Nurturing Constructive Disagreement Agonistic Design with Neurodiverse Children

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ABSTRACT

Participatory design (PD) with heterogeneous groups poses particular challenges, requiring spaces in which different agendas or visions can be negotiated. In this paper we report on our PD work with two groups of neurodiverse children to design technologies that support co-located, social play. The heterogeneity in the groups in terms of abilities, conceptions of play, motivations to be involved and individual preferences has challenged us to think of the design process and its outcomes as spaces for continuous negotiation. Drawing on the notion of agonistic PD, we sought not to necessarily reconcile all views, but foster constructive disagreement as a resource for and possible outcome of design. Using our project work as a case study, we report on controversies, big and small, and how they manifested themselves in the processes and outcomes. Reflecting on our experiences, we discuss possible implications on the notion of democratising technology innovation.

CCS CONCEPTS

• **Human-centered computing → Participatory design**.

KEYWORDS

Agonistic Design; Participatory Design; Children

ACM Reference Format:
Christopher Frauenberger, Katta Spiel, Laura Scheepmaker, Irene Posch. 2019. Nurturing Constructive Disagreement Agonistic Design with Neurodiverse Children. In *CHI Conference on Human Factors in Computing Systems Proceedings (CHI 2019), May 4–9, 2019, Glasgow, Scotland UK*. ACM, New York, NY, USA, 11 pages. https://doi.org/10.1145/3290605.3300501

CHI 2019, May 4–9, 2019, Glasgow, Scotland UK

ACM ISBN 978-1-4503-5970-2/19/05…$15.00
https://doi.org/10.1145/3290605.3300501

1 INTRODUCTION

Participatory Design (PD), i.e., the involvement of prospective users and other stakeholders in the design of interactive systems, has become an established approach within HCI research and practice. While it is widely considered the "right thing to do", the driving motivation is diverse: in its pragmatic interpretation, the involvement of relevant stakeholders in design is a way of increasing the system's fit through eliciting better requirements and influencing technology expectations in the target group. A more transformative interpretation aims to democratise the creation of technology and shaping alternative futures for a fairer and more equal socio-technical life [17].

Regardless of the orientation, what we see is an increasing heterogeneity in participants and a diversification of use contexts and publics in which digital technologies play a role. This poses a challenge for PD in which the processes themselves increasingly become spaces for negotiating power relationships, agendas and visions. We argue this challenge has evolved since the early days of PD in which it was mostly concerned with the workplace and the context of labour rights [23]. While back then, the power geometries and front lines were drawn more clearly, this is less often the case in contemporary PD efforts. Bratteteig and Wagner provide, in their analysis of power and decision making in PD, a wide range of examples that demonstrate the complex, nuanced and often tacit distributions of agency between various stakeholders [6]. So, we argue, that the idealistic quest to democratise technological innovation processes by making marginalised voices heard is not a straight forward affair.

Reflecting on some of the participatory work at the *Malmö Living Lab*, Björgvensen, Ehn and Hilgren make a similar observation [4]. They argue that with PD entering public spheres and everyday life, and by engaging in controversial matters of concern [18], democratising innovation practices requires more than consensual decision making. Rather, they argue for creating *agonistic public spaces* in which constructive conflict can play out. They build on the work of the Belgian political theorist Chantal Mouffe and her notion of agonism in a radical democracy [21]. Approaching design in and through such agonistic spaces is what they call *Thinging* (see also Binder et al. [2]).

With this paper, we report on our efforts to create agonistic spaces for *thinging* social play technologies with groups of neurodiverse children. As part of the SocialPlayTechnologies (SPT) project we engaged mixed groups of neurodiverse as well as typically developing children to explore roles of technologies for affording, mediating and scaffolding co-located, social play. Over the course of a whole school year, we conducted regular design sessions to ideate, conceptualise and build technologies. The heterogeneity in the groups means that their ideas about what it means to engage in "successful" social play differs as much as their visions of how this could be facilitated. As such, these sessions were in themselves agonistic spaces in which conflicts would naturally arise. Working in and through these spaces, we sought to turn simple otherness into constructive, rather than destructive conflict and use this as a frame for designing technology that would continue to provide opportunities for agonistic conflicts to play out.

The contributions we make with this paper are threefold: firstly, we report on our methodological insights and developments that resulted from the need to extend and re-interpret our methods from working with individual autistic children as part of the OutsideTheBox Project [13], to groups of children with mixed abilities. Secondly, we provide a detailed analysis of instances of conflict in sessions with two groups over the course of a school year. Our analytical lens is inspired by the notion of agonistic participatory design and asks about how these conflicts came about and how they became constructive or destructive contributions for design. Thirdly, we reflect across the cases in this analysis and aim to identify transferable insights for the practice and theory of agonistic PD.

The paper is organised as follows: we start by reviewing related work, including PD with diverse groups as well as the theoretical foundations on the notions of agonism, democracy and its collision with PD literature. We then describe the project context, including details about the logistics and structure of collaboration, the participating children as well as the methodology developed for engaging them in the design process. Subsequently, we describe a series of critical instances in which conflict emerged and analyse them through the lens of agonistic participatory design. Section 5 looks across these instances and develops insights and guidance for designers to effectively create agonistic spaces and how to use them in *thinging* technology. Finally, we conclude by summarising our contributions and providing an outlook for future work.

2 RELATED WORK

Early participatory design work in Scandinavia took place within a highly politicised context. When the Norwegian **Iron & Metal Workers** union approached the renowned computer scientist Kristen Nygaard and his colleague Olav Terje Bergo, the intent was to acquire the necessary knowledge about computers to strengthen their position on the negotiation table with industry [23]. While the collaboration proved to be much more a process of mutual learning, the power struggle was clearly laid out between two conflicting agendas: union versus industry. Similarly, the **UTOPIA** project involved graphic workers, the Nordic Graphic Union, academic institutions and industry to explore the design of computer systems that recognised the expertise of workers and re-skilled them within a changing work environment [8]. While the project did not result in the desired outcomes, again, the political struggles and stakeholder agendas were relatively clear cut.

When the main context of activity for PD broadened, such political fault lines were less prominent. Nevertheless, power differences in decision making continued to be a central matter of concern for the community. Bratteteig and Wagner prominently discuss this by analysing, amongst others, the **IPCity project** in which an interactive, mixed-reality table was developed to facilitate participation in urban planning [6]. They placed the *ColorTable* in a tent that was deployed in multiple cities. The PD process that led to its development was driven by a complex set of often tacit agendas and the way decisions were made reflected nuanced power relationships. Conflicts and their implications for design were mostly not immediately transparent and important decisions were formed on the basis of implicit power structures.

Participatory Design with diverse children

Such complex interplays are nowadays much more the norm in any stakeholder involvement when co-designing technology. However, the nature of design to solve problems has pushed PD processes towards either ignoring conflicts or treating them as something that is in need or reconciliation (see also the discussion in [10]). On the most pragmatic end of what still could be called PD, conflict is often denied a role in the process at all with participants relegated to inform decisions within a relatively small scope. But even in more ideologically laden contexts, conflict is often seen as a state of affairs that PD needs to mediate and find compromises for. Some examples from our immediate context of work - PD with children - may help to illustrate this point:

In the **ECHOES project**, autistic children and typically developing peers have been involved to co-design a technologically enhanced learning environment to scaffold the development of social skills [25]. The PD process has largely focused on children's preferences and modes of engagement, but did not extend to more controversial matters such as the normativity of social functions taught by the system or who's primary responsibility inclusion is. As a consequence, for example, typically-developing children were only involved

as proxies for the needs of autistic children, but not as peers in social interactions with them. Most of these conflicts were sidestepped by design of the project, its pre-set goals and approaches.

In a series of projects around the concept of **KidsTeam**[1] that originated from work by Druin [9], the intent was to involve children in innovating technology for children. The original KidsTeams were stable, long-term and co-located groups of children who collaborated with researchers on a number of design tasks, for example co-designing the visitor experience at Lincoln Memorial with the National Park Service. To include more and more diverse voices in design processes, Walsh and Foss developed an online system that allowed asynchronous and geographically distributed PD work [31]. Interesting for our argument here is that neither the original Co-opertaive Inquiry method proposed by Druin [9], nor Online KidsTeam has any explicit support or intention to deal with conflict as a resource for design. In Online KidsTeam, the extent to which conflict is structurally supported ends with children being able to like or dislike contributions to design ideas. When McNally et al. reports on an interview study on former members of KidsTeams and their experiences, it is interesting that conflicts and their resolution did not surface. One of their children expressed that at KidsTeam, it was about combining ideas "so there was never one above the other, it was all just equal" [20].

In a similar vein, Read et al. developed the **TRAck Method**, to ensure that every idea that was contributed by children in a design process had an equal chance to be considered [26]. The method aims to document which ideas children contributed, which were taken forward in the design process and which were not, ensuring that they had fair representation. The authors report that this fostered the democratic decision process in that it was more transparent that the majority consensus drove the selection of ideas. While we would not want to deny that such fostering of fair representation is very important, we argue that it is a missed opportunity for design to feed off controversies, rather than exclusively aiming for compromise or consensus.

Other work in this context focuses primarily on the ways in which children can contribute, rather than how the inherent conflicts between agendas or preferences can be harnessed as a resource for design. For example, Benton et al. provide a review on how disabled children can be involved in technology design processes [1]. Analysing a range of projects, they provide deep insight on methods, outcomes and the often complicated ethics of working with these children. However, as above, the main focus lies on how children can express their ideas and thus contribute to design decisions. While without a doubt many of the projects reviewed encountered conflicts, big and small, these have not been formalised or reported on as vital parts of doing PD. We argue, that it is in accommodating disagreement and nurturing constructive conflict, and not necessarily in striving for compromise or consensus, that most of the democratisation of design processes can take place. In fact, this is not restricted to the process, but extends to its outcomes. Here we argue that controversies in the process can translate into designs that open, rather than close opportunities for agonism by providing frames for constructive conflict.

Iverson et al. make a relevant argument for politicising the PD work with children by introducing the role of protagonist for child participants [15]. In contrast to the role of a design partner (compare [9]), supporting child participants to become protagonists means strengthening their own capacities to become critical and informed decision makers with respect to technology. It aims to re-invigorate the political dimension of PD and make participants empowered agents in the democratic arena where our relationship with technology is debated (rather than solved).

Agonism & Design

The connection between the political notion of agonism and PD's aim to democratising technology design was first made by Björgvinsson et al. [3]. Drawing on the work of the political philosopher Chantal Mouffe, they state "Questions of 'democratizing innovation' are, in this view, always political hegemonic controversies, and as such, they concern the 'constitution' of agonistic public spaces." (ibid, p48). Using case studies from their work at the *Malmö LivingLab*, they discuss how they engaged marginalised groups in society such as immigrant youths, NGO's and companies in participatory processes to generate new media innovations. Reflecting on their work, they highlighted how everything about their activities had an inherent political dimension that challenged participants in controversies around the power-relationships and structures of hegemony. Doing PD, or *Thinging* how they called it, then means "infrastructuring agonistic public spaces mainly by facilitating the building of arenas consisting of heterogeneous participants" (ibid, 50). In one of their following publication on the topic, they coin the phrase *Agonistic Participatory Design* [4].

It is worth going back briefly to the original concept of agonism by Chantal Mouffe [21]. Central to her line of argument is the definition of politics as the formal structure in which the political, the struggle of people to establish hegemonic order, takes place. Mouffe's point is that the struggle for power and hegemony can never go away in a pluralistic society and rethinking democracy means that providing space for these confrontations becomes the raison d'etre for politics [22]. In other words, politics is not just a place

[1] https://hcil.umd.edu/children-as-design-partners/

for reaching consensus, but also a political arena that facilitates and embraces continuous conflict between adversaries that shapes society. The non-existence of such spaces or conflicts in fact may be interpreted as worrying signs of oppression and totalitarianism. The aim of a radical democracy as Mouffe suggests is to embrace multiplicity and pluralism, and provide institutionalised arenas where the existing antagonisms (conflicts between enemies) are transformed in agonistic (i.e., vigourous, but non-violent, respectful and constructive) struggles.

These arenas are what Björgvinsson et al. had envisioned when they speak about agonistic public spaces in which participatory design takes place [4]. In their work they, too, engaged in conflicts that have no rational, pre-determined path towards resolution. For example, while they encountered many pre-formed prejudices around migrants, largely pushed by mass-media, they also "faced many patriarchal family views prevailing within some immigrant families". Applying this thinking more generally to design, we argue agonistic design re-orients both practice and outcomes of design processes away from striving for hegemonic solutions, towards providing common frames and spaces for a multiplicity of actors and their agendas.

This paper applies this line of thinking on the design of technology with diverse groups of children. We investigate how embracing multiplicity and allowing for controversy can create agonistic frames and spaces in the process and the actual outcomes. The following will ground this discussion in our specific case looking across antagonisms of different scales, from small conflicts around preferences in colour to the big struggles about different agendas. We subsequently aim to elicit more general insights for agonistic design by reflecting on our experiences in section 5.

3 PROJECT CONTEXT

SocialPlayTechhnologies aims to explore possible roles of technology to support social play in heterogeneous, neurodiverse groups of children in co-located settings. The aim is to develop technologies that are meaningful, engaging to children and able to mediate and scaffold social play activities. While social play is widely acknowledged as highly important for individual development and inclusion, there is also a rather normative view held by adults on what "successful" social play looks like [32]. Neurodiverse children do not just have different needs and abilities, but also different concepts of play. With the playthings we develop, we aim to question normative assumptions about what constitutes effective social play and allow different interpretations of activities by different players. We aim to scaffold free, self-directed and largely unstructured play time in which technologies offer opportunities for social play with enough ambiguity and affordances for appropriation so that children can develop their own interpretation of a "good" play experience. As such, we think of our play-things as boundary objects within an infrastructure for social play [27, 30].

Our approach follows PD principles and builds on the experiences we made in the OutsideTheBox Project [13] in which we engaged several individual autistic children to explore possible roles of smart things in their lives that are meaningful, afford positive experiences and allow for sharing such experiences with others.

Participants

In year one, we have worked with two different groups of children in two different schools (see Table 1). Over the span of the project, we will collaborate with two more groups for design and engage another four groups for the evaluation of the resulting prototypes. Both of the groups in year one have been assembled by their teachers along pre-existing relationships. We were particularly interested in having autistic and allistic[2] together. While most group members were not neurotypically developing, each group had at least one child who was. We gained access to the groups through established relationships with teachers of schools we previously worked with. In both cases, we conducted our design activities in a room adjacent to the main classroom.

	Participant	Age	Characteristics
SchoolA	Kabir	8	learning disability
	Lee	8	autism
	Mark	8	autism
	Samantha	9	trisomy 21[3]
	Tony	7	
	Uma		teacher
SchoolB	Stephen	7	autism
	Kerstin	8	
	Leo	8	ADHD
	Renato	7	autism
	Rosa	10	
	Jane		teacher

Table 1: Participants of SocialPlayTechhnologies. Names have been altered to protect their identities.

In School A, a mainstream primary school with a few inclusion classrooms, the group was already established as a subset of the classroom. The participating children were used

[2]We use *allistic* to mean non-autistic, which includes the whole range of neurodiverse, as well as neurotypically developing children.

to having some classes separately from their peers to provide extra support. As Uma, the teacher, was usually leading those separate units, she was also present during our sessions. She held a somewhat hybrid role as a participant, but also as an enforcer of rules and anchor for stability, providing the children with the structures they would expect. As the group already existed before we entered the space, there were pre-existing conflicts and hierarchies already established.

While such conflicts and hierarchies equally existed in SchoolB, the children there were specifically selected by their teacher to participate. This selection took into account previously existing friendships (for example, between Stephen and Kerstin) and their availability and general interest. Ina only joined in the fourth session after having expressed self-driven interest in the design activies. SchoolB is a special education primary school. The teacher, Jane, did not directly participate in our sessions, but was present in the classroom next door.

Structure of engagement

Our engagements with the design groups are planned to last about one and a half school-years (starting in September) with meetings approximately every two weeks. During the first year, we go through phases of relationship building, ideation, conceptualisation and prototyping. In the beginning, we meet with the teacher to understand more about the groups and their inner workings and dynamics. Then, we spend two or three sessions with the children, focusing on getting to know each other and discussing the aims of researchers as well as children for the process. At this point we also explored meanings and qualities of play with children and how they differed between them. The remaining sessions are used to iteratively explore different opportunities for design and closing in on promising concepts that we would further refine. These cycles of opening and narrowing the design space sometimes targeted the whole concept and sometimes particular aspects of a design ideas that we wanted to progress.

We planned the process so that we would arrive at a complete concept alongside functional prototypes by the end of the school year. Based on the final concepts, we subsequently developed them into research products (cf. [24]) during the summer and the beginning of the second year. As our previous experience has shown, it is key to spend sufficient time on the development of robust research products to make sure they are safe for the children, durable in light of the occasionally rough treatment they might receive and usable beyond single instalments. We plan to evaluate the resulting technologies together with the children we designed them with, across the both groups and with two unrelated groups of neurodiverse children also to understand how transferable the concepts are beyond the core design groups.

TU Wien, the institution at which the research is hosted did not require a formal ethics approval. However, being aware of the sensitive context in which our work is conducted, we adopted the ethical guidelines provided by the UK's Economic and Social Research Council (ESRC) and combined them with an in-action approach [12] and continuous reflection on situated requirements [29].

Methods

Our fundamental guiding principle was to create a Handlungsspielraum for children [19]. The concept describes a space in which children are supported in unfolding their creative potentials by providing them with the right balance between structures and freedoms. Working with individual children in OutsideTheBox, creating a Handlungspielraum meant interpreting PD methods, selecting working materials and providing social structures in ways that would allow them to fathom their creative potentials. Importantly, structures and freedoms could be tailored to the child, adjusted between sessions and on the fly. In group settings, balancing structures and freedoms has become much more delicate and the Handlungsspielraum became in itself an agonistic space. Methodologically, this meant that we needed to develop activities that were much more ambiguous in how children could interpret them, providing multiple forms of structures and freedoms that children could choose to work with. For example, in a session in which we sought to build a functional prototype together with children, we offered different levels of structures and freedoms in materials and the activity. We brought a finished example, some pre-cut elements, but also blank foam boards that allowed open explorations of forms. We also made this a group activity, so that different tasks were on offer, like planning, cutting, assembling, electronics or decorating. While this led to some considerable (agonistic) negotiations, it successfully opened up the concept of a Handlungsspielraum to groups of children with diverse needs in terms of structures and freedoms to support their creativity. Conceptually, it extended the concept of a Handlungsspielraum as a agonistic arena in which structures and freedoms and their use are negotiated between participants. One of the examples below speaks to this in more detail.

Another aspect of our participatory approach had to be evolved to account for the switch towards working in groups, rather than with individuals. Describing our design practice in OutsideTheBox, we identified a repertoire of methodological building-blocks that we fluidly combined, blended and re-interpreted for in the planning of subsequent sessions to stay responsive to how the process unfolded [11]. Elements such as material exploration and role play were blended to become an activity, not without being adapted to take into account previous outcomes, changes in context or the needs of the child or the designers. Again, we found this principle still

useful in planning sessions from week to week, but the group setting resulted in additional complexities. For example, the nature of outcomes of previous sessions can be perceived quite differently between participants (see also [14]) and consequently, building on them becomes ambiguous. E.g., while for some children, particular artefacts that were created in previous sessions, provided the main outcome and, thus, a suitable entry point for subsequent sessions, other children were more attached to particular routines or activities.

4 CONFLICTS & CONTROVERSIES

All workshops were video taped and all team members kept a detailed, reflective research diary. For this paper, we identified conflicts first in the diaries as critical instances in which differences became apparent that had an impact on design decisions or the direction of the process. We then followed up these leads in the video and analysed how precisely these instances played out. In the following, we describe vignettes of agonistic conflicts within three broad categories: between researchers and children, between the process and children and within children. Furthermore, we reflect on instances where we were less successful, either because a conflict we wanted to work with turned out to be destructive and could not be re-framed, or where we could not, in the moment, identify the conflict or felt that resolving it was the appropriate course of action.

Group A

As a closely knit group with an already established shared identity, we encountered the five children of Group A and their teacher together with already existing hierarchies and ongoing conflicts within the group. Since Uma as their teacher was a core aspect of their time together, she was also actively present in our design sessions as an anchor for grounding the children, but also occasionally translating our input, participating in the activities and providing structure for the children when needed. After several ideation and rapid prototyping sessions exploring the children's shared interests in music and spatial exploration through bodily movement, we narrowed in on a concept for *Music Pads*. These are a set of pads that together modulate different aspects (such as tracks, pitch, tone, tempo etc.) of soundscapes according to whether a child steps on a certain plate and the direction of that step. The mapping of pads is initially unknown which allows for a range of different modes of playing with them, from purely sensory experiences to strategic collaborations to figure out which pad has which function.

Figure 1 illustrates the engagement with one of the early prototypes. The children exhibit different patterns of play with the same prototype; one of them is very active, another one observant, but interested in the mechanics behind the

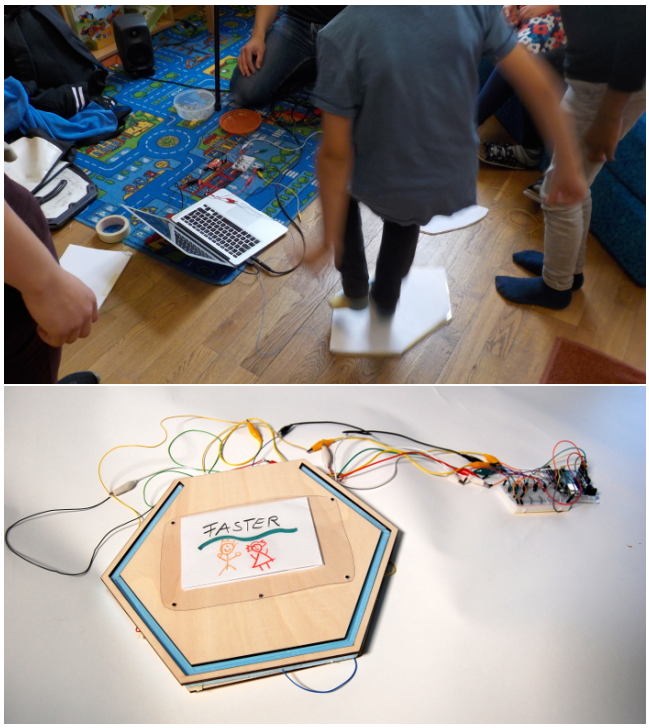

Figure 1: Testing out early prototypes of MusicPad with children of Group A and the final prototype below.

functionality and a third one (in a floral dress in the background) sits to the side content with observing and listening to the sounds. To the left, Uma is giving the children space for exploration, while one of the researchers is on the floor to handle the fragile prototype, but also to make it clear to the children that inquisitive questions and further explorations are welcome and managed through the researcher.

We encountered three different areas of conflict: a) between the process and children's agency, b) among the children themselves and c) between us as researchers and them. All of these had different implications for our design activities.

As an example for disruptions in the design process, we take two snapshots from session 4 at the boundary between ideation and early prototyping. We had brought three different abstract shapes created from blue foam. Our background story was driven by a narrative that those were alien objects from outer space that the children should re-interpret in pairs to encode them with new meaning. Lee and Mark formed a group together, but were not interested in co-developing their object collaboratively as instructed. Instead they both worked separately with the object and brought their individual agenda and intent into the design in parallel. While they created a coherent story in their presentation, during

the design process, they continuously negotiated space for inscription into the object. During the same session, Kabir worked with one of the researchers but refused to engage with the given task. To show his resistance he took a pair of scissors and started wildly hacking into the blue foam. This created an interesting pattern on the surface that eventually inspired him to further develop it by adding craft materials and creating a mock-instrument. By allowing him to resist the process, he could then engage with the task on his own terms and could start manipulating the blue foam deliberately, eventually creating a refined design prototype.

Other conflicts were chiefly between the children themselves. This often relates to their different needs and desires (which might also individually change over time) when it comes to structures and freedom in engaging with the technology. When playing with an early version of the *Music Pads*, for example, the children started writing down the name of each function on each pad as soon as they became apparent. While Mark and Lee enjoyed pushing several pads at the same time, Tony suggested a more structured way of revealing the functions: "If only one pad is touched, you can hear faster which sound is played." Researcher: "Do you prefer knowing all functions in advance?" Tony nodded, but Lee and Mark did not listen to Tony's advise and continued pushing pads simultaneously. Tony subsequently retreated from the activity, as he disliked uncertainty in play. These conflicts are part of the negotiation space in which social play happens. Our interaction design intentionally affords either mode in the final research product, i.e. open, sensory play and systematic exploration of the mappings. This serves as an example for how conflict in the process was not resolved, but translated into a design that produces an agonistic space in use.

We also experienced conflicts between researchers and children. Most notably, when the researchers' agenda for social play and the children's initially expressed design ideas did not match: while they wanted to recreate a very specific game they already played ("stop dance", a game in which everyone freezes when the music is off and dances wildly while it is on), researchers were mainly interested in creating a space for free and self-motivated play without fixed rules. Where the children wanted a clear-cut competitive game, researchers aimed for exploratory, playful social engagements. As a system, the *Musical Pads* tries not to resolve this conflict, but rather invites players to appropriate the functionality to their intentions. They offer a platform, which can react according to differently imposed meanings.

These conflicts influenced the design of the *Music Pads* in several ways. They are malleable and invite constant (re)design and (re)appropriation for different contexts and different conflicts to be articulated through them. The design does not aim to strike a compromise between the diverse needs and preferences between the children, teachers and researchers. Rather, the design reflects some of the conflicts from the process and continues to allow them to be had when using them. Mischief is not prevented, but rather integrated as a form of potential play. The children can explore different roles and redefine them as they see fit within the same setup. However, the design also challenges the availability of certain roles so that there is a constant flux of re-assigning roles not only possible, but necessary for productive engagement with the pads.

However, not all conflicts that occur can be reframed or resolved. Some conflicts between the children are unrelated to the current activity or context. The group dynamics influence their behaviour as well, leading to irritations and children feeling hurt and they would refuse to take part in the workshop activities together with the rest of the group. As our sessions were of limited time (up to an hour), we had neither the time nor the resources to address every one of these conflicts. For example, Samantha was often excluded from activities by the rest of the group. While encouraging everyone to participate in the design sessions and acknowledge different needs and desires, we did not aim to resolve this larger conflict. Rather, we aimed to create technologies and social structures that enabled children to regulate their level of engagement with others as they felt comfortable in the moment. For example, Tony also tended to choose more observant and background roles in the design process (such as documenting the process) and stepped into more active roles once they felt it was safe for them to participate more actively.

Group B

With Group B, it quickly became apparent that their main interests centred on physical play spaces and light, which they used to structure different kinds of pretend play activities. We eventually settled on a concept we called *Light Spaces*, a set of multi-coloured fabrics that can be attached to a lightweight structure of plastic tubes that children connect in different ways. A number of fabrics incorporate light elements that are controlled with an attached squeezable object. Each controller allows to "squeeze" one particular colour into the associated light with variable intensity depending on the pressure applied. When multiple of these smart fabrics are used, each controller contributes its colour to *all* lights. Hence, children collectively need to negotiate light effects in the smart fabrics that constitute different physical play spaces.

We present here two types of conflicts: a) between the process/researchers' and children's agency, and b) among the children themselves.

Figure 2: Early prototype for the Light Spaces developed with Group B and the final prototype below.

During early workshops we used different materials, crafting tools and technological artefacts like littleBits[4] to co-design artefacts. The entire group liked to bring their own materials into the design work as well, including plush toys, costumes or things they found in the classroom. Usually they used them as props in pretend play activities: Stephen and Kerstin tried to 'hatch' a wooden egg and Renato liked to create costumes with fabrics. Sometimes children preferred their own materials or appropriation over tinkering with researchers' materials or engaging with early prototypes in the way researchers intended. While our aim was to test and refine previous concepts, the children continued to incorporate their own materials and engaged with the *Light Spaces* in patterns they had established with earlier versions. By explicitly acknowledging and addressing this conflict, we could not only re-direct the children to potential engagement, but also attune ourselves to their actual activities instead of persisting on expected behaviours. This meant, that we could focus on how they often combined materials in resourceful ways and interpreted our materials in a flexible manner which opened up spaces where multiple meanings can be imbued on the same object.

As a result, we aimed to support the creative appropriation of the playthings in later prototypes. The fabrics now invite children to structure *Light Spaces* and augment them with their own materials and objects.

A second recurring situation was the need of the children to withdraw themselves from the group during or after a conflict and returning once they had time to work through it by themselves. In one event Renato left the room, visibly distraught: "I don't want to play here anymore, because I can never play." Kerstin and Rosa noticed this and tried to invite Renato back, but to no avail. Then Rosa suggested: "Let's build a dragon cave for Renato." and Kerstin added: "Yes, it definitely has to have a lot of red in it!" They continued to incorporate a special section for Renato within the existing setup, which he then felt welcome to return to.

Conflicts like this inspired us to give the children the opportunity to create their own rooms that can still be connected, but give them the opportunity to create places to 'hide' for a while. With the fabrics the children can build shared play spaces but also smaller hiding places, while still being connected to the rest of the group through the lights. Conflicting needs of engagement can then be addressed and negotiated through the same material and physical play environment.

However, in some cases, conflicts are too powerful to be negotiated through material, design activities or playful prototypes. In one session, Kerstin was very upset by not being able to create the space she envisioned with the material and how a neighbouring room permeated into her own space, leading her to frantically aim at the destruction of the entire construction. We had to take her out of the situation for her to be able to calm down, reflect on what had happened and how we can go further from there. The technology itself could not mediate the conflict and it very visibly was destructive. We could, however, gain some valuable information for the design with respect to the durability of certain parts from the session.

Another conflict between two children, Stephen and Leo, has shown us how this technology can help children to find a different format for their conflicts. The boys liked to quarrel with each other and used strong language or borderline aggressive behaviour with and on each other. When interacting with the *Light Spaces*, they transformed their conflict to non-violent ones by sending each other lights in the first prototypes or secretly changing colours in later versions of the prototype. In this scenario, the technology quite literally was able to transform antagonism into agonism. Importantly, the aim is not to suppress or resolve the conflicting stances between the children, but to encourage more productive and non-violent scenarios for engaging with these conflicts.

[4]https://littlebits.com

When we introduced the interactive lights for the first time, all children engaged in a shared play activity exploring the lights. However, they interpreted them in different ways. Kerstin and Rosa built a 'girls' cave' with the fabrics and two lights, Leo and Stephen set up a separate play space with fabrics and one interactive light next to the girls' cave. The girls had a strong preference for particular colours that would complement the atmosphere of their cave. Stephen brought a plush toy representing *Alvin*[5] to the workshop and associated the colours with the chipmunks. Stephen enjoyed to see the colours change, calling the names of the characters he associated with the colours, while the girls preferred having them fixed to support the design of the ambience in their area. This conflict lead to a productive discussion between Kerstin, Rosa and Stephen, facilitating an ongoing social play experience between them as they kept discussing their different desires regarding the behaviour of the colours, each within their own physical play space. Since Stephen is often excluded from the play activities of Rosa and Kerstin, *Light Spaces* created an opportunity for them to interact with each other outside their established patterns and hierarchies.

The examples show how agonistic spaces can spark discussions that lead to social interactions and, ultimately, social play between neurodiverse children with different interests. With our design decision to acknowledge and honour the different interpretations of the technology instead of aiming for a mutually agreed upon solutions, we designed *Light Spaces* to support individual needs and desires in collective social play.

5 DISCUSSION

While our initial strategy was simply to be attentive to conflict and trying to make it productive in design, reflecting across these cases and vignettes, there are patterns in these engagements that may serve as a more general guidance for conducting agonistic participatory design. To start with, conflicts or controversies need spaces and structures that **allow them to surface** and emerge. Working with a vulnerable population (neurodiverse children) emphasises how this requires a conscious effort and a careful design of the collaboration. From a systematic perspective this is strongly related to the power structures that naturally exist in all PD work [7], which determine the opportunities for conflict. In schools, this includes deeply ingrained expectations of social order with adults ultimately in charge of dispelling conflicts, judging right and wrong, and assigning responsibilities. When Kabir rather violently expressed his unwillingness to engage with the task by hacking into the blue foam, we needed to consciously resist our impulse to find ways for him to comply, but rather accept this conflict as an opportunity.

Spiel et al. remind us that many sources of conflict have a moral or **ethical dimension** and more often than not result in dilemmas that defy clear cut, rational judgements [29]. Again, allowing for such conflicts to surface is critical, but requires a targeted effort and a reflective practice. The conflict around what constitutes a legitimate agenda in a collaboration is an example of this that surfaced in the cases above as well as in the ones provided by Spiel et al.

When conflict breaks out in PD processes, there is a tendency for researchers to think of their role as a mediator and solver. After all, design finds **solutions to problems** and PD aims to democratise this process. In the most common interpretation this means to facilitate a consensus, a fair compromise to develop a commonly accepted, shared outcome. If one child likes red, the other blue, we may be able to settle on green. Taking Mouffe's perspective on radical democracy makes this only part of the responsibilities of democratising innovation. Agonism points to facilitating spaces that allow for conflicts to be had in a respectful and constructive way (see also [10]). Rather than meeting different needs half-way, this suggests allowing for structures in which multiple positions can co-exist. Or, if one child likes red, the other blue, agonistic design may mean designing a white canvas and providing erasable finger paint.

This perspective is applicable to **processes and outcomes**, i.e. agonistic struggles which are not suffocated by a compromise in the process can become features in the design. For example, the different ways in which children in group A wanted to play with the *Music Pads* created conflict that we avoided to solve in the workshop sessions. Rather, the conflict was the motivation to design the pads in a way so that different kinds of play activities were possible, in fact encouraged. In group B the observed conflict during the workshop between Stephen and two other children, Kerstin and Rosa, inspired us to *not* allow individual controls for lights, but to make all controllers effect all lights. As such, the conflict was preserved in the process and carried over into the design as an opportunity space for agonistic struggle.

The examples above provide a range of conflicts that are conceptually on very different levels - from negotiating needs or preferences to agendas and motivations. We consciously decided to take some of these conflicts further and make them **features of the design**. The question, then is which conflicts are "worth" being provided with agonistic spaces to live on? Reflecting critically on our work in the first year of this project, our choices were pragmatic, value driven and determined by our research agenda. They were pragmatic in that some types of conflicts kept surfacing and clear patterns became visible. For example, the diverse interpretations of play in both groups of children became apparent throughout

[5] *Alvin* is a character from the animated Chipmunks band https://en.wikipedia.org/wiki/Alvin_and_the_Chipmunk

our collaboration. Turning this divergence into a design feature, rather than seeking to find a compromise was driven by our shared value of non-normative empowerment held within the research group.

Other choices in carrying conflicts through to the design were clearly driven by our research interests. Making controllers effecting all lights in *Light Spaces* prevented subgroups to isolate themselves in their play activities and required children to socially interact with each other. This clearly aligned with our research objective to scaffold social play. I.e., one could argue that nurturing this conflict served our agenda.

The other main question remaining is how to delineate agonistic design and design that leads to **antagonism**, i.e. sparks violent conflict and oppression. We have experienced how technology can help re-frame antagonistic struggles into agonistic ones, for example in the case of Stephen and Leo, for which the *Light Spaces* seemed to work like a catalyst. But it is also easy to imagine how *Music Pads* can lead to play that forcibly excludes some group members when the majority settles on specific game rules. It is clear that designed artefacts cannot make this difference on their own, but that their use needs to infrastructured [16, 30], i.e. many socio-material structures around the artefact need to create conditions in which one behaviour is more likely than another. However, as a possible contribution from the artefact, our experience suggests that ambiguity and "staying open for interpretation" [28] in design is key. Allowing multiple interpretations that can exist in parallel and avoiding to make such interpretations mutually exclusive, generates spaces in which conflicts can exist without the need for a winning side. This comes back to the notion of a play object as a boundary object, which provides weak structure in common use, but strong structure in individual interpretations [27].

Finally, we want to offer some reflections on what agonistic PD and our experiences with using it as a guiding principle in our practice mean for the much used claim to **democratise technological innovation**. While giving often marginalised groups or stakeholders a space within the design process, is no doubt necessary, we argue that too much emphasis is put on finding ways to making their voices heard, rather than what to do with these voices. Understanding design as a political activity helps to, maybe counter-intuitively, resist design's impulse to find solutions for every disagreement [5]. Mouffe's political concepts help dispel the need for consensus or compromise, and suggest reorienting the notion of democratising technological innovation towards an understanding of design as an opportunity to create agonistic spaces in which constructive conflict is nurtured.

6 CONCLUSION

In this paper we have reported on our experiences with involving diverse groups of children in the design of technology to support co-located social play. We have reported on our methodological approach, building on our experiences in the OutsideTheBox project, shifting from working with individuals to groups of children to design technology. The diversity in participants with respect to concepts of play, preferences and needs, also challenged us to think about emerging conflicts in different ways. We argue that conflicts or controversies need not be solved all the time, rather they can provide a powerful resource for design and have their place both, in the process and the artefact or outcome. Theoretically, we situate this perspective in the concept of agonistic PD and in the political concept of agonism more generally. We use this theoretical lens to reflect on a number of vignettes from our work and aim to show how we resisted design's inherent reflex to solve problems, but conversely embraced conflicts as potential design features.

In the discussion, we reflect on our experience and connect them back to the theoretical argument for agonism in design. We highlight that conditions in which conflicts can emerge are not a given, nor is it a trivial endeavour to create them. We also discuss how to *not* solve problems and how it may be possible to create agonistic spaces in which these conflicts can live on in the resulting design in respectful and constructive ways. There are still many open questions that warrant future work, for example, regarding the choices made when allowing conflicts, and the ways in which design can scaffold these conflicts to become agonistic struggles, rather antagonistic ones. Also, while our own strategy to engage with conflict was rather opportunistic, further work is needed to produce guidance for researchers and designers on how to productively engage with conflict in the process.

With this paper we have made contributions to methods, in terms of designing with diverse groups of children, to theory, elaborating the concept of agonistic participatory design and to practice by grounding these discussion in case studies from our own design work with neurodiverse children.

7 ACKNOWLEDGEMENTS

We would like to thank all participating children, their families, teachers and the local department for education at the City of Vienna for their energy and support. This work has been supported by the Austrian Science Fund [P29970-N31].

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