A robot or a dumper truck? Facilitating play-based social learning across neurotypes

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Abstract

Structured abstract Background & aims: How can non-autistic adults facilitate social learning with children on the spectrum? A new theoretical understanding of autism is currently emerging that has made this question more relevant than ever. At the intersection of two growing research areas in the field of autism, the borderland that separates the experience of social interaction between neurotypes is increasingly mapped out. By integrating anthropological research on autistic sociality and the neurocognitive framework of predictive processing, this paper explores the question: If autistic people experience the world in a fundamentally different way, what is a meaningful strategy for supporting them in developing their socialities?

Methods: The paper reports an in-depth analysis of a 2-min sequence in which a non-autistic adult facilitates a collaboration game between three autistic children (8–12 years). The data comes from a participatory research project that develops a new pedagogical approach to social learning based on open-ended construction play. The analytical strategy is informed by conversation analysis.

Results: We find that the facilitation supports the children in accomplishing social interaction and collaboration, but it also in several instances gives rise to misunderstandings between the children. Whereas the facilitator aims to support the children's direct verbal communication about the construction task, we observe that the children use a broad repertoire of non-direct communication strategies that enables them to coordinate and align their shared process. We find that the children's actions with their hands in the construction task count as turns in the communication. Regarding the play-based learning environment, we find that the children are engaged in the shared construction task and that they competently navigate social tension when it arises without the facilitator's help.

Conclusion: We conclude that the misunderstandings between the children created by the facilitation from a non-autistic adult emerge from a discrepancy of attention in the situation. The facilitator focuses on the words, but the children focus on the task. Even though this discrepancy is not necessarily a result of different neurotypes, we find that it emerges from the social dynamics of facilitation by non-autistic adults that is key in many social intervention settings. Furthermore, we conclude that the play-based learning environment enables the facilitator to support the children without directly

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instructing them in their social behavior. This appears to give the children an opportunity to acquire complex social experiences through their collaboration.

Implications: The interaction dynamics in the data clip is shaped by the non-autistic adult's expectations of the children's interaction. This made us wonder whether we can establish a learning environment that begins from the learners' perspectives instead. The analysis caused us to change the facilitation strategy that we employ in our project. It is our hope that our approach will inspire reflection and curiosity in researchers and practitioners who develop social interventions targeting autistic people.

Introduction

The research field of autism[1] is changing. Across the field, an aim is emerging to understand autistic sociality rather than to focus on identifying social challenges for diagnostic and therapeutic purposes. The change is evident in basic research questions asked across the field as well as in design principles used among practitioners to develop and implement new interventions targeting autistic people. In working towards the overall goal to improve well-being in the lives of autistic people, the emerging social model of autism appears to be an important complement to the medical model on which the field is built.

Over the last decade, there has been a growth in anthropological studies of autism and autistic sociality (Di Paolo et al., 2018; Milton, 2012; Ochs & Solomon, 2010; Solomon & Bagatell, 2010). Researchers from across the humanities and social sciences zoom in on the lived experience of autistic people to understand how autism shapes human worldviews in different ways, and research is guided by questions such as: How is social interaction experienced by autistic people (e.g. De Jaegher, 2020; Hull et al., 2017; Williams, 2020)? How and why do autistic people use atypical linguistic strategies when they engage in social interaction (Sterponi et al., 2015)? How do autistic people rate their own quality of life (Robeyns, 2016; Rodogno et al., 2016)?

An important perspective that emerges from this research is that autistic voices have not previously been adequately represented (Happé & Frith, 2020; Pellicano & Stears, 2011). Concepts such as 'participatory sense-making' and 'the double empathy problem' have been introduced to shift the focus towards understanding the social challenges of autism as a two-way problem of interaction across neurotypes rather than a deficit in autistic people (De Jaegher 2020; Milton, 2012).

Concurrent to this development, a new theoretical understanding of autism has gained ground among neuroscientists and cognitive psychologists (Lawson et al., 2014; Pellicano & Burr, 2012; Skewes et al., 2015; van de Cruys et al., 2014). In this understanding, autism may be explained by a non-typical neuronal wiring of the perceptual network, which means that sensory inputs weigh relatively more than prior experiences. Perception-first models of autism correspond with the embodied cognition framework in which human cognition is understood as a process that involves the entire body as it interacts with the environment and other bodies (Barsalou, 2009; Di Paolo et al., 2018; Varela et al., 1991). From this theoretical perspective, autistic people perceive the world in a way that is fundamentally different well before intellectual reasoning and reflection set in.

Together, these two developments in the field of autism bring into focus a borderland of understanding between neurotypes. In any given situation, two people may be attentive to entirely different information in the surroundings, which would set their experiences fundamentally apart. If the world looks different when perceived through an autistic nervous system, then how can non-autistics make sense of autistic persons' actions and reactions? This question is not only significant from a research perspective; it is crucial to practitioners who work in this borderland every day in education, in social services, and in psychological practice. This paper zooms in on facilitation across neurotypes through an in-depth qualitative analysis of a 2-min video clip where a non-autistic psychologist facilitates a collaboration game between three autistic children in a play-based social learning environment. "Introduction" presents the theoretical framework, "Methods" explains methods and methodology, "Analysis: A robot or a dumper truck?" contains the data analysis, and "Discussion: How can we facilitate social learning across neurotypes?" discusses the results in relation to the role of play in autistic social learning.

A social model of autism

In the 70 years that have passed since autism emerged in a clinical setting, the main focus has been on understanding and defining the diagnosis to be able to improve the life conditions of diagnosed persons. With every update of

diagnostic manuals and classifications, autism has been redefined, and researchers have suggested different theories about the underlying cause of autism (e.g. Baron-Cohen, 2002; Baron-Cohen et al., 1985; Frith, 1989; Happé et al., 2006; Markram & Markram, 2010; Ramachandran & Oberman, 2006; Wing & Gould, 1979). These theories take their point of departure in the clinical implications of autism, and they aim at identifying an underlying cause to be able to develop effective autism interventions and programs.

Since the turn of the millennium, the medical model of autism has been complemented by a social model that focuses on social lives and lived experience of autism. Rather than searching for the cause of non-typical behavior, the social model aims to document and understand the strategies for learning and communicating that autistic people use in their everyday lives (Milton & Sims, 2016; Ochs et al., 2004; Ochs & Solomon, 2010; Visuri 2020). Cross-sectional research on quality of life shows that autistic people report that social isolation and loneliness are the main threats to their quality of life. The finding that social belonging and relationships are rated just as high among autistic people as in the general population is consistent among children, young people, and adults (Brauminger & Kasari, 2000; Calder et al., 2013; Gebauer & Rodogno, in preparation; McConachie et al., 2018). This research contribute to the field of autism by documenting that lack of social competence should not be mistaken for lack of social wishes and needs.

In recent years, researchers have turned their attention to identify and understand the strategies employed by autistic people to hide their autistic traits in order to fit in (Hull et al., 2017; Livingston et al., 2019; Livingston & Happé, 2017; Pearson & Rose, 2021). These strategies are often referred to as compensation, camouflage, or masking. Autistic people report that they camouflage in order to get a job or to maintain social relationships. Most studies focus on the negative consequences of camouflage such as exhaustion, anxiety, and feelings of pretending to be someone else (Beck et al., 2020; Hull et al., 2017). Yet, research also suggests that some strategies may be helpful (Livingston & Happé, 2017). The literature on camouflaging gives rise to new discussion about how to design social interventions targeting autistic people: How can we avoid the negative consequences of camouflaging when autistic people are supported in developing social strategies (Fombonne, 2020; Livingston et al., 2019)?

A large number of social interventions targeting autistic people exist (Gibson et al., 2021; Kasari & Patterson, 2012). Many of these interventions take their point of departure in the clinical model by looking at the diagnostic indicators and designing highly structured methods to train autistic people in neurotypical social behavior, e.g. increased social knowledge or joint attention. The social model of autism and the research on camouflaging provide an opportunity to reevaluate the design of social interventions. Increasingly, researchers highlight that we need to include a rich variety of autistic voices to develop interventions that take the lived experience of each individual as point of departure to support the development of social strategies that are helpful rather than anxiety provoking (Livingston & Happé, 2017; Pearson & Rose, 2021).

An important step in creating room for autistic voices is to reframe our approach to communication. In the last decade, the problem of communication across neurotypes has been treated using concepts such as 'participatory sense-making' and 'the double empathy problem' (De Jaegher 2020; Milton, 2012). Rather than looking at communication with a neurotypical set of interaction norms, researchers develop strategies to analyze interactions as a two-way problem of reaching a shared understanding. This changes the basic goal of social interventions. Rather than training autistic people in neurotypical communication, a two-way approach calls for interventions that support social development that begins from each individual's own autistic sociality. If autistic people have the opportunity to develop compensatory strategies that play to their own strengths, these may be more flexible and resistant to breakdowns than rote-learning based 'surface strategies' (Livingston & Happé, 2017).

A basic hypothesis that emerges from this approach is that if autistic people develop social strategies that are meaningful from their own perspective, these strategies are more sustainable across different life situations. The research reported in this paper does not test this hypothesis. Rather, it paves the road towards testing by zooming in on the social dynamics of facilitation across neurotypes in a social learning environment with autistic children.

Autistic communication and interaction across neurotypes

The two-way approach to autistic sociality makes relevant a new set of problems in the design of social interventions. It brings the borderland of understanding between neurotypes into focus because it raises the fundamental question of how different neurotypes accomplish interaction and shared sense-making in a situation (De Jaegher 2020; Sterponi & de Kirby, 2016). We need to understand what the borderland means in real life interaction to be able to design environments that invite participation from both sides.

The approach to atypical language use in research on autistic communication has changed over the years. The observation that repetitive, rigid, and echolalic language is frequent in autistic children goes back to Kanner's first report (1943). Subsequent research on linguistic development fleshes out the difficulties of autistic children in following neurotypical norms for conversation such as pragmatic competence (Baltaxe, 1977) and dialogical linkage and resonance (Hobson et al. 2012). More recently,

repetitive and echolalic language has been analyzed as a strategy to accomplish interaction rather than as a deficit (Rydell & Mirenda, 1991; Sterponi & de Kirby, 2016; Sterponi et al., 2015). The finding that repetitive language may be understood as an active coping strategy that enables the child to navigate an unpredictable social environment resonates with perception-first explanations of autism and predictive processing theory.

In predictive processing theory, cognition is an ongoing and dynamic process in which the individual perceives the environment by comparing sensory stimuli with predictions based on prior experience (Clark, 2013; Friston, 2005; Friston & Kiebel, 2009; Hohwy, 2013). Perception-first explanations of autism theorize that the relative balance between priors and sensory signals is different in autistic people (Lawson et al., 2014; Pellicano & Burr, 2012; Skewes et al., 2015; van de Cruys et al., 2014). If sensory signals weigh relatively more in perception, it would be difficult to generate useful predictions that enable a person to navigate their environment. In social interaction, we process each other's behavior by inferring the intentions of others based on our predictions of our own behavior in the perceived environment (Friston & Frith, 2015). In interactions across neurotypes, differences in perception would make it difficult to accurately infer the intentions of others. We would risk making mutually imprecise inferences about how others relate to and act in the communicative environment (Di Paolo et al., 2018).

More than any other theory, perception-first models of autism make irrelevant the search for a treatment or therapy aimed at training autistic people in behaving like neurotypicals. Instead, it points to the importance of designing environments that invite autistic participation in a way that acknowledges the borderland of understanding between neurotypes. This may enable autistic people to develop social strategies that are meaningful from their perspective. If social behaviors often associated with autism are rooted in the very fabric of the perceptive network, autistic experiences of interaction within and across neurotypes are the necessary starting point for anyone who aims to support autistic social development.

Research question

The research reported in this paper explores the social dynamics of facilitation across neurotypes in a social intervention setting. A basic epistemological problem that emerges from the two-way approach to communication across neurotypes is fundamental to the project: What opportunities for meaningful social learning arise when neurotypical adults facilitate interaction with autistic children?

Methods

The data for this paper consists of a two-minute video clip in which a non-autistic psychologist facilitates a collaboration game between three autistic children. The video comes from the CollaboLearn project that co-develops a play-based approach to social learning with autistic children, their pedagogs, teachers, school administrators, and their parents. The project is a partnership between researchers at the Interacting Minds Centre, Aarhus University and practitioners at a specialized public school in Aarhus, Langagerskolen.

Between August 2018 and November 2019, we ran three rounds of co-development courses with autistic (n = 28) and non-autistic (n = 12) children. The autistic children were divided into small groups (2–6 children) that participated in ten-week courses where members of the research team set up weekly sessions (30–90 min duration) at the school. Each group was chosen in collaboration with school staff, psychologists, and parents. All parents signed informed consent agreements, and they participated in interviews before and after the course. The study was approved by the Committee for Research Ethics in the Central Denmark Region in September 2018. A continuous dialogue about the project was kept with the children, their parents, and school staff.

In each session, the project team facilitated play activities to give the children an opportunity to acquire social experiences (Steensgaard et al., 2021). The social play activities involved that the children collaborated in different ways. In the project, social play is defined along a continuum from solo play, over parallel play, rule-based games, to open-ended play. Collaboration is defined as engaging together in a shared building process. Naturally, there is more collaboration in open-ended play than in solo play, but we aim to support collaboration whenever it occurs along the continuum. The activity in the video clip is a rule-based game, i.e. the children roll a die to determine their turns, with open-ended play elements, i.e. no building instructions or predetermined end-goal. To support the children in collaborating, some activities use predefined roles, narration, or gamification (e.g. dice or 'guess my secret figure'). In addition, the children were invited to reflect on their social strategies. The play activities were developed with inspiration from other play-based methods (LeGoff et al., 2014; Roos & Bart, 1999) and from constructionist approaches to learning (Giudici et al., 2001; Krechevsky et al., 2013). Input from the children, their teachers, and their parents were used to continuously redevelop and change the activities. The children's perspectives on the activities were explored through discussions and through video observation.

The video clip in this paper was recorded in May 2019. The video comes from session nine in a ten-week course. This means that the children were familiar with the room, with the activities, and with each other. For one of the children, Asbjorn (12 years), this is the second time that he participates in a ten-week course. He enjoyed the first ten sessions, and was invited to participate in a new group as

a 'teacher's assistant'. The two other children, Anders (8.5 years) and Sander (9 years) are part of the same group at school, i.e. they share a classroom and know each other well. Note that these are not their real names. The three children are on the autism spectrum, two have ADHD, and all are within normal range IQ.

The clip was selected as an example of a group of children that were able to collaborate, negotiate, and solve problems between them. Yet, there were moments in the interaction that we wanted to understand better. Moreover, we were curious to see how the children negotiated in a newly developed game that was more open-ended than usually (i.e. no fixed end-result of the building process). In the project, there is considerable variation in the children's social competence, ranging from highly introverted to hyperactive children. Relative to the other groups, this is among the better functioning groups, but it is not exceptional. The interaction in this video clip is typical for this group and for the better functioning groups in the project when it comes to intensity and engagement. We chose this clip because we expected that an in-depth analysis of a sequence like this would be helpful in developing the play activities and facilitation strategy further.

The clip was analyzed by the research team, by an interdisciplinary group of qualitative researchers affiliated with the Interacting Minds Centre, Aarhus University, and by a group of experienced conversation analysts at the Department of Linguistics, Aarhus University. The analysis reported in this paper is informed by Conversation Analysis (Hutchby & Wooffitt, 2008). The interaction is in Danish, but a translation is provided. We used Childes Clan to transcribe the data following Gail Jefferson's system (2004). Since we were trying to support both verbal and non-verbal turns in the interaction, body language is also annotated. Gestures are annotated consecutively as they occur in the interaction. The arrows in the margin (e.g. 13 and 17) mark when the children look at each other's faces. An anonymized still from the video may be found in Figure 1 to give the reader an understanding of the environment. The transcript of the full video clip is available in the Supplementary Material.

Description and brief summary of the video clip

The video clip contains a sequence of the interaction where the three children have just begun a construction dice game. The rules of the game are: The children collaborate to build a shared construction. They decide what to build, but they have to agree. They take turns at rolling a die with three possible outcomes. If they roll a blue, they tell the child to their right which brick to pick and where to place it. If they roll a white, they get to choose a brick and place it where they want. If they roll a two, they get to choose two bricks and place them where they want. The children

have not played this game before, but they have played similar games.

The clip contains four die rolls in the game, and it begins with a suggestion from Anders that they build a robot. The facilitator acknowledges Anders' suggestion, and the two other children do not respond. Anders then finishes his roll by instructing Sander where to place a brick. Second, Sander rolls a blue, and he instructs Asbjorn in placing a brick. Anders objects to Sander's instruction because it interferes with the plan to build a robot. Asbjorn suggests how they can build a robot at the same time as following Sander's instruction. Third, Asbjorn rolls a two, which means that he gets to pick and place two bricks.

While Asbjorn is fiddling with the bricks, the facilitator encourages the children to communicate about what they are building. This makes Anders suggest that it could be a dumper truck instead of a robot. Asbjorn replies that he thought that they had already agreed that it was a robot. The two other children agree. The fourth roll is a two, which makes Anders very happy. Anders and Asbjorn co-hum 'Halleluja' from Händel's Messiah while Anders places two bricks. The clip finishes as Sander impatiently asks for the die, and Anders slams it in front of him in a playful-aggressive way.

Analysis: A robot or a dumper truck?

The analysis in this section zooms in on the children's interaction turn by turn in the conversation. The analysis consists of three sub-sections: "Getting the transcript right" shows that some turns in the communication between the children are difficult to make sense of for outsider analysts. "Facilitation supports engagement and communication" shows how the facilitator supports the children in communicating and reaching a consensus. "Facilitation provokes ambiguity and social tension" shows that the facilitation also introduces ambiguity and social tension in the children. Together, the three sections below show that the facilitation creates a social environment in which the children acquire both positive and frustrating social experiences. Most notably, we find that the facilitation in some instances results in misunderstandings and give rise to tension between the children. Please note that the numbers refer to the lines in the transcription.

Getting the transcript right

This section tells the story of the transcription of 171–177. This turn is interesting because it took eight adult analysts several hours to figure out what Anders said and to make sense of the situation. In the discussion of the transcript, the facilitator said that she had not understood what Anders said when the situation unfolded. Yet, the analysis in "Facilitation provokes ambiguity and social tension" shows that the peer interlocutors seem to make sense of

Figure 1. Anonymized still from video clip (171). From left to right: Asbjorn, Sander, Rikke (facilitator), and Anders.

Anders' turn. We include this description of the transcription process because it shows how difficult it was for outsiders to understand the children's interaction. This observation may seem trivial, but we argue below that it holds important implications if we want to design learning environments that truly invite children's participation on their own terms.

First, the clip was transcribed by a member of the research team. She had previously facilitated sessions, and she knew the three children. The initial transcript is shown in Figure 2. The words carry no semantic meaning in neither Danish nor English. The initial interpretation was that 171 was a semantically non-significant utterance intended as prosodic alignment.

Second, the transcript was edited by a team member with more experience with conversation analysis to go through the text and to add pauses and prosody markers. She had also facilitated sessions, and she knew one of the children. The second transcript is shown in Figure 3. Even though the contour of real words is appearing, the utterance still carries no semantic meaning that is relevant to the process of the children in that moment. We continued to interpret the turn as prosodic alignment.

Third, we brought our transcript to a Conversation Analysis data session at the Department of Linguistics, Aarhus University. For the first 45 min of the session, the transcript was checked by five experienced conversation analysts. We zoomed in on specific turns to discuss potential disagreements. After approximately 30 min, one of the analysts pointed to 171. We then listened to the turn on repeat, before we finally realized that Anders was talking about a dumper truck. The final transcript is shown in Figure 4. In this interpretation, the turn is semantically relevant for the interaction. Anders replies to the interaction

```
171    *AND:        °mmm rumba dum- (.) dump
                     mmm rumba dum- (.) dump
```

Figure 2. The first transcript of 171.

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171    *AND:        °de:t dumba trump (.) truck
                     A dumba trump (.) truck
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Figure 3. The second transcript of 171.

between Rikke and Sander in 159–166 in which the robot theme is challenged.

Even though it is unusual to report on the transcription process, we include it here because it demonstrates how difficult it was for outsiders to make sense of what was going on between the children. This observation may seem trivial. Yet, it exposes a fundamental premise of play-based social interventions: Adults ask children to play as a means to teach them something else. The overt aim of the activity was that the children build something together, but the covert goal was to encourage them to use direct verbal communication about their actions. This created a mismatch in attention: The children focused on the shared construction, but the facilitator and analysts focused on their words. Only when one analysts turned their attention to what the children were actually doing with their hands, did Anders' turn make sense.

In this situation, we misunderstood Anders because we focused more on the process than on the product that unfolded between the children. Had our analytical strategy been less in-depth, we might not have coded Anders' turn as social even though it is an integral part of the children's negotiation (see "Facilitation provokes ambiguity and social tension"). The facilitator as well as the analysts readily ascribed our lack of understanding to Anders'

```
171    *AND:      °en dumper trump
                  a dumper trump
172
173               (0.3)
174
176    *AND:      truck°
                  truck
177    *AND:      ((sits quietly and observes Asbjorn's actions while speaking))
```

Figure 4. The final transcript of 171–177.

autism because we knew that autistic people tend to have atypical language use. The misunderstanding may be a simple question of a mismatch in attention, but it also points to an important aspect of the social dynamics of facilitation: Our expectations shape our understanding of the situation. If we as facilitators do not notice the children's social initiatives, how can we truly invite a two-way approach to interaction that constitutes a meaningful opportunity for learning from the children's perspective?

Facilitation supports engagement and communication

This section zooms in on the strategies employed by the facilitator that support the children in their communication as they play. The game is designed to invite children to engage in social play and collaboration. They need to work together to be able to finish the construction that they want to build. In the two-minute sequence chosen for this paper, the children are able to solve the problems that occur, which means that the facilitator is relatively passive. Most of her turns may be ascribed to two functional categories, which we use to structure the analysis below (see Figure 5):

1. Procedural support: The facilitator supports the children in maintaining the procedural structure of the game (e.g. 51–53, 57–59, 63–65, 144, and 205).
2. Consensus reminders: The facilitator reminds the children to communicate and to reach consensus (e.g. 18–19, 22, 31, 125–129, and 159–60).

We focus on procedural support in this section and take a closer look at consensus reminders in "Facilitation provokes ambiguity and social tension".

Procedural support: From 'rules of interaction' to 'rules of the game'. The video clip shows that the three children need different types of support to participate. Asbjorn knows the activities well, so he hardly needs facilitation. Rather, he has a need to discuss abstract concepts and hypothetical situations (e.g. earlier in the same session, Asbjorn opens a philosophical discussion about using plastic bricks to build houses or cars in real life). Anders looks up to Asbjorn and

works hard to maintain a good relationship with him. He tends to get frustrated with Sander, and he needs support to cope with his frustration. With support from the facilitator, Anders is able to help Sander instead of telling him off for his difficulties in following the building instructions (e.g. earlier in the same session, he walks over to Sander and shows him the instructions when Sander makes a mistake). Sander needs continuous support and validation from Rikke. All except one of Rikke's procedural support turns are either explicitly asked for by Sander or directed at him as in 60–65 in Figure 6.

The facilitator supports the structure of interaction by always referencing the rules and aims of the play activity. In 60–61, Sander asks for procedural support with the words "is this a blue?" Rather than simply answering his question with a 'yes', Rikke repeats the initial instruction connected with the blue: "blue yes (.) and that means that you need to ask Asbjorn. (…)". When she phrases it as a repetition of the game rules, she is not directly instructing the children's behavior; rather, she gives them an opportunity to find their own way in navigating their collaboration. The facilitation is focused on the rules of the game as a shared third rather than on face-to-face behavioral instructions. By continuing to focus on the activity, the facilitator is able to support the participation of each child with their individual interests and needs.

Minimal facilitation and social problem solving. The children begin building their shared construction without agreeing what they are building. In fact, the decision making process goes on for the majority of the sequence until 181–185 (Figure 11). Along the way, social tension emerges from the collaboration between the children in two instances. The first instance is 100–115 (Figure 7) during Sander's first turn in the game. This sequence is interesting because the children resolve the conflict without the facilitator's help.

The tension emerges as a natural part of the game. It arises because the two core rules of the game are brought into conflict. Sander has the right to determine where to place the next brick, but the brick conflicts with Anders' robot idea. This leads Anders to challenge Sander's instructions in 103–104: "Will- then we can't build upwards (.) it's supposed to be a robot". Anders' phrasing is direct and confrontational, and it causes all three children to look up at

Procedural support

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51  *RIK:  o:g så skal du slå˃ (.) og hvis man slår to↗ betyder det man: må
            a:nd then you roll the die (.) and if you hit a two yo:u are
52  *RIK:  selv sætte to klodser på˃ ˳selvfølgelig˳
            allowed to place two bricks of your own choosing of course
53  *RIK:  ((picks up die, points at 'two', hands it to Sander))

57  *RIK:  ((shifts bricks around, places construction in the center))
58  *SAN:  ((shakes die in hands and rolls it onto table))
59  *RIK:  vi Δsætter den herΔ i midten af det ˎhe:le=
            we'll place this one in the center of it a:ll

63  *RIK:  blå ja (.) og det betyder at du ska spørge ↑Asbjørn (.) eller
            blue yes (.) and that means that you need to ask Asbjorn (.) or
64  *RIK:  ((points to Asbjorn))
65  *RIK:  sige til Asbjørn °hva han ska bygge→°
            tell Asbjorn what to build

144 *RIK:  det ↗betyder man selv ˃ta to klodser at sætte ˎpå
            that means that you get to take two bricks and place them

205 *RIK:  ˳↗ja:˳ Δnu har duΔ frit valg på to klodserˎ
            we:ll now you get to choose two bricks
```

Consensus reminders

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18  *RIK:  →((looks at Anders, nods, opens palm towards him))
19  *RIK:  GODT du foreslår det
            well done to suggest that

22  *RIK:  I må ↗hele tiden aftale hvad I (synes-)
            you need to continuously agree about what you (think-)

31  *RIK:  ↗m[:: så du ↑tænker på en robot↓
            m:: so you're thinking about a robot

125 *RIK:  =m så skal du gi terningen til Asbjørnˎ og I må ↑hele tiden
            m then you pass the die to Asbjorn and you need to keep on
126 *RIK:  ((points to Asbjorn))
127 *SAN:  ((gives die to Asbjorn without looking up at him))
128 *ASB:  ((Sits back up and shakes the die))
129 *RIK:  aftale ‾hva er det vi bygger og hvordan gør vi det‾ [og:
            agreeing what is it we're building and how do we do it a:nd

159 *RIK:  °↑hva mon det ska bli til˃°
            I wonder what it will be
160 *RIK:  ((lifts hand to put her hair behind her ear))
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Figure 5. The turns of the facilitator divided into two functional categories for the analyses in "The facilitation by the adult: Misunderstandings across neurotypes?" and "Implications for designing social learning environments".

```
60   *SAN:    =m- æ:h (.) er det her blå↗
               b- u:hm (.) is this a blue
61   *SAN:    ((lifts up die and shows it to Rikke))
62   *ASB:    ((yawns, glances at die that Sander holds up to show to Rikke))
63   *RIK:    blå ja (.) og det betyder at du ska spørge ↑Asbjørn (.) eller
               blue yes (.) and that means that you need to ask Asbjorn (.) or
64   *RIK:                                        ((points to Asbjorn))
65   *RIK:    sige til [Asbjørn °hva han ska bygge→°
               tell [Asbjorn what to build
66   *SAN:             [ASBJØ:RN↗
                       [ASBJO:RN
```

Figure 6. A structure maintaining turn (63–65) explicitly asked for by Sander (60–61).

each other's faces (102, 104, 106, and 113). After a 0.4 s pause, Sander begins to self-repair in 110: "U:hm no I never meant-". Asbjorn then cuts him off and offers a solution in 111–112: "Let's say that somebody places that one right there then we can build upwards no problem." With his turn, Asbjorn circumnavigates the conflict between his two younger interlocutors in 111–113. He uses the construction to demonstrate his solution by pointing.

Even though Asbjorn's hypothetical phrasing may seem curious at first glance, it is a neat way of dealing with Anders' challenge. Via the hypothetical phrasing, he manages to display acceptance of Sander's instructions while incorporating Anders' insistence on building a robot. Not only does Asbjorn modulate his other-repair, he also waits until Sander has had a chance to self-repair. With this phrasing, Asbjorn demonstrates that he has a thorough understanding of the rules and their consequences. He quite elegantly finds a mid-way between the two conflicting rules without breaking any rules himself. He is not instructing the others outside of his turn; rather, he phrases his solution as a hypothetical suggestion. He also modulates his own frustration by keeping a quiet and patient tone of voice despite the fact that he confided his impatience with

the slower pace of his two interlocutors in English to the facilitator right before the two-minute data clip begins.

The facilitator remains silent despite the sudden outburst of tension. With her silence, she gives the children an opportunity to solve the conflict themselves. As they succeed, she signals in 119–120 that she condones their solution with a minimal response "m:hm:::" and an approving nod.

A broad repertoire of communication strategies. Even though the facilitator focuses on supporting direct verbal communication about the process between the children, they employ a number of different communication strategies to accomplish the building game, such as humming, singing, chit-chatting, and citing popular culture. One example is towards the end of the two-minute sequence, where Anders and Asbjorn spontaneously co-hum parts of Händel's Messiah (214–218 and 220 in Figure 8). The humming is not semantically related to the building process and provides the analyst with a conundrum. It may be interpreted as a celebration of the successful completion of Anders' turn in the game before moving on to Sander's next die roll. In the following, we argue that the

```
100   *ASB:    ((tries to place brick in the right spot))
101   *SAN:    s[å:-
               ri[ght:-
102   *SAN: →  ((looks up at Anders))
103   *AND:    [kommer- så kan vi jo ik bygge den opad (.) de:t jo en robot
               [will- then we can't build upwards (.) it's supposed to be a
               robot
104   *AND: →  ((looks up at Sander, looks down and nods emphatically))
105   *RIK: →  ((looks up at Anders))
106   *ASB: →  ((glances up at Anders, scratches back of head))
107
108            (0.4)
109
110   *SAN:    ⊚ø:h nej jeg [mener ik-⊚
                 u:hm no I [never meant-
111   *ASB:                 [hvis det er at en eller anden sætter den der på så
                            [let's say that somebody places that one right
112   *ASB:    kan vi ↗sagtens bygge opad→=
               there then we can build upwards no problem=
113   *ASB: →  ((indicates where to place the brick and looks up at Anders))
114   *SAN:    =ja (.) det syns jeg er en god ide
               =yes (.) I think that is a good idea
115   *SAN: →  ((looks down at bricks on table and then up at Rikke))
```

Figure 7. Sander's first turn in which he instructs Asbjorn in placing a brick. Social tension arises as Anders notes that Sander's instruction conflicts with the robot plan.

```
214   *AND:    ♪da::n dan dan dan♪
               ♪da::n dan dan dan♪
215   *AND:    ((places bricks, sings melody of Halleluja in Händel's Messiah))
216   *SAN:    °og så den røde° (.) [(°ta den°)
               and the the red one (.) [[take it)
217   *SAN:    ((observes Anders' actions, starts smiling when Anders sings))
218   *AND:                          [♪da::n dan dan dan♪=
                                     [♪da::n dan dan dan♪=
219   *AND:                          ((continues to rummage with bricks))
220   *ASB:    ⁻♪U:: U U: U U  U::♪ [U:⁻
               ♪U:: U U: U U  U::♪ [U:
221   *ASB: →  ((continues Halleluja in falsetto, looks up at Anders))
222   *AND:                          [de:t [(en guld)
                                     [tha:t's [(gold)
223   *AND:    ((places second brick and sits back))
224   *SAN:                          [og hvad med MIG
                                     [and what about me
225   *SAN:    ((stands up and opens arms with palms upwards))
```

Figure 8. Anders and Asbjorn co-hum Händel's Messiah to structure their turn-taking and align their actions.

children use their humming to structure their turns and align their actions.

Anders starts humming in 214 while he searches for the two bricks that he has the right to pick and place after rolling a two with the die. This outcome is important for Anders because he now has the opportunity to secure the next steps in his robot plan. When Anders begins to hum, Sander starts smiling (217). Sander proceeds to comment on Anders' actions in a mumbling, low voice in 216 "and then the red one (.) [[take it)." This seems to signal to the other children that he is part of the process even though Anders is currently in control. Asbjorn also follows Anders' actions. He looks up at Anders as he continues

humming the tune where Anders stopped (220–221). Like Sander, he seems to communicate that he is part of the process even though Anders is currently in control.

The children not only communicate with their voices, they also communicate with their hands. In several instances, they seem to interpret the actions carried out with the bricks as turns in the interaction, and they follow each other's handling of the bricks intently. Anders' turn in 103 "will- then we can't build upwards (.) it's supposed to be a robot" (Figure 7) is a verbal reaction to Sander's positioning of the brick. Sander's and Anders' turns in 150 (Sander leans forward to look at Asbjorn's hands) and 151–152 (Anders says "fuck" while nodding

emphatically as he looks at Asbjorn's hands) are reactions to Asbjorn's difficulties with placing a brick (149, Figure 9). Please note that in Danish, it is acceptable for a child to say the f-word; it has translated into a rather trivial exclamation (see e.g. The Local 2021). Sander's turn in 216 is a comment that verbally aligns to the actions carried out by Anders who is singing as he places the bricks (Figure 8). With humming, exclamations, pop culture references, and subtle commentaries, the children successfully coordinate their actions in the shared building process.

'Direct verbal communication' and 'non-direct communication'. The observation that the children employ a mix of different communication strategies has led us to distinguish between 'direct verbal communication' and 'non-direct communication'. Direct verbal communication is what the facilitator aims for when she encourages the children to use words to describe their thoughts about the shared process. The non-direct communication includes all the communication that the children employ to align and negotiate their process through related topics or themes. Some of these strategies include words, such as songs, quotes, or stories. A quote from a shared cultural reference may relate to a shared process without explicitly dealing with it. Thus, it may be considered as relevant to the interaction even though it is not direct verbal communication. This distinction is useful in developing the facilitation strategy as we will discuss in "Discussion: How can we facilitate social learning across neurotypes?".

Facilitation provokes ambiguity and social tension

We tend to think of social facilitation as a factor that diminishes tension, but when we take a closer look, it also provokes tension between the children in several instances. From a double-empathy perspective, this is an important observation because it highlights that social facilitation is not always meaningful from the perspective of an autistic child. This opens for a new analytical

perspective on the facilitation strategy: How can it be a source of social tension? In this section, we zoom in on two aspects of the communication, namely the initial lack of commitment in the decision-making process and the consensus reminders from the facilitator.

The initial lack of commitment: "Couldn't we build a robot?"

As noted above, the decision to build a robot extends from 13 (Figure 10) to 185 (Figure 11). When Anders puts forward the suggestion in 13, he phrases it as a direct question "but (.) couldn't we build a robot." Sander looks up at Anders in 14, which shows that he heard him, but neither Sander nor Asbjorn reply. After a 0.7 break, the facilitator tries to open a dialogue in 18–19 by saying "well done to suggest that" while she opens her palms and moves her hands in the space between the children. The other children still do not respond.

The lack of an answer to a question is unusual in conversations. Questions and answers belong to a category called adjacency pairs by conversation analysts (Schegloff & Sacks, 1973). It follows from the underlying structure of conversation that the first part of the pair calls for a second part. The second part is not always an answer to the question. It can be a new question or it can be silence. When the second part does not fulfill the expectation generated by the first part, one of the interlocutors will often investigate the reason by initiating a conversational repair in the form of a new question or a clarifying comment (Sacks et al., 1974).

As mentioned, neither of the children react to Anders' suggestion. Instead, the facilitator evaluates the suggestion in 19 "well done to suggest that". Then she gives a general instruction in 22 ("you need to continuously agree about what you (think-)") and in 31, she invites Anders to confirm his suggestion ("m:: so you're thinking about a robot"), but instead of talking about a 'suggestion' as she did in 19, she now rephrases it as something Anders is 'thinking'. Again, no reaction from Sander and Asbjorn. At this point, Anders takes another turn that seems to back down from his initial unrequited suggestion from 13

```
145    *ASB:    ((reaches in to place brick on construction without looking up))
146
147             (2.8)
148
149    *ASB:    ((struggles to place brick, but drops brick on the table))
150    *SAN:    ((leans forward looking at Asbjorn's hands))
151    *AND:    °f[uck°
                 f[uck
152    *AND:    ((looks intently at Asbjorn's hands and nods emphatically))
153    *ASB:    [↑DA:RH
                 [DA:RH
154    *ASB:    ((tinkers with construction and sits still while 'screaming'))
```

Figure 9. Sander and Anders follow Asbjorn's struggle with the bricks intently and react verbally when a brick slips his fingers and falls onto the table.

```
13      *AND:       me:n (.) kan vi ik bygge e:n robot
                    but (.) couldn't we build a robot
14      *SAN: →     ((looks up at Anders))
15
16                  (0.7)
17
18      *RIK: →     ((looks at Anders, nods, opens palm towards him))
19      *RIK:       GODT du foreslår det
                    well done to suggest that
20      *AND: →     ((looks up at Rikke))
21      *AND:       *øa:[h-*
                    uh:[m
22      *RIK:           [I må ↗hele [tiden aftale hvad I (synes-)
                        [you need to continuously agree about what you (think-)
23      *SAN:                      [hvor skal den så sidde hen[ne↗
                                   [where does this one go [then
24      *SAN: →               ((looks up at Anders and leans in with brick in hand))
25      *AND:                                            [oven på den her
                                                         [on top of this one
26      *AND:                                       ((points to construction,
27      *AND:                             looks at brick in Sander's hand))
28
29                  (0.3)
30
31      *RIK:       ↗m[:: så du ↑tænker på en robot↓
                    m[:: so you're thinking about a robot
32      *SAN:         [den ↑her
                      [this ↑one
33      *SAN:         ((leans in to push brick into place as directed))
34      *AND:         ((smiles vaguely and quickly as response to Rikke's question))
35
36                  (0.2)
37
38      *SAN:       *a:[:hm:*
                    u:[:hm:
39      *SAN:       ((struggles with fitting the brick onto construction))
40      *AND:           [↗eller (.) noget ande:t↘
                        [or (.) something e:lse
41      *AND:           ((gazes at construction))
```

Figure 10. Anders' initial suggestion that they build a robot (13) and the lack of response from the other children that follows.

when he says "or (.) something e:lse" in 40. His turn seems to be elicited by the facilitator's turn in 31, because he acknowledges her turn with a quick smile while looking intently at the construction in 34. Sander and Asbjørn continue the process as though nothing had been said.

Anders and Rikke tone down the urgency of the second-pair part for every time they repeat the suggestion. The first phrasing is a direct question, the next is labeled by the facilitator as a suggestion. Then follows an ascertainment of the robot idea, and at last, Anders reopens the negotiation explicitly by suggesting that they build something else. Sander and Asbjørn do not reply verbally; yet, they are already in the process of building a robot, which becomes clear in the interaction in Figure 11 below.

Consensus reminders and the dumper truck. The aim of the facilitator is to encourage the children to communicate as part of their collaboration. As noted above, she uses two strategies to this end, namely procedural support and consensus reminders. Here, we zoom in on the consensus

reminders. Whereas the children explicitly ask for support in maintaining structure (as Sander when he asks "u:hm (.) is this a blue" in 60, Figure 6), they show minimal or no reactions to the consensus reminders. Yet, one of the consensus reminders yields a reaction, and this reaction even gives rise to ambiguity and social tension between the children.

In 159, the facilitator rhetorically says "I wonder what it will be" (Figure 11). The turn occurs in a phase of the interaction where Asbjørn is struggling to click the first of two bricks onto the construction. At this point, both Sander and Anders are deeply engaged with following Asbjørn's actions, and they treat Asbjørns actions as turns in the interaction (as noted in "Facilitation supports engagement and communication"). The facilitator remains passive for most of the interaction in Figure 11. She is not part of the construction process, and her turn "I wonder what it will be" in 159 could be interpreted as a verbal signal of engagement as well as a consensus reminder. Sander replies to the rhetorical question with a cheerful and patient 'we'll see' in 165 that mirrors the playful rhetorical quality of Rikke's turn.

```
159    *RIK:     °↑hva mon det ska bli til↘°
                    I wonder what it will be
160    *RIK:     ((lifts hand to put her hair behind her ear))
161    *ASB:     ((pushes other bricks better onto the construction))
162
163              (0.5)
164
165    *SAN:     DET ser vi
                    we'll see
166    *SAN: →   ((sits back and looks up at Rikke))
167
168              (0.9)
169
170    *ASB:     ((looks through bricks with hands to select his second brick))
171    *AND:     °en dumper trump
                    a dumper trump
172
173              (0.3)
174
176    *AND:     truck°
                    truck
177    *AND:     ((sits quietly and observes Asbjorn's actions while speaking))
178
179              (1.8)
180
181    *ASB:     jeg troede vi startede med at sige en robot↘
                    I thought we already agreed on a robot
182    *ASB:     ((looking down at bricks while speaking))
183    *SAN:     det [der det ku jo være e:n en rustning på den-
                    that [one could be an armor on it-
184    *SAN:     ((points to the construction))
185    *AND:          [okay det kan vi godt sige (.) nu er det min tur
                         [alright that's a deal (.) it's my turn now
186    *AND:                              ((reaches in to pick up die))
```

Figure 11. Anders' suggestion that they build a dumper truck and the final commitment to the robot plan by Sander and Asbjorn.

A 0.9 pause follows the interaction between the facilitator and Sander, before Anders suddenly suggests that they are building a dumper truck in 171–177. This turn seems curious. Why does Anders betray his initial robot plan and suggest that they build a dumper truck? The suggestion is phrased in a mumbling and quiet voice, and the initial mispronunciation of the word 'truck' makes it even harder to hear (as noted in "Getting the transcript right"). Anders looks at Asbjorn's hands and sits quietly with his own hands in his lap. He almost seems a bit worried as he utters his turn. Is the turn Anders' way of finally giving up on the robot plan? Or is he navigating an ambiguous situation competently as the two core rules are in conflict once again?

In a strict interpretation of the rules, Anders has no agency in this particular phase of the game. Asbjorn rolled a two, which means that he gets to pick two bricks and place them himself. Anders has no right to question or challenge what Asbjorn chooses to do with the bricks. Yet, with the verbal suggestion of the dumper truck, Anders is able to test Asbjorn's commitment to the robot plan without breaking the rules. Indeed, the dumper truck suggestion comes just as Asbjorn begins to search for his

second brick; a search that Anders follows intently. Anders' turn can be understood as an answer to the facilitator's implied question "I wonder what it will be" in 159. And by introducing the new motif of the dumper truck, Ander's turn also becomes a statement that asks Asbjorn to agree or disagree.

The phrasing and intonation of Anders' turn makes it seem like a neutral comment to what he observes that is not really directed at anyone. This ambiguity in the delivery of the turn may also explain why neither the transcribers nor the facilitator understood the turn as explained in "Getting the transcript right". Yet, Asbjorn has no trouble understanding Anders. After a long pause (1.8) in which he places his second brick, he replies in a way that shows that he interprets Anders' 171 as a suggestion because he counters it by referring to what he takes to be the original plan (181–182). Asbjorn's phrasing is strange and temporally complex: "I thought that we began by saying a robot." This indicates that he had been committed to the robot plan from the beginning despite his lack of verbal commitment.

Sander immediately agrees and happily begins planning the construction of the robot by pointing and saying "that one could be an armor on it-" in 183. He is

cut off by Anders who reacts with a burst of energy to the unequivocal commitment from his friends as he says "alright that's a deal (.) it's my turn now" and picks up the die in 185–186. He hopes to roll a two, and he celebrates energetically when he succeeds with a gesture and quote that references a meme from the computer game Fortnite. This reaction from Anders stands in stark contrast to the quiet and mumbling phrasing of his turns before the other children committed to his plan. His change in energy may be interpreted as relief that the social tension from before is now over.

Discussion: How can we facilitate social learning across neurotypes?

The analysis showed that the facilitation creates a learning environment that gave the children an opportunity to acquire positive experiences as well as social frustration. In several instances, the children were able to resolve the social tension between them. The framework of the game as well as the object-mediated communication provided by the construction task enabled them to negotiate and navigate the shared process. The analysis found that even though the facilitation supported the children in collaborating, it also created misunderstandings, ambiguity and frustration. Thus, the analysis explored the social dynamics of facilitation in social interventions. It did not test perception-first accounts of autism, but it contributes an anthropological perspective on the borderland of understanding between neurotypes in social interventions.

The interaction between the children: A play-based environment

Regarding the interaction between the children, we note three main observations from the analysis above: (1) The children employed a broad repertoire of communication strategies to accomplish the task. In particular, non-direct communication strategies were prominent in their negotiation of the shared project. (2) The children responded to each other's actions with the bricks as though they were turns in the conversation. In other words, they seemed to speak with their hands as well as their mouths. (3) The children competently negotiated the construction process as it proceeded, and they navigated the social tension that arose between them. Moreover, they demonstrated an understanding of each other's perspective in relation to the social rules of the game and the learning environment.

The learning environment was based on an open-ended construction play task, which seemed to support the children's social interaction in two important ways. First, the nature and the structure of the building task itself supported them in engaging in the interaction. The children were motivated to engage in the task, and the task was designed so that they needed to interact. Their interaction emerged naturally from the construction process, and the facilitator was able to guide them by reminding them of the rules rather than instructing them directly. This gave the children agency in the social learning environment. We found that the children took responsibility for finding solutions to the social tension that arose.

Second, construction play provided the opportunity for object-mediated communication, which gave the children a natural framework for employing a broad range of communication strategies. The task did not necessarily require direct verbal communication or eye-contact. Instead, the children organized their interaction using other communication strategies. We found that they competently navigated social tension without the facilitator's help. In other words, they got the opportunity to acquire complex social experiences on their own terms. Even though research into the effects of play-based interventions exists (Gibson et al., 2021), we suggest that further research into the inner workings of play-based social learning is needed. In particular, we see potential in (1) the intrinsically motivating qualities of play, (2) the broadening of communicative strategies that follows from using play objects and narratives, and (3) open-ended play where the lack of a fixed goal grants agency to the children.

The facilitation by the adult: Misunderstandings across neurotypes?

Regarding the facilitation, we are particularly interested in those instances where it created misunderstandings and social tension between the children. We do not know whether the misunderstanding was the result of neurocognitive or personality-related variance, but the analysis showed that it emerged from the social dynamics involved in adult facilitation of interaction between autistic children. We divided the facilitator's turns into two categories: procedural support and consensus reminders. We found that the procedural support scaffolded the children in collaborating. When we zoomed in on the consensus reminders, we found that the children showed minimal responses or no responses at all when the facilitator reminded them to agree.

There is one important distinction between the facilitator's two categories of turns: the procedural support was more clearly directive than the consensus reminders. The procedural support directed the behavior of the children, and from the structure of the game followed that the children knew to whom the turn was addressed. The consensus reminders did not direct specific actions; rather, they maintained the relevance of the topic of consensus, and they were directed at all three children at once. This observation that direct instruction from the adult elicits

more adjacent responses in autistic children corresponds with previous findings in research on the functional relevance of echolalia (Curcio & Paccia, 1987; Rydell & Mirenda, 1991).

These findings have been discussed in terms of the cognitive demands required to process the information. One study suggests that children employ echolalia when the cognitive demands exceed the child's linguistic capacity (Rydell & Mirenda, 1991). Even though none of the children in this data clip used echolalia, a cognitive demands model is consistent with the observation that the children responded more to the procedural support. Following well-established rules clearly directed by an adult is less demanding than negotiating a consensus with peers.

Another interpretation that emerged in the collaborative analysis with the Conversation Analysis group was that the children did not respond to the consensus reminders simply because they established a consensus using other communicative strategies than the facilitator. If the children interpreted each other's building turns as part of the communication, placing bricks on the shared construction was part of the consensus negotiation. Moreover, they made verbal responses superfluous. This interpretation makes Anders' verbal replies to Sander and Asbjorn's placing of bricks meaningful. He objected as soon as he saw something that challenged his idea, and in doing so, he followed the logic of the shared communicative process.

In this interpretation, the facilitator's consensus reminders may be confusing to the children. After all, she had access to the same information as the children in the process, yet she kept reminding them to establish a consensus that they saw as already established. As Asbjorn said in 181–182, they already agreed on a robot at the outset. From the perspective of the facilitator, the robot plan was never explicitly negotiated. She did not follow the children's construction process closely enough to notice the subtle agreement between them. In this interpretation, the social tension instilled by the facilitator may be seen as a double empathy problem because rather than taking their perspective, she encouraged the children from her position as adult facilitator. From a double-empathy approach, she failed to invite the children's participation on *their* terms. This demonstrates the difficulties of navigating the borderland of understanding in a way that truly invites participation across neurotypes.

Implications for designing social learning environments

In conclusion, we point to the implications of our findings for designing social interventions targeting autistic people. The analysis showed that misunderstandings emerge in the situation where an adult facilitated social interaction between children. Zooming in on the communication in this data clip made us question our facilitation strategies in the project. Could we support children's learning in a more meaningful way if we focus more on the process that emerges between them than on our own predetermined goals? How do we develop guidelines that support facilitators in entering the borderland of understanding with more curiosity and openness to the children's experience of the situation?

The analysis had significant implications for our own work with developing facilitation strategies. First, the observation that play-based open-ended learning environments are an opportunity to explore social dynamics made us investigate different setups for creating open-endedness with children with varying social competencies. In particular, we took inspiration from the observation that non-directive procedural support from the facilitator supported the children's agency. Among other initiatives, we are currently collaborating with a team of educators to develop a set of observable indicators for children's curiosity and agency, which facilitators can look for to configure open-ended learning activities (with inspiration from and in collaboration with Baker & Ryan, 2021; ISB & POP, 2019; Mardell et al., 2016).

Second, the observation that the children did not respond to the facilitator's consensus reminders caused us to search for a facilitation strategy that support social coordination in a way that is meaningful from the children's perspective. We realized that simply inviting them to play collaboration games is not enough. We began to implement and develop documentation practices that invite children to reflect together on the learning that happens between them (Giudici et al., 2001). We currently explore how we can use construction play as a documentation strategy to scaffold social meta-reflection. Taking inspiration from visual learning approaches, we construct figurines together with the children that represent their social reflections, often mediated by metaphors and storytelling (Krechevsky et al., 2013; Roos & Bart, 1999). By using our hands and non-direct communication to negotiate social dynamics, we seem to invite the children into the learning environment in a way that is more meaningful.

Social interventions targeting autistic children usually involve some form of instruction, teaching, or facilitation by non-diagnosed adults. The analysis in this paper suggests that when we fail to invite children's participation from their own perspective, we run at half capacity. If the perception-first models of autism hold true, the experience of social environments is fundamentally different across neurotypes. Yet, this does not mean that we cannot interact within this borderland of understanding.

We wrote this paper because the analysis gave us new questions, which we find to be relevant beyond our own project. Even though we do not know how our analysis

generalizes, we hope that our methodological reflections may provide a useful perspective for other researchers and developers in rethinking social interventions within a two-way approach to communication across neurotypes. To strengthen autistic children's access to society in the long run, we need to design learning environments that invite participation from each child's own perspective. Only then will autistic children have a truly meaningful opportunity to learn about and develop strategies for the misunderstandings that occur in the borderland of communication across neurotypes.

Supplemental material

Supplemental material for this article is available online.

Note

1. We use the term 'autism' to denote the entire autism spectrum. We use the terms 'autistic' or 'autistic person' in accordance with identity-first language, which is preferred by the majority of people on the spectrum. We also acknowledge and respect that many prefer person-first language.

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