009), capturing four tiers: literal transcription (v; mainly Swiss-German, German, or mixed), standard German normalization (sd), selected multimodal activities (nv), and annotations (a; Luginbühl et al. 2021:188). Because CA-based quantification requires detailed and qualitative case studies as a basis (Schegloff 1993:102), Luginbühl et al. (2021:182) began with an intensive, close examination of the data. The coding scheme for the annotation tier was then developed iteratively through alternating phases of qualitative analyses, test coding, and data sessions (Luginbühl et al. 2021:228). This process moved from broad, global analyses to fine-grained, microscopic examination, ultimately coding individual actions with codes that "do justice to the argumentative process/interactivity and show various interactive references of argumentative actions […] to one another", indicating that the codes are conversation-analytically grounded (Luginbühl et al. 2021:184).

A key foundation for the coding scheme is the GLOBE model (Hausendorf/Quasthoff 1996:124-150), originally developed as an inductive reconstruction of the sequential organization participants orient to in narrative interactions (Hausendorf/Quasthoff 2005:604-605). Based on detailed sequential analysis of children's conversations, Heller (2012:68) adapted this model for conversational argumentation, identifying five jobs interactants demonstrably orient to when processing argumentative interactions: "establishing dissent / problematizing", "establishing the obligation to give reasons", "justifying", "concluding", and "transitioning" (Heller 2012:68).

The coding system is organized into four levels. The first level captures actions that potentially trigger argumentation by introducing a task-related object or project into the discussion, thus addressing the first job outlined above (Luginbühl et al. 2021:193; see Table 1). This includes simply referring to an object or project (coded as *1-th* for 'thematizing'; the codes are abbreviations of German words, the English translations of which are introduced here in single quotes), expressing support or opposition (*1-für/1-geg* for 'for' and 'against'), or assigning a preferred rank (*1-platz*

2 The data of the entire corpus can be inspected via an interactive website: https://argcomp.shinyapps.io/baselargVis (2 March 2025).
All (anonymized) transcripts and videos with audio of the whole corpus along with the coding manuals used for annotation will be made available on the Datenbank für Gesprochenes Deutsch (DGD) in autumn 2026 (https://dgd.ids-mannheim.de/, 2 March 2025).

for 'placing'). These codes are conversation-analytically justified, as they rely solely on observable surface references to objects or projects (see, for example, Schegloff 2007a:436) and on displays of stance that can be identified through sequential analysis (see, for example, Kärkkäinen 2006:704).

Turn		Code	Function
001 S1:	*so bush knife*	1-th	The child mentions an object/project without taking a stance on it ('thematizing')
001 S2: 001 S2:	*I'm in favor of the tent* *you don't really need bandages*	1-für 1-geg	The child expresses their opinion by speaking out for or against an object/project ('for' or 'against').
001 S3:	*bees in first place*	1-platz	The child proposes a project for a certain rank ('placing').

Table 1: Codes of the first level: actions potentially triggering argumentation (Luginbühl et al. 2021:193; slightly adapted)

The codes at the second level identify the specific task-related objects or donation projects referenced in the coded turns (Luginbühl et al. 2021:194; for example, *2a-zel* for 'tent', *2a-leu* for 'flares', *2a-wol* for 'woolen blanket', or *2a-bus* for 'bush knife'; see Table 2). The third-level codes mark justifications (Luginbühl et al. 2021:195; see Table 2), which correspond to the processing of the third job of the GLOBE model. Although justifications are broadly described as *giving reasons* (Luginbühl et al. 2021:182), they can be defined more precisely by their sequential embedding: in conversational argumentation, justifications satisfy and simultaneously renew the conditional obligation to give reasons (Heller 2012:78-81). This is evident in how interactants behave: when the obligation to give reasons is established, positions must be supported by justification (Heller 2012:78). Co-participants are held accountable for their positions, and failing to provide reasons typically results in sanctions or requires proactive defense through an account (Heller 2012:78). The fact that proactive justifications can also initiate this obligation by instantiation highlights their role in maintaining it as an interactional norm (Heller 2012:81).

Using the conversation-analytical concept of *(dis)affiliation* (Stivers et al. 2011:2), justifications can be further classified based on their sequential embedding: *initiating* (*3a-in* for 'initiating'), *validating* (*3a-zu* for 'agreeing'), and *oppositional justifications* (*3a-ab* for 'rejecting').

Previous research has shown that both conversational argumentation (Hannken-Illjes/Bose 2019:489-490; Kreuz et al. 2019:42-45; Kreuz/Mundwiler 2016:103; Mirivel 2011) and participation more broadly (Goodwin 2007:53; Goodwin/Goodwin 2005:222-223; Pfänder et al. 2024a:6; Pfänder et al. 2024b:1689-1690) are fundamentally multimodal. Accordingly, embodied actions were also considered when assigning codes (for example, pointing to a picture of an object to express a stance or using gestures to enact how an object might be useful to justify a position).

The codes at the fourth level (*4-x*) were applied less systematically and mark features such as norm invocations and co-constructions (Luginbühl et al. 2021:196).

Relevant and previous turn	Code	Function
001 S1: *I'm in favor of the tent* 002 S2: *yes but can't we just sleep in a tree*	1-für 2a-zel 2a-zel 3a-ab	The child expresses a justification that opposes the previous turn ('rejecting').
001 S1: *let's choose the flares* 002 S2: *yes because then we can send emergency signals*	1-für 2a-leu 2a-leu 3a-zu	The child expresses a justification that supports the previous turn ('agreeing').
001 S1: *we could choose the wool blanket* 002 S2: *and the bush knife as it we need it to hunt*	1-für 2a-wol 2a-bus 3a-in	The child initiates a justification for the bush knife – that is, it introduces a new topic without argumentatively referring to the previous turn ('initiating').

Table 2: Codes of the third level: justifications (Luginbühl et al. 2021:195; slightly adapted)

After introducing these codes, the next subsection explains how participation and events of disagreement and overlap can be operationalized using them.

4.2. Operationalization of participation, disagreement, and overlaps

It is important to emphasize that the operationalizations presented here should not be seen as final conclusions, but rather as hypotheses to be tested for accuracy and usefulness through quantification and sequential post-analysis. With this in mind, the next two subsections outline how participation and the interactional events of disagreement and overlaps were operationalized in order to later transform them into exploratory visualizations.

4.2.1. Computation of participation

What counts as a *relevant* contribution to the interaction depends heavily on the type of activity in relation to which the interactants' share in the joint production of meaning is measured. In this sense, the operationalization presented here reflects a specific kind of participation tailored to the research goal: it measures children's discursive participation in constructing *argumentative structures* (see the discussion in Subsection 3.2).

The turns that contribute to this argumentative meaning-making – referred to here as *argumentation-related* – are those annotated with codes from the first level (actions potentially triggering argumentation) and the third level (justifications). These turns contribute directly to the joint processing of the GLOBE jobs and thus to the progression of the argumentation itself. Justifications are given greater weight because they explicitly develop the arguments by elaborating on reasons for adopting a particular stance.

This added weight can be justified from an emic perspective: the third-level codes were developed with attention to the participants' own perspective and relevancies. Actions were coded as justifications if they are *demonstrably recognized* by them as justifications (Heller 2012:85). Because justifications are defined sequentially as actions that progressively satisfy the previously established obligation to give reasons (Subsection 4.1), they mark the transition from the job of "establishing the obligation to give reasons" to that of "justifying", and continue until participants display sufficient satisfaction to move on to the next job of "concluding".

In this way, justifications contribute far more than merely triggering argumentation – they play a key role in advancing it. Even on a local level, participants treat justifications as 'heavier' contributions, since establishing an obligation to give reasons displays that *more* than simply expressing a stance is required and considered relevant at that point in the interaction.

Initiating justifications (with the code *3a-in*) were assigned more weight than other justifications because they mark the establishment of the argumentative activity itself – shifting from the job of "establishing the obligation to give reasons" to that of "justifying". In this way, they represent a crucial step in the argumentative process, as they set up the 'argumentative machinery' (see Subsection 3.2) as the preferred means to mediate conflicting positions and ultimately work toward reaching a joint decision.

Codes at the fourth level were not systematically annotated, with one exception: *quaestio shifts* (*4-quae*). These were included in the participation measure because they almost always signal argumentative activity, occurring when objects or projects are argumentatively contrasted or compared. However, since quaestio shifts are usually turns already annotated with third-level codes, they were assigned a low weight, equal to that of first-level codes.

Another important code is *3a-mehrfach* (multiple-related reasoning), which links or juxtaposes at least two justificatory relations by presenting different argumentative perspectives on the same issue. In this sense, due to their multiperspectivity, such turns establish multiple (parts of) arguments simultaneously, indicating competent action and more complex argumentation (Grundler 2011:292-293). Therefore, this code was given the highest weight.

These weightings, while grounded in participants' own perspectives (emic measures), are also justified from an analyst's viewpoint (etic motivation). The tasks were introduced to the children without explicitly mentioning argumentation, yet they were designed to encourage the use of argumentative strategies to reach a joint decision when facing conflicting views. Previous studies in this setting have shown that as children get older, more of them use justifications (Luginbühl et al. 2021: 213), and the number of justified statements increases (Luginbühl et al. submitted). Notably, older children also tend to engage in argumentative problem-solving strategies even *before* disagreement arises (Spiess/Luginbühl submitted). Thus, weighting justifications – and especially those that initiate argumentative sequences – more heavily aims to capture children's socialization into the discursive practice of argumentation. It helps measure whether they proactively identify interactional affordances to start and engage in extended argumentative discourse units to negotiate and resolve conflicting positions.

Table 3 provides an overview of the weights assigned to each coded action. Speech duration was not considered, as it can be skewed by slow speaking or frequent pauses. Instead, coded actions were further weighted by the number of words they contained, measured relative to the conversation's own standards: each coded turn's weight was multiplied by the ratio of its length to the average length of all coded turns in that conversation. For example, a turn with a base weight of 2 (multiple-related reasoning) containing 15 words – 50% longer than the conversation's average coded turn length of 10 words – would be assigned a final weight of 3 (2 × 1.5).

Of course, this word-count weighting remains an *approximation* of each utterance's conceptual contribution to the argumentative process. The intuitive assumption is that longer arguments generally play a larger role in constructing joint argumentative meaning, since more words are typically needed to develop multiple or more complex arguments.

Category	**Code**	**Weight**
Potential triggers of argumentation (*1-x*)	Thematizing (*1-th*)	0.5
	Speaking out for an object/project (*1-für*)	0.5
	Speaking out against an object/project (*1-geg*)	0.5
	Proposing a rank (*1-platz*)	0.5
Justifications (*3a-x*)	Validating justification (*3a-zu*)	1.0
	Oppositional justification (*3a-ab*)	1.0
	Initiating justification (*3a-in*)	1.5
	Multiple-related justification (*3a-mehrfach*)	2.0
Other actions (*4-x*)	Quaestio shift (*4-quae*)	0.5

Table 3: Actions that were considered for computing participation and weights chosen based on the assumed average contribution to the argumentative production of meaning

To highlight one of the key advantages of CA methods for quantifying phenomena (see Section 2), these measures of participation can be further formalized using mathematical formulae. While this might seem unusual to conversation analysts, it offers three main benefits for applied CA research: first, it allows the operationalizations to be specified with more precision; second, it improves methodological transparency and promotes replicability; third, it makes the research more accessible to other disciplines and a broader audience, which is one of the main strengths of combining quantitative methods with CA, as noted by Stivers (2015:12). Accordingly, the participation contributed by one turn can be formalized as follows:

$$\text{PART} = \left(\sum_{i \in \mathcal{E}} c_i \times w_i\right) \times \left(\frac{n}{\bar{n}}\right) \quad (1)$$

Where:

- $\mathcal{E} = \{$*1-th*, *1-für*, *1-geg*, *1-platz*, *3a-zu*, *3a-ab*, *3a-in*, *3a-mehrfach*, *4-quae*$\}$ is the set of all coded events.
- c_i represents the count of the event i in the turn, where $i \in \mathcal{E}$.
- w_i is the weight assigned to the event i, with the values specified in Table 3.
- n is the number of words in the turn.
- $\bar{n}$ is the average number of words per turn in the conversation.

It is important to emphasize that the exact numerical weightings are contingent. This entails certain risks that can be mitigated through careful reflection. First, since different coded events are aggregated into a single participation value per time point and interactant, and only these aggregated values are compared, the absolute differences between weights are less critical than their relative ordering. Second, assigning fixed weights might create the misleading impression that certain actions (for example, validating justifications) lack in-group variability across individual instances. This concern can be addressed by analyzing a sufficiently large corpus that allows for generalization despite variability in the data. Third, some types of actions may be systematically over- or underrated relative to others. Although weightings are inevitably based on expert knowledge and assumptions, conducting sensitivity analyses is a valuable additional step to further strengthen and validate these assumptions. In this study, the weights were systematically varied to assess the effects of these changes. Table 4 summarizes the sets of weights tested.

Code	**Weight sets**					
	0.25	**0.5**	**0.75**	**1**	**1.25**	**1.5**
1-th	0.5	0.5	0.5	0.5	0.5	0.5
1-für	0.5	0.5	0.5	0.5	0.5	0.5
1-geg	0.5	0.5	0.5	0.5	0.5	0.5
1-platz	0.5	0.5	0.5	0.5	0.5	0.5
3a-zu	0.75	1.0	1.25	1.5	1.75	2
3a-ab	0.75	1.0	1.25	1.5	1.75	2
3a-in	1.0	1.5	2.0	2.5	3.0	3.5
3a-mehrfach	1.25	2.0	2.75	3.5	4.25	5
4-quae	0.5	0.5	0.5	0.5	0.5	0.5

Table 4: Weight sets used in sensitivity analysis, the numbers in bold are the weight set titles and reflect the absolute differences between the four different weighting levels

Next, for every second of each conversation and for each set of weights, the proportions of participation were calculated relative to the summed total participation of all four participants. Specifically, the PART values (see Equation 1) of all turns produced by each interactant up to a given time point were summed and then divided by the total sum of PART values of all turns from all interactants up to that same time point. These shares were then converted into percentages and plotted according to the following function:

$$y_{p,w}(t) = \frac{\sum_{\tau \le t}\left(\left(\sum_{i \in \mathcal{E}} c_{i,p,\tau} \times w_i\right) \times \left(\frac{n_{p,\tau}}{\bar{n}}\right)\right)}{\sum_{p=1}^{4}\left(\sum_{\tau \le t}\left(\left(\sum_{i \in \mathcal{E}} c_{i,p,\tau} \times w_i\right) \times \left(\frac{n_{p,\tau}}{\bar{n}}\right)\right)\right)} \times 100 \qquad (2)$$

Where:

- $c_{i,p,\tau}$ is the count of event i for participant p at time point τ.
- $n_{p,\tau}$ is the number of words in participant p's turn at time point τ.

Figure 1 shows a graph of a conversation that, after qualitative examination of all 180 conversation plots, is considered representative of the general trends observed across the dataset. The trajectories are distinguished by a unique line type for each participant and by different colors representing the various sets of weights.

Figure 1 shows that participation values tend to stabilize over time, with the final order of participation likely holding the greatest explanatory power. Moreover, different weight sets have little impact on the variance of the trajectories, which run relatively parallel. This suggests that the participation measures aren't overly sensitive to changes in weighting, although weight variations may still influence the values in critical phases of the conversation.

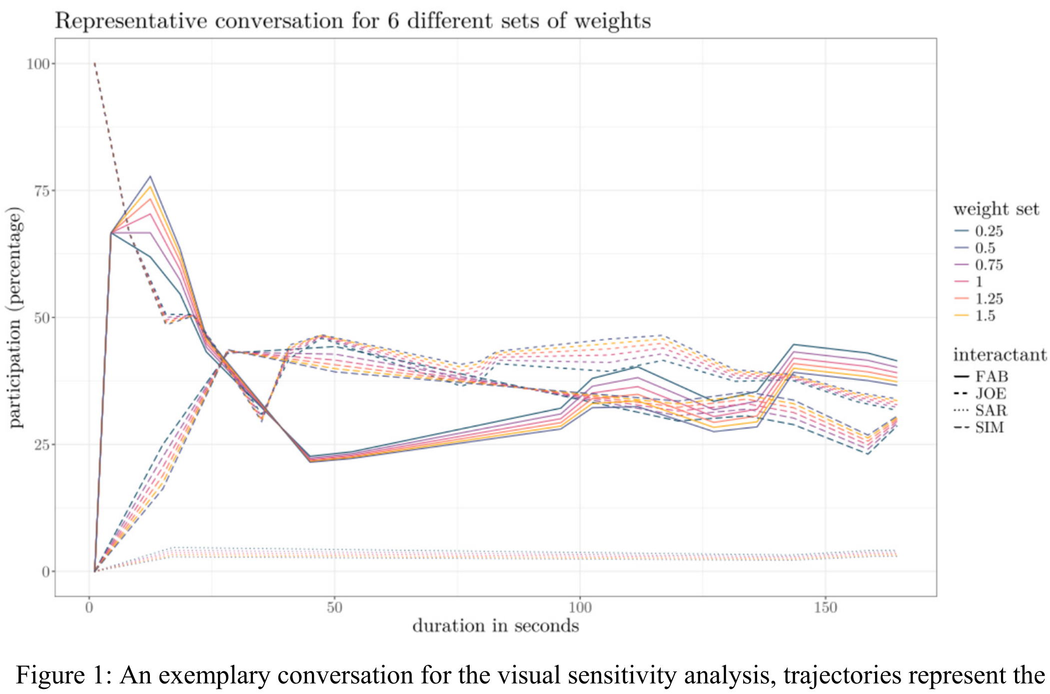

Figure 1: An exemplary conversation for the visual sensitivity analysis, trajectories represent the proportions of participation in the total sum of all four participants

At first glance, the decision to sum up participatory events over time might seem to conflict with CA's notion of participation as locally constituted at every moment and oriented to as such by participants. However, there are both conceptual and methodological reasons supporting the summative approach, which align with the developmental perspective and aims of the present study.

First, the conversations analyzed here were collected in a semi-experimental setting: they were elicited with a fixed goal but left open regarding duration and conversational dynamics. Thus, while the conversations unfold naturally, they are always situated within the context of ultimately reaching a joint decision on a given task. This setting thus makes a global orientation relevant, wherein argumentative negotiation of positions must continue until consensus is reached. The summative approach reflects this requirement by mapping the participants' awareness of the conversation's boundaries and their need to sustain argumentative activity until the goal is achieved.

Furthermore, computing participation as percentage of the total argumentative contributions directly represents discursive participation as a share in the joint constitution of argumentative conversations (see Subsection 3.2). This allows for exploration of participatory dynamics by directly comparing participants' trajectories in real time, thereby approximating the degree of *collaborativeness* in argumentation – an aspect shown to be central for learning gains (see Section 1). The normalization also facilitates comparability across conversations, which is essential for the developmental perspective adopted here. Lastly, the summative visualization reduces visual noise and supports a more intuitive interpretation of how participation is gained, maintained, or lost over time following specific interactional events.

4.2.2. Computation of disagreement and overlap

Category	Sequential pattern	Operationalization
Disagreement	Oppositional positioning (opp_pos)	Equation 3
	Oppositional justification (opp_just)	Equation 4
Overlap	Type 1: Long overlap (overlap)	Equation 5
	Type 2: Disaffiliating interjection (overlap)	Equation 6

Table 5: Variables that were coded as markers of disagreement and overlaps

Four variables are used as markers of disagreement and overlap events (see Table 5): *oppositional positioning*, *oppositional justification*, and *overlap type 1* and *2.*

Oppositional positionings (see Equation 3) occur when a turn T_{n+1} follows a turn T_n that expresses an opposing stance on the same object or project (indicated by *1-für* or *1-geg*):

$$\text{OppositionalPositioning} = \mathbf{-1}\left\{\begin{matrix}\begin{pmatrix} ObjectCode_{T_n} = \\ ObjectCode_{T_{n+1}} \end{pmatrix} \wedge \\ \left(\begin{matrix}\begin{pmatrix} Code_{T_n} = \textit{1-geg} \wedge \\ Code_{T_{n+1}} = \textit{1-für} \end{pmatrix} \oplus \\ \begin{pmatrix} Code_{T_n} = \textit{1-für} \\ \wedge\ Code_{T_{n+1}} = \textit{1-geg} \end{pmatrix}\end{matrix}\right)\end{matrix}\right\} \tag{3}$$

Where:

- $\mathbf{-1}\{\cdot\}$ is an indicator function that returns -1 if the condition inside the brackets is true, and 0 otherwise.
- T_n is the current turn.
- T_{n+1} is the subsequent turn (by another participant).

Oppositional justifications describe sequential patterns where a justification in turn T_{n+1} rejects the prior stance in turn T_n (the object/project reference can be ignored here, since the justification codes *3a-zu*/*3a-ab* per definition refer to the previous turn). These patterns are defined by Equation 4.

$$\text{OppositionalJustification} = \mathbf{-1}\left\{Code_{T_{n+1}} = \textit{3-ab}\right\} \tag{4}$$

To focus on overlapping talk that might indicate disruptions in participatory structures, we aimed to approximate deviations from regular overlaps – those that commonly occur without disturbing the flow of participation. To exclude onset overlaps – particularly those arising from speakers' self-selection – we only included cases where one of the overlapping interactants had already perceptibly established the right to speak before the other began their turn. This criterion was based on reaction times to auditory signals. Ladefoged et al. (1973:1106-1107) found that speakers typically need about 300ms to interrupt their speech in response to an acoustic signal. However, this reaction time can increase significantly (up to 800ms) if the signal occurs just before the interactant starts talking (Ladefoged et al. 1973:1106-1107). To be conservative, we added a safety margin, setting a threshold of 1000ms. Therefore, the interactant whose turn is overlapped must have started speaking at least one second before the overlapping interactant began.

Within these overlaps, we approximated a first type of norm-violating cases by selecting overlaps that lasted unusually long – significantly exceeding the general tendency for overlaps to be brief (Schegloff 2000:23-24). This minimum overlap duration was determined relative to the factual norms of each conversation: a critical overlap length was defined as exceeding one standard deviation above the mean overlap duration for that conversation. These 'long overlaps' (see Table 5) are formalized by Equation 5:

$$\text{Overlap}_{type1} = \mathbf{-1}\left\{\begin{matrix} t_{start,n+1} \geq t_{start,n} + 1 \ \wedge \\ d_{overlap} > \bar{d}_{overlap} + \sigma_{d_{overlap}} \end{matrix}\right\} \tag{5}$$

Where:

- $t_{start,n+1}$ is the start time of the subsequent turn.
- $t_{start,n}$ is the start time of the current turn (by another participant).
- $\mathrm{d}_{overlap}$ is the duration of the overlap in question.
- $\bar{d}_{overlap}$ is the mean duration of all overlaps in the conversation.
- $\sigma_{d_{overlap}}$ is the standard deviation of all overlap durations in the conversation.

A second type of overlap considered is 'disaffiliating interjections' (see Table 5). Longer overlaps are excluded here, as they are already captured by the first type of overlap. Among the shorter overlaps, those that mark disagreement are strong candidates for departures from typical overlaps, which are usually affiliative (Drew 2009:72). Therefore, all overlaps that fall below the critical minimum duration – but display disagreement according to the coding – were included. The 1000ms safety margin was also applied in this context. Equation 6 below formalizes the calculation of this second type of overlap:

$$\mathrm{Overlap}_{type2} = -\mathbf{1}\left\{\begin{array}{c} t_{start,n+1} \geq t_{start,n} + 1 \ \wedge \\ d_{overlap} < \bar{d}_{overlap} + \sigma_{d_{overlap}} \ \wedge \\ \left(\begin{array}{c} \mathrm{OppositionalPositioning}_{T_n,T_{n+1}} \vee \\ \mathrm{OppositionalJustification}_{T_{n+1}} \end{array}\right) \end{array}\right\} \tag{6}$$

All four variables were further normalized. The total number of occurrences of each event was calculated for every participant at each point in time. This total was then divided by the number of opportunities the interactant had to experience such an event. In other words, all events were divided by the number of (argumentation-related) turns the participant had already made up to that point. The only exception was oppositional positionings, which were normalized by dividing by the number of positionings, since oppositional positionings can only occur in response to one's own positioning. This standardization reduces the impact of individual differences between single participants or conversations (for example, it accounts for cases where high absolute numbers of disagreement reflect a generally frequent occurrence of stance-taking). As a result, it enables better comparability across conversations. The normalized value for each variable is calculated as follows:

$$\mathrm{EventPrevalence}_{EventType,p}(t) = \frac{\sum_{\tau \leq t} EventType_p(\tau)}{\sum_{\tau \leq t} \mathbf{1}\{ArgumentationRelated_p(\tau)\}} \tag{7}$$

Where:

- $EventType$ is $OppositionalPositioning$, $OppositionalJustification$, or $Overlap_{type1/2}$.
- $ArgumentationRelated$ is true for all turns that were coded as *1-für* or *1-geg* when calculating the prevalence for $OppositionalPositioning$ and for all turns that were coded with any code when calculating the prevalence for one of the other $EventTypes$.

After calculating participation values for each participant using Equation (1) and (2), and coding disagreement and overlap based on Equations (3) through (7) across the entire corpus, the data is now ready to be quantified and visualized in the next section.

5. Results: Exploring participatory dynamics

5.1. Characterization of typical interactional trajectories

As a first step toward quantitatively and visually characterizing participatory dynamics, the 180 conversations in the corpus were classified based on how the participation trajectories of the four participants in each conversation related to one another. By manually comparing visualizations of all conversations, six different conversation types were identified.

The 'upward deviator' type (Figure 2A) describes conversations where one interactant's participation is noticeably higher than the others', while 'downward deviator' (Figure 2B) reflects the opposite pattern.

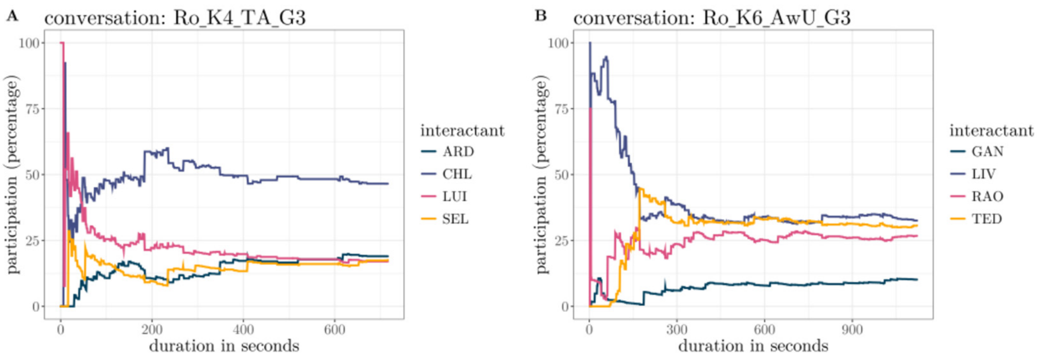

Figure 2: Exemplary cases of the conversation types 'upward deviator' (A) and 'downward deviator' (B)

The 'mirrored' type (Figure 3A) refers to conversations where participation trajectories of the most and least participating interactants differ markedly from those of the other two interactants. Conversations were labeled 'uniform' (Figure 3B) when all four participants contributed roughly equal shares.

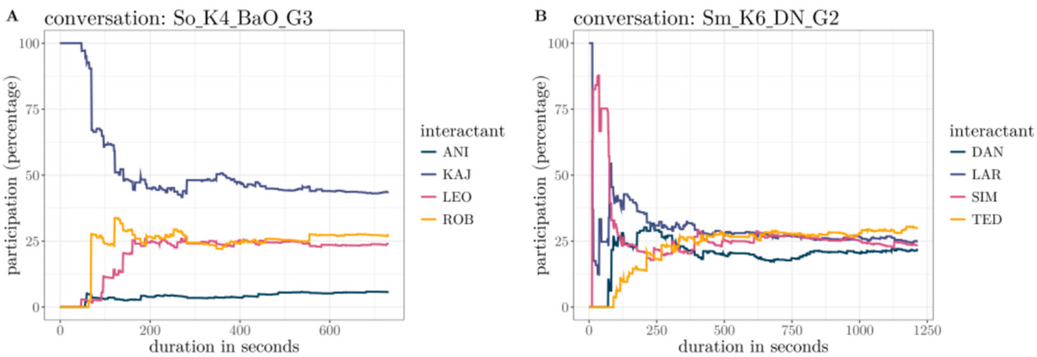

Figure 3: Exemplary cases of the conversation types 'mirrored' (A) and 'uniform' (B)

The 'staircase' pattern (Figure 4A) captures conversations with more varied participation levels, yet with roughly equal gaps between them. Lastly, the 'two-two' type (Figure 4B) characterizes conversations where two interactants have clearly higher participation than the other two.

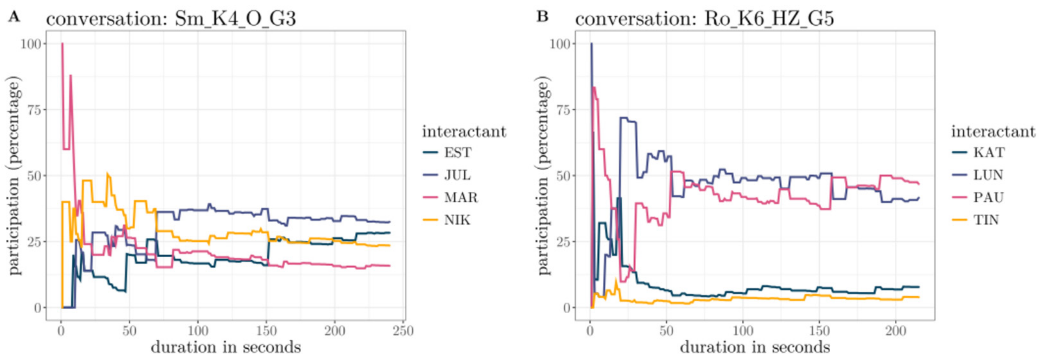

Figure 4: Exemplary cases of the conversation types 'staircase' (A) and 'two-two' (B)

In a second step, the participation trajectories from all conversations were normalized to 50 data points each and then clustered into four groups per conversation type – each representing one interactant – using *dtwclust* (Sardá-Espinosa 2019; see Figure 5).

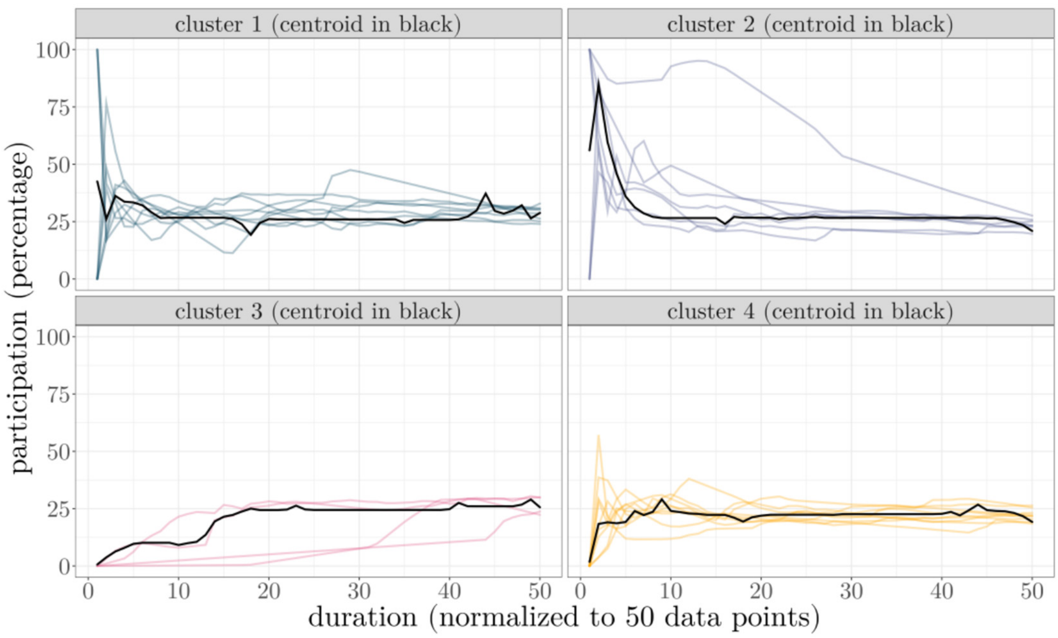

Figure 5: Clustering of all trajectories of the conversation type 'uniform' into four groups

This clustering allows us to average all trajectories within each group and conversation type by calculating *centroids* – essentially the average trajectory of each cluster – using *DTW barycenter averaging* (Petitjean et al. 2011). These centroids can then be used to visualize the 'ideal trajectories' for each conversation type (see Figure 6)

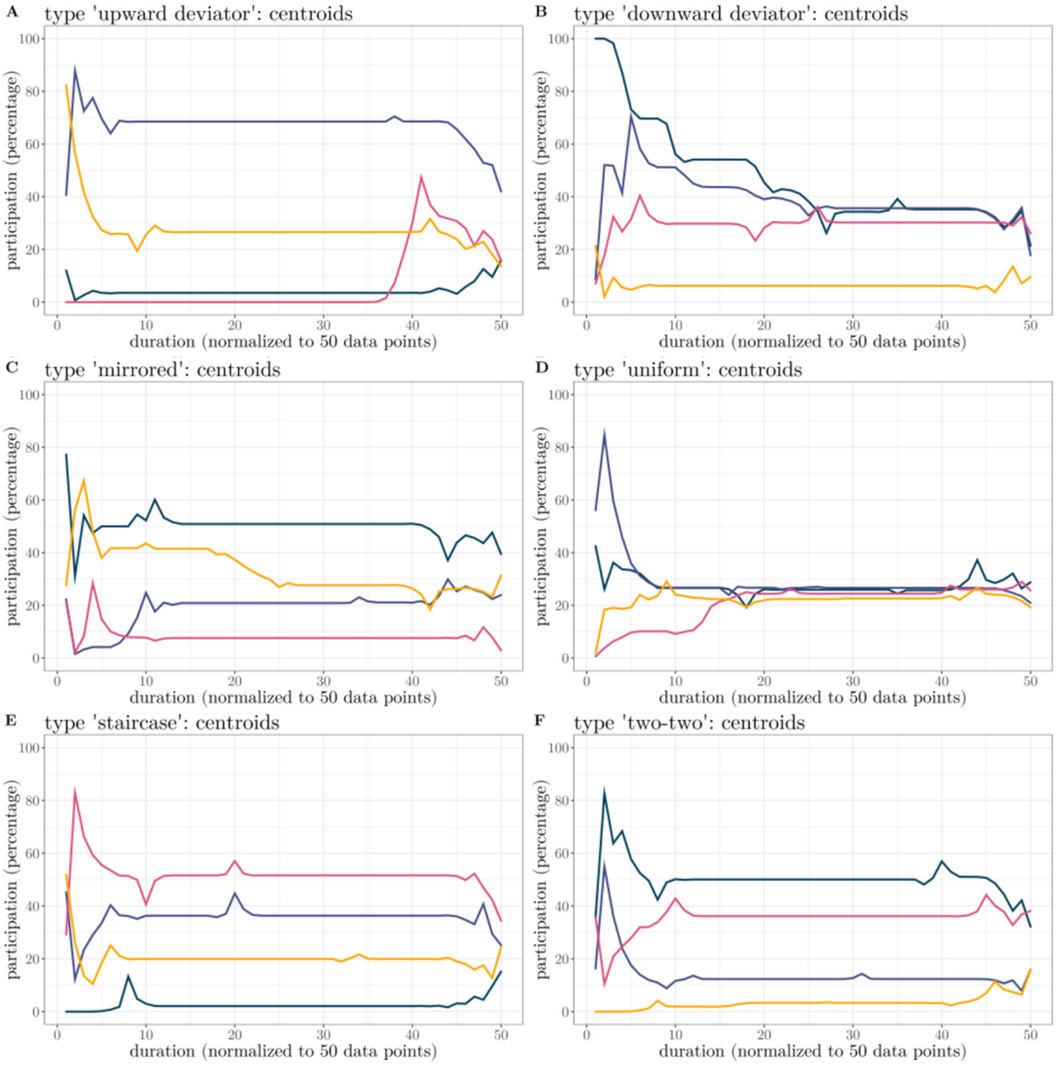

Figure 6: Centroids (~ typical trajectories) of the six conversation types (A–F)

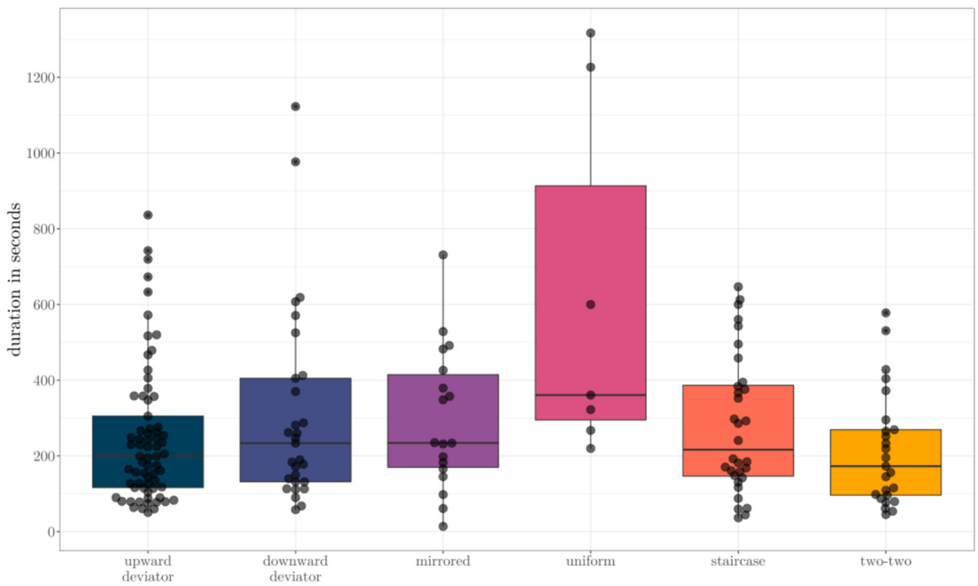

Figure 7: Distribution of conversation durations across conversation types

Figure 7 shows the distribution of conversation durations across the different types. Although no statistical test was performed – mainly because the 'uniform' type has a borderline sample size (n = 7), which is noticeable in itself – future analyses on a larger corpus could test the hypothesis suggested by Figure 7: that conversations with quite equal shares of participation tend to last longer.

Finally, 'degrees of uniformity' were calculated by grade level. For each participant, one data point was collected every ten seconds by measuring the difference between their average participation during that interval and the 'ideal share' of 25%. This yielded a total of 20'131 data points: 4776 from grade 2, 7602 from grade 4, and 7753 from grade 6. As shown in Figure 8, moments when an interactant's participation closely matches the 'ideal share' occur much more frequently in grades 4 and 6, as indicated by the higher density of values near the lower edge of the violin plots.

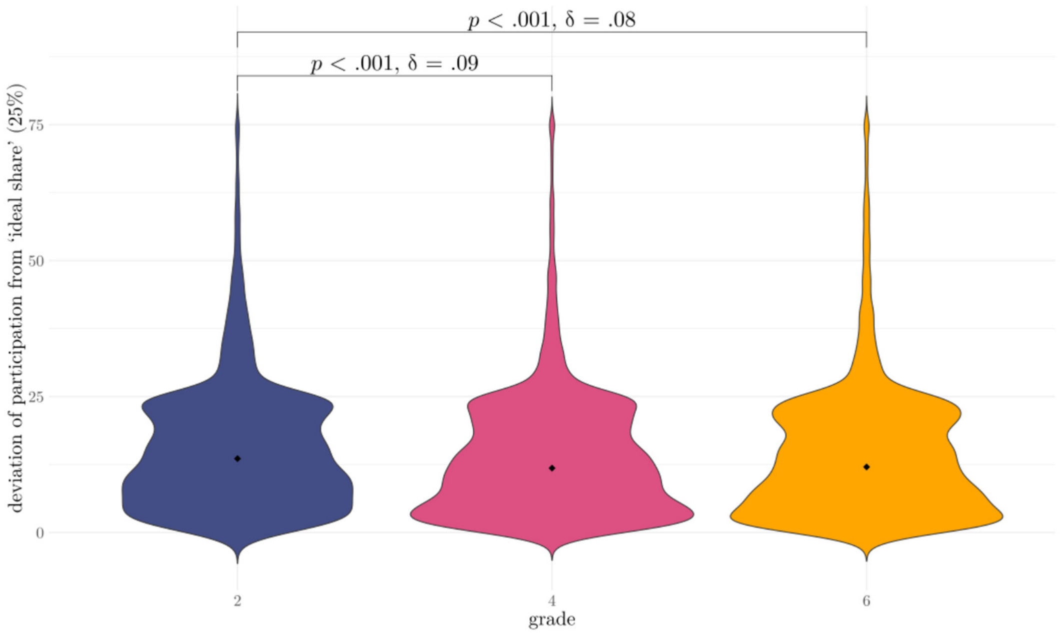

Figure 8: Degrees of uniformity (deviations from the 'ideal share' of 25%) across grades

A Kruskal-Wallis test (*H statistics* = 82.80, *df* = 2) revealed a significant difference in degrees of uniformity across grades ($p < .001$). Pairwise Dunn's tests further showed significant differences between grades 2 and 4, as well as between grades 2 and 6 (see Bonferroni-corrected *p* values in Figure 8). Although the effect sizes, measured by *Cliff's deltas*, are relatively small (also shown in Figure 8), the findings are intuitively plausible and suggest a developmental trend toward more balanced participation in conversations as children grow older.

The visualizations in this subsection represent an even greater "reduction from the intricate complexities of human behavior" (Stivers 2015:2) than the previous step of coding. However, they also offer specific opportunities for guiding further analytical directions. One example of this kind of synergy will we illustrated in the next subsection.

5.2. Identifying critical moments for participation: Sequential post-analysis

As noted in Section 2, the use of visualizations to explore various interactional phenomena has gained increasing traction in CA in recent years. The partiture metaphor – particularly influential in transcript layouts (Bubenhofer 2020:154-160; Spiess et al. in press) – has evolved in recent approaches that visually differentiate types of turns or contributions within interactions.

One such example, developed by Luginbühl et al. (2021:223), is shown in Figure 9 (see also Kelterer/Schuppler 2025:30; Rühlemann/Ptak 2023:22, for other examples). This plot displays the turns of four interactants in an argumentative conversation, with time mapped along the x-axis and participants represented by horizontal tracks. Justificatory turns are color-coded based to their characterization: blue for initiating justifications, red for oppositional justifications, green for validating justifications, and pink for multiple-related reasoning.

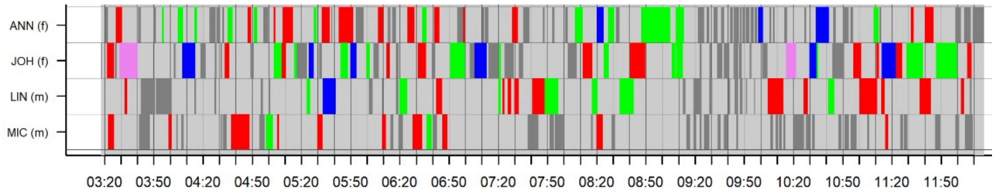

Figure 9: Turns in an argumentative conversation. Time is mapped along the x-axis and participants are represented by horizontal tracks. Justificatory turns are color-coded based on their characterization; blue for initiating justifications, red for oppositional justifications, green for validating justifications, and pink for multiple-related reasoning. (Luginbühl et al. 2021:223)

Visualizations like the one in Figure 9 have the clear advantage of closely reflecting the original partiture-style transcript. Speakers are layered over one another, with their turns naturally arranged along the x-axis according to their timing. These representations also preserve the length of each turn through the width of the boxes, making it easy to intuitively follow moments of turn-taking. However, they tend to be quite dense with the existing information; leaving little room to add further analytical layers.

To address this, the following visualizations summarize turns into a single participation value per time point and interactant (see Equation 2, Figure 1). As discussed in Subsection 4.2.1 and demonstrated throughout this subsection, this summative approach provides a clearer picture of each participant's overall participation. Additionally, normalizing these contributions enables meaningful comparisons across different conversations and categories, which is essential for many applied CA approaches.

Figure 10 illustrates how additional information can be incorporated into these visualizations. A color gradient is applied to the participation trajectories to represent the running totals of disagreement and overlap events for each participant up to that point in time. This approach helps highlight where events accumulate during the conversation. The sums are calculated as follows:

$$\text{EventPrevTot}_p(t) = \sum_{EventType\in\{OP,OJ,O\}} \frac{\sum_{\tau\leq t} EventType_p(\tau)}{\sum_{\tau\leq t} \mathbf{1}\{ArgumentationRelated_p(\tau)\}} \tag{8}$$

Where:

- OP is $OppositionalPositioning$, OJ is $OppositionalJustification$, and O is $Overlap_{type1/2}$.

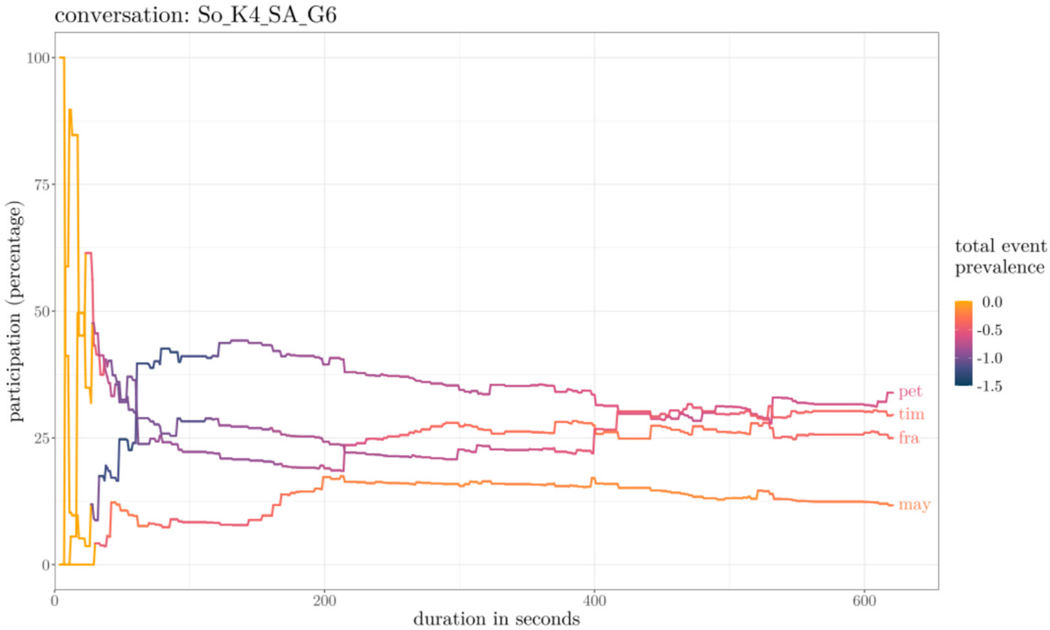

Figure 10: Trajectories of participation and summed event prevalence visualized by color gradient

To identify moments when coded events accumulated, phases with particularly high frequencies of these events were automatically extracted. These events are then marked as symbols at their corresponding points in time (see Figure 11).

Finally, conversations where these accumulations cooccurred with a noticeable drop in participation were manually selected for further qualitative analysis. This quantitative-visual exploration thus provides a quick and intuitive way to identify potentially interesting cases.

An exemplary sequential analysis of one interactant's trajectory is now presented with two goals: first, to demonstrate the value of visualization-based selection of extracts for examining the interplay of participation and coded events; and second, to reflect on the operationalizations used and identify areas for improvement.

Figure 12 shows the first two thirds of the conversation depicted in Figure 11, focusing solely on Peter's participation. The analysis centers on Peter because of the rapid increase in his participation from around 0:40 to 1:00, which is followed by an accumulation of coded events (overlaps and oppositional justifications). After a brief stagnation or a slight rise until approximately 2:00, his participation then drops sharply and steadily.

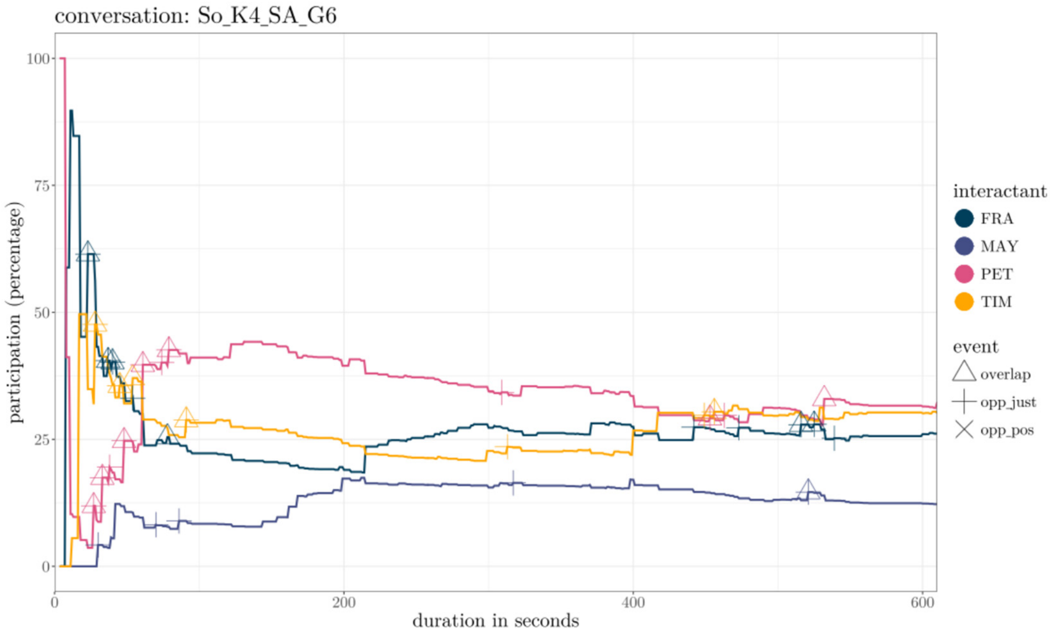

Figure 11: Events of disagreement and overlap ($OppositionalPositioning$, $OppositionalJustification$, and $Overlap_{type1/2}$) over trajectories of participation

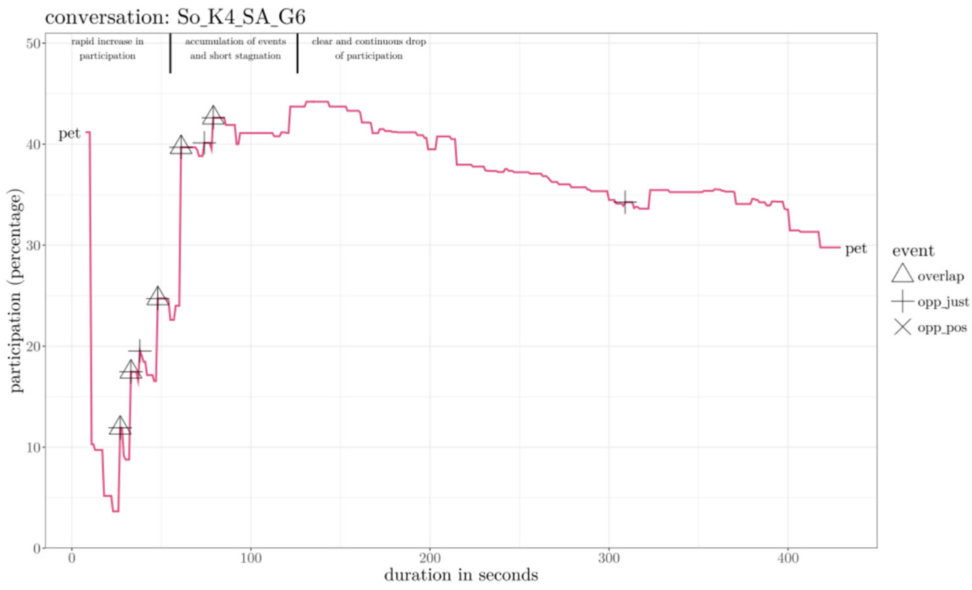

Figure 12: Events of disagreement and overlap over Peter's trajectory of participation

Extract 1 begins during the rapid increase in Peter's participation. After dismissing the discussion about the bears in 001, 003, and 008, Peter introduces the topic of bees in lines 010 and 011, effectively initiating his own interactional project. Francesca's turns in lines 012 and 014 – which she herself marks as interruptions with an explicit request for Peter to stop his project saying *wart schnell* ('wait a moment') – are sharply overridden by Peter. He overlaps her speech and explicitly tells her to stop talking in lines 013, 015, and 016 ('look for a sec' / 'wait now it's me talking' / 'you talk afterwards'; also marked by the directive verbalization).

In lines 015 and 016, Peter also uses an interrupting gesture – a defensive palm orientation toward Francesca (see Kendon 2004:248-249; Figures 13–14) – to reinforce his stance. Peter thus emphatically asserts both the topic of bees and his right to speak. This effort appears to succeed, as he can quickly follow up with an argument about the bees in lines 019 and 020 without further overlap.

Extract 1: So_K4_SA_G6 (00:48–01:10; Tim, Francesca, Maya, Peter)

```
001      PET: °h he di BÄÄ:re ey das sind ja Äifach so (.) di für
              was brUUchsch e bÄÄr;
              hey the bears ey they are just such they for
              what do you need a bear
002                (0.2)
003           °h damEt er dich UMbringt jo okE;
              so that he kills you yes okay
004      SER: [°h jO;    ]
              yes
005      TIM: [wäisch für] [wA (.) ö wä wÄisch für  ]
              was DU e bÄÄr bruuchsch;
              do you know what for uhm do you kno do you know
              what you need a bear for
006      FRA:              [bÄÄre sind (aber) (xxx)-]
                           but bears are (xxx)
007      TIM: zum ABknalle und dEnnen als tEppich benutze. °h
              to be killed and then to be used as a carpet
008      PET: nÄi bruuchi NED-
              no I don't need that
009      TIM: ö HÖ hö [°h ö hÖ   ] hö °h-
              o ho ho o ho ho
010  →   PET:         [also LUEG-]
                      okay look
011  →        aber [lUeg e BEEne;       ]
              but look a bee
012  →   FRA:      [aber kUmm mir mAches] [e-SO-        ]
                   but come on we do it like that
013  →   PET:                             [lUeg schnäll ] (.)
              [e BEEne;      ]
                                          look for a sec
              a bee
014  →   FRA: [WART schnell; ]
              wait a moment
015  →   PET: wArt jez red I:CH e-mol.
              wait now it's me talking for once
```

Figure 13: Line 015

016 → DU redsch nOchär.
you talk afterwards

Figure 14: Line 016

017 FRA: [kch::-]
kch
018 PET: [e] BIIne.
a bee
019 °h ooni BIIne kö gibts gar käni FRÜCHT,
without bees ca there are no fruits at all
020 und käini PFLANze.
and no plants

In extract 2, the disagreements in lines 021 and 024, combined with the ongoing overlapping laughter from the other three participants, seem to prompt Peter to defend his point of view even more vigorously. This is especially clear in lines 027–028 and 032–035, where he remains the only one continuing the argumentative negotiation and even introduces a new topic – the donation project for children's vacations – despite being overlapped by laughter.

Extract 2: So_K4_SA_G6 (01:10–01:25; Tim, Francesca, Maya, Peter)

021 → MAY: FRÜCHT gIds.
there are fruits
022 (0.1)
023 PET: [jA SCHO,]
yes
024 → FRA: [TROZdÄm.]
still
025 PET: [°h aber nÖd,]
but not
026 FRA: [aber käni be!STÖI!bti] frÜcht.
but no pruinose fruits
027 → PET: jo !E!be.
yes
tim: *((laughing))*
fra: *((laughing))*
may: *((laughing))*
028 → PET: das isch ja !SAU!WICHtig.
that is extremely important
tim: *((laughing))*
fra: *((laughing))*
may: *((laughing))*
029 (0.4)

```
030    MAY: be!STÄU!be dIch.
            pollinate yourself
031    TIM: (isch WÜRKlich),
            is really
       fra: ((laughing))
       may: ((laughing))
032  → PET: ALso was ich-
            so what I
       fra: ((laughing))
       may: ((laughing))
033  → PET: was ich ganz ZLETSCHT würd MAche?
            what I would rank at the very lowest
       tim: ((laughing))
       fra: ((laughing))
       may: ((laughing))
034                (0.6)
035  → PET: was ich ganz zlEtscht würd mache wär
            KINderfErie.
            what I would rank at the very lowest would be
            children's vacations
       tim: ((laughing))
       fra: ((laughing))
       may: ((laughing))
036                (0.4)
```

After partially agreeing with Peter's stance on the bees in lines 026 and 031, the co-participants respond quite differently to his position on the children's vacations in line 035. In extract 3, the other three children express indignation through overlapping and energetic disagreement in lines 038–044 and 048. Although Peter attempts to defend himself in lines 045–047, the others remain engaged and do not back down from the argument.

Extract 3: So_K4_SA_G6 (01:25–01:38; Tim, Francesca, Maya, Peter)

```
037    PET: isch MIR doch [egal wie di kInder-]
            I don't care about how the children
038  → MAY:               [!OHA:              ][
            [:!    ]]
                          whoaa
039    FRA:                                    [HALlo das sind
            [!AR!mi ] !KIN!der.]
                                                hello these are
            poor children
040    TIM: [[o!HA! ] MANN;    ]
            whoaa man
```

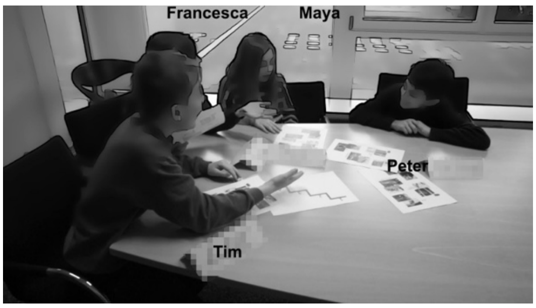

Figure 15: Line 040

041 MAY: das fInd ich ez [!UN!fäär.]
I think this is unfair
042 → FRA: [BLÖdiA:n.]
derp
043 TIM: was WÄRSCH wenn !DU! so wenn !DU!
ned so vill gÄld hättsch.
what would you be if you had so if you
had not so much money
fra: *((laughing))*
044 TIM: w denn wÜrdsch [dich ä FRÖIe.]
w then you would be glad too
045 → PET: [CHUM scho.]
come on
046 (0.2)
047 → die [LÄbed [i de schwIIz.]]
they live in Switzerland
048 → MAY: [ich fInd [kInderfErie of em]]
[ERschte plA:tz;]
I think children's vacations on
rank one
049 → FRA: [[näi WART schnä-]]
no wait a se
050 → [chUm mir möchids eSO.]
come on we do it like that

Shortly after this escalation of dissent, Francesca asserts control over the course of action by repeating her call to establish a new procedure in lines 049–052 of extracts 3–4 ('no wait a se' / 'come on we do it like that' / 'come on we do it come on we do it like that'; see also figure 16). Although Maya's simultaneous proposal to vote is acknowledged by Francesca, what follows is not a traditional vote but rather a phase where each participant lists their preferred projects in turn (see Kreuz et al. 2019:40).

Extract 4: So_K4_SA_G6 (01:38–01:55; Tim, Francesca, Maya, Peter)

051 → FRA: chUm mir maches (.) chum mir maches eSO.
come on we do it come on we do it like that

Figure 16: Line 051

052 → jede säit sini MÄInig wa
uf !ERSCHTE! platz chUnd?
everyone gives their own opinion
on what should be in first place
053 uf zwÄIte uf dritte uf VIERte.
in second in third in fourth

054 und wänn dänn alli sage !DÄ! chund uf VIERte (.) denn
machemer !DÄ! sicher mal uf [VIERte.]
and if then everyone says this is in fourth then
we put this in fourth for sure

Figure 17: Line 054

055 MAY: [wie wärs] mit
[ABstimmig?]
how about
voting
056 FRA: [und dänn mache] mirs;
and then we do it
057 (0.7)
058 mAche mir ja GRAD,
that's exactly what we do now
059 → PET: ja ICH fang AA.
yes I start

Peter multimodally withdraws from the discussion by leaning back and looking down at the table (see figure 17). By choosing not to argue further, he implicitly aligns with the proposed procedure. This is also reflected in line 059, where Peter claims the right to be the *first* speaker – but not the *only* one. After extract 4, Peter's participation declines as he yields the floor to the others once he has named his four preferences. While he continues to participate by occasionally repeating his positions and encouraging others to share their preferences, Peter no longer extends his turns into longer argumentative sequences, allowing the others to present their opinions.

This brief post-analysis highlights the crucial role of argumentation skills in sustaining participation. At the beginning, Peter responds quickly and in a way that is sequentially tailored to oppositional and overlapping turns. This flexible, context-sensitive behavior is key to keeping the floor and advancing one's own positions.

However, when the topic shifts to the children's vacations, the nature of opposition changes. Initially, disagreements are partial and isolated, accompanied by playful departures from Peter's interactional project – such as the playful enactment in 030, followed by laughter. Later, all three other participants express stronger, more energetic disagreement. This sparks intense argumentative activity, which reduces Peter's exceptionally high participation rate – over 45% of all contributions. Once others begin actively defending their positions, maintaining such a high level of participation becomes nearly impossible.

In this sense, the participation patterns of the group act like a self-regulating system: Peter dominates the course of actions for a while, but as soon as he takes a controversial stance that engages everyone else, his participation inevitably declines. After maintaining such a strong argumentative presence, Peter's quick acceptance of Francesca's proposed procedural change – marked by his ceasing to interrupt and stepping back from his interactional project – is particularly noteworthy. One possible interpretation, which would need further qualitative analyses, is that Peter is strategically adapting. Facing a firm oppositional alliance (Kangasharju 2002) from all three co-participants, the chances of success by sticking to his original interactional project may be minimal, prompting him to reorient his approach. In this instance, that shift is accompanied by a clear drop in participation.

Another interesting observation comes from comparing the weighted measure of argumentative participation above (see also Figure 18A) with a simpler measure based solely on word count (see Figure 18B). When participation is reduced to word counts, the dynamics appear quite different: around minute 2:00, Francesca's participation surpasses Peter's. Looking closely at the transcript after Extract 4, this difference arises from the nature of Francesca's contributions. Although she does not engage directly in argumentative positioning or justifying, she strongly influences the interaction by managing the floor and moderating the speaking in turn. This highlights the inherently interactional and co-constructive nature of argumentative participation: even without making argumentative moves herself, Francesca creates the conditions that allow others to advance the argument.

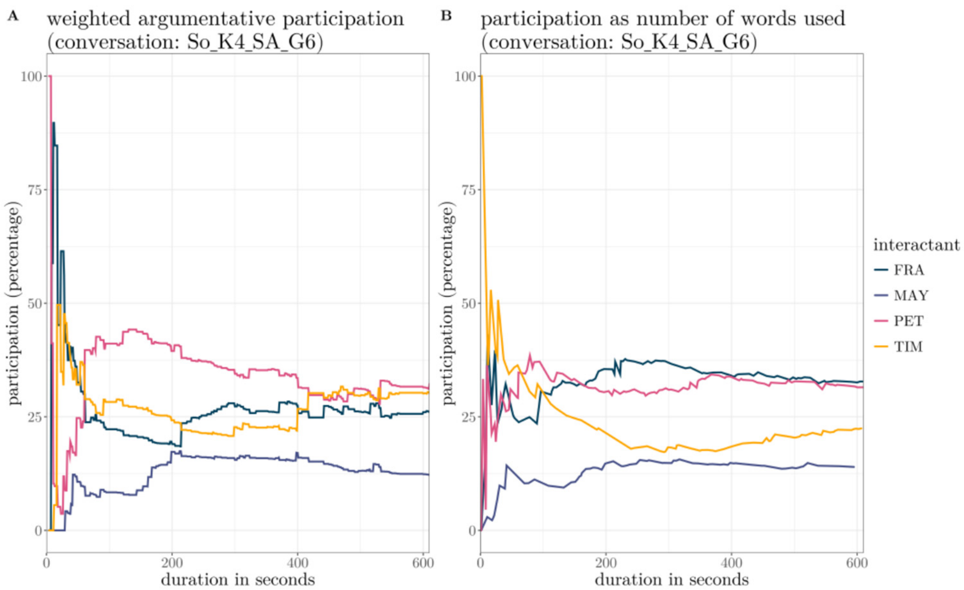

Figure 18: Trajectories of participation with two different types of operationalization

At the same time, it underscores this paper's distinction between 'general' participation and participation in argumentative discourse activities. By operationalizing and visualizing the latter, we gain insight into the specific interactional environments that include argumentative negotiation – that is, processing of the interactional jobs of conversational argumentation.

From a methodological perspective, these results point to two important considerations. First, while disagreement is a key element of argumentation and can boost participation by advancing the progression of interactional jobs, a minimal level of agreement may be essential to sustaining high participation. This is especially true when disagreeing turns are outright rejections without further justifications – turns that don't open space to build on an interactional project or connect counterarguments – and when these rejections come from numerically dominant oppositional alliances.

For this reason, it could be valuable to include events of agreement in the quantifications and visualizations. Doing so would help identify (moments in) conversations that are well suited for qualitative analysis of whether and how disagreement, agreement, and participation correlate with each other.

Second, participation likely behaves as strongly autocorrelated dimension, meaning that current participation depends on its previous values. For example, very high participation rates might be inherently unstable and tend to decrease over time, unlike more moderate values. Therefore, it's important to consider lagged participation values as key predictors when modeling participatory dynamics.

6. Discussion and perspectives

The discussion of notions of participation in Section 3 argued that applied CA approaches need to tailor their operationalization of participation to fit the specific research goals. In the context of argumentation skills, this means enabling the attribution of participation values to individual participants. It was argued that conceptualizing discursive participation as the share each participant has in jointly processing argumentative jobs can be grounded in emic categories – that is, categories demonstrably relevant to the participants themselves.

Section 4 addressed the first research question by proposing a CA-based operationalization of argumentative-discursive participation. Through a discussion of weighting different types of actions and using a summative approach to calculate participation as the proportion of argumentative contributions to genre-specific interactional jobs, this section showed how such methodological choices can be justified both conceptually and in relation to the research aims. Although these numerical formalizations necessarily simplify interactional complexities, they also open doors for further analyses and interdisciplinary connections.

These opportunities were explored in Section 5, which focused on the second research question: what insights into participatory dynamics can be gained through exploratory visualization methods? The visualizations allow us to explore various conversation types and the participatory dynamics unfolding within them. In terms of assessing argumentation skills, this approach enables the identification of phases in the conversation where interactants' trajectories change, revealing when and how argumentative jobs related to the task are processed and which children are involved.

Events of disagreement and overlapping talk were used to illustrate another advantage of this approach. Visually correlating these events with changes in participation helps us analyze how different interactional phenomena interact. Furthermore, a standardized way of operationalizing and normalizing participation allows for comparisons across grades, paving the way to detect age-related differences in participatory dynamics and developmental trends. This knowledge can then inform pedagogical approaches aimed at fostering argumentation skills.

Importantly, visualizations of individual conversations can serve as valuable tools for narrowing down large collections by pinpointing critical moments in participatory dynamics. These visual tools provide strong impulses for further qualitative analysis, where the categories and operationalizations used can be reflected and the relevant changes noticed in the visualizations can be examined in detail.

Accordingly, the sequential analysis of an example conversation in Subsection 5.2 was conducted to demonstrate how coded events of disagreement and overlap relate to participation in context, and to help interpret the visualizations in terms of how participation is interactionally negotiated, maintained, and constructed in conversation. This analysis showed that maintaining high participation during phases of disagreement requires substantial argumentation skills – specifically, the ability to adapt flexibly to challenges in the sequential context by quickly generating new arguments and timing stance-taking turns strategically, even amid considerable overlapping talk.

Clearly, further analyses are needed to deepen our understanding of the complex phenomenon of argumentative participation. One promising direction would be more extensive qualitative studies focusing on specific conversation types to evaluate how global participatory dynamics are associated with the negotiation and opportunities of participation. Additionally, the differentiation and weighting of disagreement and overlap events could be refined. Existing literature might guide this effort – for example, Tseronis (2021:1762) proposes classifying contradictory statements based on their face-threatening potential, and Müller-Feldmeth et al. (2023:256) emphasize that different 'attacking strategies' provoke distinct reactions. Thus, weights could be developed based on the observed effects of interactional phenomena in the data.

Finally, there is great potential in expanding the statistical toolkit. Investigating associations between participation and interactional events like disagreement and overlap could generate hypotheses to be tested through further qualitative-sequential analyses. Such combined approaches would enhance our understanding of how argumentative participation – a factor shown in previous research to be vital for various learning goals – is enabled or hindered in peer interactions among schoolchildren.

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