

# Creating Creative Spaces for Co-Designing with Autistic Children - The Concept of a “Handlungsspielraum”

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## ABSTRACT

Participatory design is inherently concerned with creatively inventing alternative futures. From this perspective we argue that facilitating meaningful participation is configuring processes that allow for the unfolding of creative potentials of participants. To this end, we have developed the concept of “Handlungsspielraum” – the conceptual creative space in which participants and designers collaborate, exploring unique pathways by balancing given structures and freedoms in order to creatively think about the design at hand. Beyond the theoretical value of this perspective, we have found the concept to be a powerful, practical tool which allows designers to plan, conduct and reflect on co-design activities. In the Outside-TheBox project it has supported us in systematically developing tailored co-design activities with autistic children to design interactive “smart” objects. It has allowed us to consciously design creative spaces by providing social, physical and mental – methodological structures as well as creative freedoms. In the paper we establish the concept of a “Handlungsspielraum” and provide four case studies to demonstrate the practical guidance that it offers.

## CCS Concepts

•Human-centered computing → Participatory design;

## Keywords

creativity; children; autism; participatory design

## 1. INTRODUCTION

Historically, concepts of “participation” have evolved in response to different domains and purposes. While the Scandinavian tradition was ideologically concerned about workplace democracy, understandings of participation shifted to involve users in the design of interactive technologies, systems and products, for more pragmatic reasons [24]. Despite the differences in interpretation, participatory design (PD) practices are fundamentally concerned about facilitating creative processes to create alternative futures. However, although the creative process is considered a central and un-

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derlying mechanism in PD, creativity as a concept is rarely explicitly discussed in PD literature (e.g., [44, 40, 3]).

In this paper we argue that using creativity as a conceptual lens on participation provides a powerful means to design, conduct and reflect on participatory work. While much PD literature is concerned about methodological contributions [24], a creativity perspective shifts the focus toward creating the right conditions for participants to contribute in creative ways. The challenge of meaningful participation is a challenge of configuring structures and freedoms for a gradual unfolding of the creative potentials of participants. This perspective supports designers and researchers to have a broader view on how to facilitate participation within their specific context. It provides a systematic approach to tailor processes to participants and go beyond adapting or (re-)interpreting methods.

We are motivated to explore this avenue by the challenge of involving autistic<sup>1</sup> children in the design of ubiquitous computing artefacts. Our specific context requires customised configurations to enable the children to meaningfully participate in the design process. It also requires us not only to stay responsive to the evolving collaboration but also to be flexible in planning and conducting participatory work with autistic children. To systematically inform the process, we developed the concept of “Handlungsspielraum”(HSR), inspired by the experiences of Malinverni et al. [34] in facilitating creative processes in a similar context, Peschl and Fundneider’s [37] framework of enabling spaces and the framework of Benton et al. [3] for involving neurodiverse children in the technology design process. The concept allows us to prepare, conduct and reflect on the creative process at hand and to stay responsive to the individual needs of different participants within PD sessions. The German term “Handlungsspielraum” signifies a range of different meanings: the common translation “Scope of Action” suggests constraints while the literal translation of the three components of the compound word: Handlungs-Spiel-Raum – Action-Play-Space – hints at the notion of creatively making use of the given room for manoeuvre. In our interpretation, the concept of “HSR” supports designers in planning co-design sessions by framing the creative process through structures and freedoms, in conducting co-design work by exploring the individual pathways to unfold the creative potentials of participants within these frames and in reflecting on the process to inform the planning of subsequent co-design sessions.

In this paper we develop the concept of “HSR” and demonstrate how it guided us in designing the participatory work in the Outside-TheBox project. We begin by discussing related work in creativity

<sup>1</sup>We are fully aware about the complex discussions surrounding person-first vs. label-first language; we opt for the latter, due to it being the predominantly self-chosen form [31].

research, PD and creativity, PD with autistic children and the seemingly contradictory status of creativity in autism, then follow by introducing the concept of “HSR” in more detail, before turning to specific examples from OutsideTheBox, and conclude by reflecting on our experiences.

## 2. RELATED WORK

### 2.1 Creativity

The term creativity “originates” from the Latin word “creare”, which means “to make” or “to create”. It was first applied only in the field of arts and only to individuals considered geniuses. Contemporary psychological notions of creativity go back to Paul Guilford in 1950, who in his research linked creativity to divergent thinking of individual persons. Over the decades, the concepts of creativity have been researched from different perspectives, other than the psychological, and were broadened to an understanding of creativity as resulting from the synergy of different socio-material sources, moving away from the individual perspective as a sudden insight of the individual creative mind [33, 10]. All approaches of creativity research are explained best by considering four aspects: the person, including individual experience and creative behaviour, the creative outcome, the creative process and the creative situation or environment [43].

For researchers of cognitive science, creativity occurs inside people’s mind as part of a cognitive system. Boden [5] examines creativity as “an aspect of human intelligence [...] grounded in everyday abilities” and “the ability to come up with ideas or artefacts that are new, surprising and valuable”. She defines as “psychological creative”, outcomes that are new and valuable to the person, thus categorising something as new depends on an individual subjective point of view, as opposed to what she calls “historical creative”, outcomes that are new and valuable to the majority of people. This definition focuses on the novelty and value of the outcomes.

Boden’s concept of “psychological creativity” takes into consideration the individual creative interpretation similarly to the “C Model” of Kaufman and Beghetto [1]. However, as opposed to Boden, they highlight the creative experience and the process “within a particular socio-cultural context” [29]. To be able to consider everyone’s creative potentials, Kaufmann and Beghetto focus on the distinction between “Big-C”, “little-c” and “mini-c”; which they describe, “mini-c” as “personally meaningful interpretation of the creative experience”, “little-c” as everyday creativity and “Big-C” as “breakthrough creativity that changes a field”.

Several researchers of the creative process argue that creativity occurs as a reaction to different environmental and socio-cultural aspects. Hennessey and Amabile [25], for example, stressed the “intrinsically” and “extrinsically” factors of motivation for creative activity, as well as Csikszentmihalyi [10], who also defines his interrelational “systems model” of creativity to include three parts: domain, field and individual person. Csikszentmihalyi introduces and defines a “flow experience” of creativity in relation to the process and the individual experience as a feeling when “the abilities are well matched to opportunities for action”.

The notion of creativity as an everyday activity embedded in a social and cultural context, went on to be taken up by anthropological research on cultural creativity. Friedman [22] defines social and existential conditions, as well as explicit and implicit constraints, as a foundation for creativity, and explains the concept of creativity as a “social phenomenon” producing cultural worlds. Liep [33] identifies two modes of creativity: “conventional creativity” that occurs as “the small-scale or everyday production of solutions to current problems following habituated generative structures” and

“true” creativity where “meaningful forms are renewed or emerge through unconventional extension or application”.

The concept of “conventional creativity”, which involves continually making implicit decisions and improvising in the moment according to the constantly changing social and physical environment [27], could be connected to the approach of “little-c” and “mini-c” creativity, that refer to the situation in which creativity appears. Petruschat [38] argues that there is a strong connection between creativity and consciousness: following the theory of consciousness by Edelman and Tononi [16], he sees consciousness as a cognitive process of an individual in which a continuous stream of data, delivered by the central nervous system, is used to construct an inner model of the external context within which the self operates [12]. This awareness of a situated self, enables individuals to act beyond their instinctive and predefined behaviours, and this ability to set up an inner model for self awareness and for acting in a physical environment and its socio-cultural dimensions, he claims, should be considered as the fundamental action and framework for any kind of human creativity.

These diverse perspectives on creativity allow us to extract a meaning that serves as a lens on our work with autistic children. Relevant for our research on autistic creativity is the individual ability of the children to act and produce solutions in a socio-material context. The next sections discuss the notions of creativity in a collaborative setting of PD, in general and with autistic children.

### 2.2 PD and Creativity

Creativity in the context of PD refers to the capacity for creating meaningful alternative futures and constitutes a core resource in design practice. Although PD researchers and practitioners recognise the explicit need to provide appropriate methods and conditions to enable “participatory creativity” (e.g. [6, 34]), only little explanation, as emphasised by Warr and O’Neill [44], is provided of what is actually meant by this and what the creative process consists of. Fischer [17] describes “the social nature of creativity” and points out that in collaborative design practices, creativity occurs within a cultural context, particularly through interaction with others or with artefacts. Concerning the design process in PD as a collective and social practice, Warr and O’Neill [44] discuss the potentials and challenges in terms of social influences on the collective creativity that design teams have, such as generating and expressing ideas, evaluating apprehension and social loafing. In addition, Sanders et al. [40] highlight the general difficulty many people have “to believe they are creative” and to be able to contribute their ideas in the unfamiliar role as co-creators. They suggest different levels of creativity that take place in the daily lives of the participants.

The idea that “everyone is creative” can be directly connected to the theories of “C-Model”, “conventional creativity”, “improvisation” and “self awareness and acting” [1, 33, 27, 38] mentioned previously. These concepts of creativity fundamentally shape our perspective on creativity in participatory processes presented in this paper. We argue that this perspective allows PD practitioners and researchers to appreciate the creative ability in non-professional participants and shift the focus to the design of appropriate environments and conditions to fathom creative potentials. For our design practice with autistic children and on the basis of the theories presented above, we define creativity as a quality everyone possesses that gives rise to something novel within and contingent on the particular socio-material environment, including social interactions and the wider cultural context.

## 2.3 PD with Autistic Children

A diagnosis of Autism Spectrum Conditions (ASC) is given across a wide range of possible characteristics including unusual reciprocal socio-communicative interaction and repetitive interests or behaviours, which are expressed differently between autistic individuals. Worldwide prevalence is estimated at about 1% [8]. It is widely recognised that the design of technologies for autistic children fundamentally benefits from their inclusion in the design process and a range of methods to do so have emerged in recent years (cf. [2] for a review on involving children with special needs in design). As Millen et al. [35] point out, tasks have to be presented in a structured, focused and constrained way. For them, this means preparing PD sessions well, but also being flexible when unplanned events occur.

Frauenberger et al. [20] conducted PD sessions with typically developing and autistic children. They structured their sessions along experiences with sensory objects and storytelling. They also point out how important it is to leave design processes open ended, to not suggest that outcomes have to be correct. In related work, Frauenberger et al. [19] also highlight the specific challenges for involving autistic children in the design process, which include managing narrow interests, perfectionism or social anxiety. In a more general approach, Benton et al. [3] address a whole range of neurodiverse children with their concept and put a focus on considering the children's strengths. They identify four steps for facilitating PD workshops in such a fashion: understanding the culture of the child, tailoring sessions to individual strengths and needs, structuring the environment appropriately and providing support when needed. Another angle is provided by Malinverni et al. [34], who consider the benefits of PD processes for the children. They make clear that the activities have to be meaningful to the children and create a feeling of competency for them. This does not only entail that researchers have to be aware of a child's current mood and feeling in a session and adapt to that, but also continuously reflect on how the session was meaningful for the child.

## 2.4 Creative Potentials in Autistic Children

Earlier studies refer to a connection between executive dysfunction and imagination deficit in autism (e.g., [36, 39]). Ozonoff et al., e.g., describe the executive function "as the ability to maintain an appropriate problem-solving set for attainment of a future goal" [36]. Limitations in skills associated with executive function, such as planning, organised searching, flexibility in thinking and acting, are therefore limiting creative behaviours in autistic people. Consistent with the cognitive theory of executive dysfunction in autism, Baron-Cohen and Craig tested and assessed creative thinking of autistic children and illustrated that children with autism and Asperger syndrome tend to perform less creative on given tasks [9].

However, all of these studies and recent research (e.g., [4, 13]) show that autistic children do have the ability for creative thinking. Many people with ASCs are visual and pattern thinkers, typically with great attention to detail. Often they show extraordinary skills, remarkable abilities and a passion for particular subject areas [23]. According to our conception of creativity as an innate quality of everyone, autistic creativity is individual and subjective, as all children have talents and creative potentials in unique ways, but particularly for children on the autistic spectrum it is difficult to unfold their potential of creativity in environments shaped by and for non-autistic adults and children. Well-intentioned efforts to integrate autistic children into non-autistic living conditions by designing rules and structures often miss the needs for self-determination, autistic expression and support for individual abilities. Focusing on the special needs of autistic children highlights the limits and

deficits of the disability and does little to create environments in which alternative ways of being creative are positively scaffolded (cf. [18]). Creativity as we defined it, arises within a social-material context rooted in the individual experience of the socio-physical environment. We therefore have to create safe and customised conditions that encourage, enable and motivate an autistic child towards unfolding their creative potentials.

## 3. THE CONCEPT OF "HANDLUNGSSPIELRAUM"

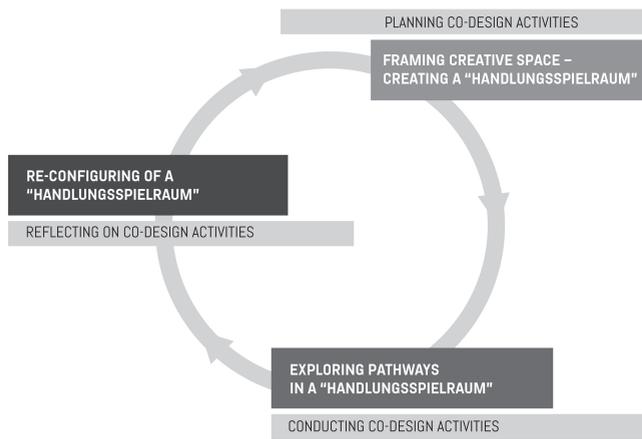
We developed the concept of "Handlungsspielraum" (HSR) to refer to the conceptual space in which creative co-design activities take place, and were inspired by Peschel and Fundneider's concept of enabling spaces as a framework of factors to support innovation activities [37]. Our approach enables PD practitioners and researchers to systematically prepare, conduct and reflect on collaborative creative processes. It emphasises the relevance of tailored conditions that enable the flexible exploration of creative potentials of participants, in order to make meaningful contributions within the PD process. The German term "Handlungsspielraum" fits our intentions, both in the sense of its common translation "Scope-of-Action" as well as in the verbatim translation of "Handlungs-Spiel-Raum" in "Action-Play-Space".

We suggest structure and creative freedom as the two core components of "HSR" and recognise, along with Malinverni et al. [34], "the balance between creative freedom and structure" as a vital instrument to facilitate creative processes and to create favourable conditions for gradual testing of boundaries and unfolding of creative potentials of participants [21]. The space for creative action and exploration within the creative process emerges from the tension between creative freedom and structure, as the creative freedom offers possibilities for creative action and the structures focus the direction of the explorations. Johnson-Laird defines "freedom and constraint in creativity" as "individual's freedom of choice" and this "choice is made from among options that are specified by criteria" [28], but instead of rigid constraints, we intentionally describe such criteria with the term "structure" to allow more flexibility within. "HSR" frames the dynamic balance between structure and creative freedom, aiming to find the appropriate balance for each participant, thus enabling them to experience their own creativity. It allows for a systematic adjustment of configurations to facilitate a creative process.

We see the concept of "HSR" not only as a theoretical lens but also as a practical tool that supports designers in three ways:

1. In **planning** co-design activities: we frame a creative space – a HSR – by configuring structures and freedoms that are tailored to our participants.
2. In **conducting** activities: we explore individual pathways through the HSR to fathom creative potentials. The concept supports the continuous balancing act between structure and freedom and allows a participant to stay in the flow.
3. In **reflecting** on activities after the fact: we analyse the pathway taken in the session and consider the features of the HSR and how they facilitated choices. This directly informs the planning process for subsequent sessions.

Figure 1 illustrates the iterative process of configuring the participation. In the following sections we provide further detail on the three iterative stages in which we use our concept.



**Figure 1: Iterative Re-Configuration of Participatory Work through the Concept of “Handlungsspielraum”(HSR)**

### 3.1 Framing Creative Space – Creating a HSR

The individual capacities and abilities of participants serve as the basis for developing possible structures and aspects of creative freedom which frame the creative space – the HSR – for a co-design activity. Focusing on neurodiverse children, Benton et al. emphasise the significance of carefully considering their cultures, interests, talents and strengths [3]. We agree and argue that these individual requirements are fundamental for meaningful participation in any group of participants and should be taken into account during the preparation of each PD session.

To systematically develop and prepare different kinds of structures to create the HSR, we propose three categories: social structures, physical structures, and mental - methodological structures. Social structures include the roles and relations of all involved human actors. These structures can also be partly hidden, such as implicit power-structures (cf. [7]). Physical structures define the environmental and material frames of the session, including features of the physical spaces in which the collaboration takes place or the kinds of materials that are available to the participants. Mental structures include the interests, thought patterns or habits of participants, and while being internal, with less scope for actively designing them, can be embedded into activities to different degrees, thus providing more or less structure for the participants. Methodological structures include the actual PD methods or the design intent. Scope for creative freedom is systematically created in one of two ways: On the one hand, it emerges from the conscious decision to omit or limit different kinds of structures, for example, reducing the specificity of the task opens the creative freedom to explore the design space more freely or reducing affordances of materials create opportunities for divergent thinking. On the other hand, and conversely, introducing structures as opportunity spaces can unlock creative freedoms, for example, through technology immersion techniques [15], narrative frames [14] or simply by diversifying materials. Other creative freedoms are created through attitudes: this includes, for example, positive enforcement of explorative behaviours or a non-judgemental atmosphere.

Depending on the domain and the context, structures and creative freedoms can take on various forms. However, the underlying intention can be clearly articulated: structures aim to provide safe spaces in which participants feel comfortable, relaxed and stimulated. Spaces for creative freedom open possibilities for participants to contribute their own ideas. It is the subtle interplay and

balance between those two that, we argue, leads to meaningful participation.

### 3.2 Exploring Pathways in a HSR

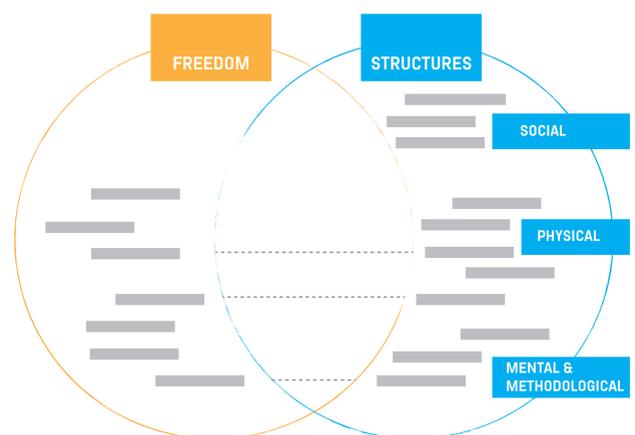
After having created a possible HSR for a co-design activity by designing structures and freedoms, we interpret conducting the activity as exploring pathways through this creative space. Facilitating this exploration means staying attentive to the situation and being flexible about balancing structures and freedoms as needed. This process of fathoming creative potentials is likely marked with cycles of trial and error. Starting from well known structures, a gradually scope for creative freedom is introduced until its potential declines or becomes an obstacle. This is not always a continuum, in that structures and freedoms can be scaled at will, but also an exploration of the appropriate kinds of structures and freedoms to scaffold the creative process. The concept here bears similarities to the concept of *flow* by Csikszentmihalyi [11]. Seeking the balance between structure and freedom with the aim of finding sweet spots for creative contributions could be interpreted as a variation of balancing skills and challenges to experience flow.

A consequence of viewing co-design activities as exploring pathways through a HSR, is that facilitators are required to stay agile in the process. This relates to Schön’s concept of reflection in action [41] as it draws attention to the fact that practitioners deal with uncertainties, instabilities and uniqueness by drawing on their tacit knowledge, accumulated through reflecting in action. A HSR provides them a conceptual frame that supports this kind of reflective work.

### 3.3 Reflection and Re-Configuration

In closing the iteration cycle, the concept of the “HSR” enables designers and researchers to systematically reflect on their experiences with the goal to inform the re-configuration of the participation for future sessions. Reviewing the pathways taken and identifying enablers and obstacles to creative expressions in the process, provides the basis for evolving or replacing the structures and creative freedoms. For example, if the participants had difficulties to participate in a specific task, what kind of structures and freedom were particularly hindering, or, if the participants were in the creative flow, what kind of structures and freedom were particularly enabling. The evaluated insights can be used to create a new HSR for the next session.

### 3.4 Format of the Concept



**Figure 2: Blueprint for the Conception of the HSR**

The blueprint in Figure 2 is presented as a visual aid for designers to start creating unique HSR appropriate to the particular context and participants group. When applying the concept of “HSR” for the first time, it can be helpful to list the possible structures and aspects of freedom to develop a repertoire of facilitating strategies and to reflect afterwards on how they shaped the creative process. In our experiences, the visualisation is particularly helpful in earlier stages of the collaboration, but it also reflects a way-of-thinking that does not always need to be externalised, i.e., it becomes a lightweight, practical tool-to-think-with that allows designers to stay agile and responsive during their work. We also want to emphasise that designers will need to develop their own strategy and appropriate formats for balancing between structure and freedom, depending on their own particular socio-material environment.

## 4. CASE STUDIES

In this section we present four case studies, prefaced with a short description of OutsideTheBox to put them into their research context. Throughout the descriptions, we have *set in italic the elements of the HSR (structures and aspects of freedom) as well as the decisions during the process and the insights during the reflection.*

### 4.1 OutsideTheBox

OutsideTheBox explores new roles of technologies in the lives of autistic children and promotes a paradigm shift away from a narrow focus on limitations and deficits towards a holistic and participatory perspective. Autistic children are individually involved in a one-year design process with the goal to design their own technological objects, that affords positive experience and supports them in sharing those experiences with their social environment. Our research aims to demonstrate, how focusing on child-led innovation of assistive technologies by considering the experiences, preferences and individual interests of the child, can result in valuable and unique contributions. In order to provide appropriate PD methods for each child, we re-interpreted different design co-working methods to the individual contexts.

During the first year of OutsideTheBox we worked with four children: Bruno, Thomas, Holger and Lucas<sup>2</sup>, and developed with and for each of them their very own personal smart object, based on the individual interests and desires of each child. They were aged between 6 and 8 years and attended integrative main schools in Austria, where we met with each of them every other week during the school year for a total of 10 to 14 sessions per child. Their individual diagnosis varied as much as their strengths and abilities, as we discuss in their individual case studies below.

When we met with the children, two researchers were always present. One of them took the role of a Play Partner while the other one acted as an Active Observer. The Play Partner took on the role of a design partner who fulfilled undesired tasks, such as writing, that the Active Observer gave the design team consisting of child and Play Partner. The Active Observer was responsible for giving feedback, handing out tasks, structuring the sessions and documenting them. Next to these social structures, we also designed spatial structures for different activities (publication forthcoming). Over the span of the sessions, we identified five overall design activities: ideation, conceptualisation, prototyping, testing and evaluation. We consider these phases to be overlapping, iterative and flexible. The following case studies present examples from these different activities and for different children, to demonstrate how our concept can be applied throughout the design process. For

<sup>2</sup>Pseudonyms were used for this publication in order to ensure the privacy of each child.

each case study, we present how we first conceptualised the HSR for one particular session, second how we conducted the session and finally how we reflected on it to inform subsequent work. A more detailed description of our project and our four design processes with the children during the first project year, including the finished prototypes, is provided in [21])

In the following sections we demonstrate how the concept of “HSR” has guided us through the participatory work in the OutsideTheBox project. We are presenting figures exemplifying one of our case studies to illustrate our co-design activities.

### 4.2 Ideation-Session with Bruno

Bruno has been diagnosed with High Functioning Autism. During our collaboration he was 6 years old and attending the first grade. We met Bruno at school in a small nurse room furnished initially with one table and three big chairs. When we got to know him on our first meeting, we identified a great interest in letters. Despite his young age he was already very good at reading and writing. The following case study describes the second session of contextual exploration with Bruno, during the initial ideation design activity. The goal of the planned session was to set up the documentation folder of the project and to design its personal front page.

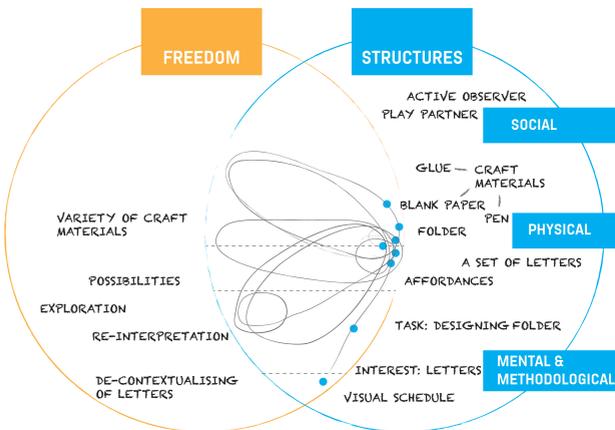
**Framing the creative space:** As a first methodological structure we created a *visual schedule* in form of numbered tasks in order to support Bruno’s need for predictability. To create scope for creative freedom we opted for a *variety of craft materials*, such as glue and paper, that offered an open ended range of affordances and possibilities. As a mental structure we prepared a *set of letters* made of paper, with the intention to connect the activity to his *special interest*. We also planned to experiment with *de-contextualising the letters* from writing and to observe how Bruno could re-interpret them in other possible ways, e.g. as graphic patterns. This opened another potential creative space to explore in the session.

**Exploring pathways:** First, Bruno read the schedule with the numbered tasks and tallied them when he was ready to go to the next. For the task of designing the folder, *the Active Observer offered all materials* by putting them on the table. The letters were more interesting than all other materials, including the folder, and Bruno quickly compounded different letters into words. To put this letter play aside and return to the purposed task of designing the front page of the folder, *the Play Partner suggested to glue* one of the composed words on it. Bruno then took the glue and delegated the task to his Play Partner. As the first word was on the folder, he picked the coloured pen and replicated the word with his handwriting. He then asked his Play Partner to draw the object that the word referred to. In order to involve Bruno in the drawing activity, *the Play Partner drew only the outline and asked Bruno to colour it*. This procedure was repeated until the front page of the folder was full of words and drawings. After the design was finished, *the Active Observer proposed Bruno to draw his favourite toy on a blank sheet of paper*, offering Bruno a lot of creative space, but instead, he started to write down the names of his classmates and stopped only after all of them were written down. As the session ended, Bruno started to feel uncomfortable sitting on a chair that was too big for him. He changed his position frequently and was working with us while standing most of the time.

**Reflection:** After the session, we reviewed our observations concerning our interaction with Bruno as well as the conditions of the session. First, we discerned that the physical environment of the room provided *little opportunities for flexible movement, play and creative action* for any of us. To improve this we agreed on *the necessity to rearrange the physical space* of the room by moving the

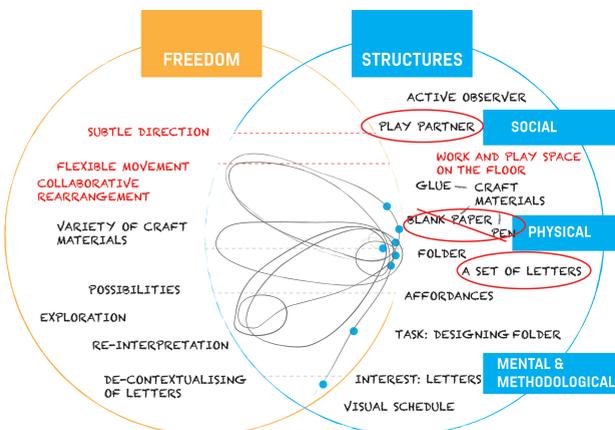
table to the side and creating a work and play space on the floor. *The collaborative redesign of the space* in the next session should also increase Bruno's acceptance of the physical environment and his overall well-being in the room. Second, we recognised *the importance of the role of the Play Partner* as a social structure. Letting the Play Partner *direct activities subtly*, opens creative spaces for Bruno as it reduces the feeling of task-obedience when instructions were given by the Active Observer. Lastly, while the mental structure of letters has proven powerful, it also restricted his creative input. The role of *paper, pen and letters had to be limited* in the activity to not let him fall into rigid behaviour patterns with little possibilities to divert his attention toward exploring new things.

Figure 3 shows the planning stage of the concept of "HSR" and the conducting activities, illustrating a pathway through the HSR with Bruno.



**Figure 3: Example of the Planning of Structures and Aspects of Freedom, and Concluding Exploration of a Pathway through the HSR in the Ideation Session with Bruno**

Figure 4 illustrates the reflecting stage of the concept of "HSR" presenting our considerations for the subsequent session with Bruno.



**Figure 4: Example of the Reflection on Co-Design Activities with Bruno**

### 4.3 Conceptualisation-Session with Thomas

Thomas has been diagnosed with a Pervasive Developmental Disorder and was attending the third grade during our collaboration. He was additionally supported individually through a special education teacher. We got to know Thomas, then at the age of 9, as a friendly but very shy child, who loved playing computer games and drawing. Due to limited functional language, Thomas used his drawing skills as an instrument for communicating with his environment. We worked with Thomas in a play room attached to his classroom. Initially, his special education teacher was present to reduce the anxiety for this unknown social setting. In this case study we present the first session of the conceptualisation activity with Thomas. Based on how relevant drawing is for him, we wanted to observe in detail his interaction with his own drawings in different contexts.

**Framing the creative space:** First, we prepared already known physical structures, like *pens and paper*, which always motivated Thomas to interact with us through his drawings. With the purpose to open the space for novel explorations, we took one of *his original drawings* of a cat and reproduced it in *different sizes*. Even though *the defined character of the cat*, as physical and mental structure, might implicitly frame the activity, the variety of sizes was deemed to provide more creative space and inspire him to use the character in different ways, e.g. for a puppet show. In addition, to give Thomas the space to freely explore his drawings, we decided to facilitate the session *without a concrete task*. As social structures, *the Active Observer* was prepared to give Thomas *continuous positive feedback* and *the Play Partner* intended to *constantly support him and to try out new things first* in order to enable him.

**Exploring pathways:** At the beginning of the session, Thomas refused to work with us and sought shelter under a couple of blankets on the couch. *The Play Partner encouraged Thomas by impromptu also taking cover under another blanket* as well as further covering him up with it. *The Active Observer showed Thomas and his Play Partner his sketches from the last session and invited them to explore these*. As Thomas recognised his own drawing of the cat, he was curious and started interacting with us. He kept his blanket around him as an element that increased his feeling of safety in this new situation. *The Play Partner also kept the blanket around them*, giving him a feeling of acceptance. *The Active Observer continued revealing copies of the drawing in different sizes*. First, Thomas explored all the drawings and verbally gave them different roles; for instance, the smallest one was identified as "a baby-cat" whereas the largest one became "a grandpa-cat". He then arranged the cats according to their size and explained this to his Play Partner. While apparently having fun with the replicated drawings, he removed his blanket cover soon after. Later on, to provide more structure for the explorations, *the Active Observer gave Thomas a pen* and suggested to sign the drawings with their new roles, but he instead drew on them new added elements like wings, magic wands or crowns and described new roles for the characters: "the butterfly cat", "the magic cat" and "the princess cat", for example. As he finished, Thomas expressed his wish to present his new drawings to his teacher.

**Reflection:** Reflecting on the session, we noted that to begin, Thomas required a known physical structure, *the blanket*, to feel safe, but simultaneously exciting physical structures, *his drawing of the cat in different sizes*, to engage him, motivate him and to get his curiosity peaked to start interacting with us. *Pens and blank paper* were also important physical structures. Concerning the social structures, the Active Observer gave Thomas *constant positive feedback and praise* and the Play Partner took on a *strict non-judgemental role* and created a playful atmosphere *imitating his*

actions, both of which reduced his stress and enabled him to act freely. At last, we recognised *his own tacit rules* as mental-structure that guided him through the non-directed exploration of his drawings, and realised that in order to be able to close the session successfully and satisfyingly for Thomas, as methodological structure, a *space for sharing* his achievements has to be implemented.

#### 4.4 Prototyping-Session with Holger

Holger has been diagnosed with High-Functioning Autism. He was 6 years old and in his first year at school during our collaboration. Right from the very beginning we have come to appreciate his great verbal communication and reflection skills. He identified himself as our research colleague, showed great interest in research and discovery and was very excited to develop his own novel smart object. Taking into consideration our previous experiences with Bruno, we redesigned the room where we met, together with Holger, into a consistent physical environment: a “research lab”. Holger developed during the ideation and conceptualisation activities the idea of a thinking and remembering machine. However, his first concept result was a one-on-one copy of the Gyro Gearloose<sup>3</sup> thinking cap. The following case study shows our first prototyping session with Holger. The main goal of the purposed session was to encourage Holger to create his own thinking cap and to explore the possible forms, sizes and elements of the machine.

**Framing the creative space:** We prepared two type of physical structures: first, *diverse craft materials that were open for multiple interpretation*, like different types of cardboard, paper, scissors, glue, threads and rods, and second, *various materials that would suggest some applications and afford specific actions*, in case he would be needing more structural support. As a methodological structure, we decided to use *the representation of his first prototype in form of a photograph* to serve as a basis for the generation of ideas, but we also elaborated specific *critical questions* to challenge the existing idea of the thinking cap to open the creative space for new design ideas. Finally, as another methodological structure, we created a *visual schedule* to provide an overview of the session and to keep focus of the main purposed goal.

**Exploring pathways:** We started the session as usual with a *short view on the schedule and reflecting on the last session*, opening a space for an exchange of ideas. The photograph of his last prototype initiated a discussion between Holger and his Play Partner. *The Active Observer gave the task to brainstorm and write down novel ideas* for the thinking and remembering machine, based on the collaborative insights regarding advantages and disadvantages of the previous prototype. Because of his self proclaimed “imperfection in writing and drawing”, he delegated the writing task to his Play Partner. While in the flow of ideas exchange, the *Play Partner asked Holger how to draw or to write some of the ideas in a better way*, effectively encouraging him to take the pen himself and to assist. In the next step, *the Active Observer suggested materials* and Holger chose the appropriate ones according to the criteria of the discussed prototype ideas. Interestingly, he straightaway rejected all materials that were concretely defined and had a concretely defined application. Holger also managed the chronological order of the prototyping activities and delegated more difficult tasks to his Play Partner. From time to time during the whole process, he turned away from the topic to explain scientific stories not related to the work to both the Play Partner and the Active Observer, but *the visual schedule and above all the prototyping of a concrete object helped to return the direction back to the topic*. While constructed from different materials, the prototype of this session was still very much fuelled by the initial inspiration

<sup>3</sup>a Walt Disney fictional character of an inventor duck

of Gyro Gearloose’s thinking cap. However, the functionality was expanded towards remembering situations as well.

**Reflection:** As a social structure, we discerned as fundamentally important *the function of the Play Partner in supporting Holger* by taking on the writing task and giving him therefore the space to focus completely on the development of ideas and not be diverted by his hang-up about writing. Furthermore, by working as a design team *the Play Partner creatively affected Holger with her contributions*, offering him a space for his own ideas and encouraging him to try more difficult tasks. *The ideas defined together and particularly their visualisation* created an implicit mental structure that framed the selection of the materials for the prototyping activities. Despite the discussed ideas and the different elements, the new prototype embodied the same form as the first copy of the Gyro Gearloose thinking cap, but incorporated additional functionality realised by an attached second object. For the next session, in order to open more space for Holger’s own creative ideas, we decided to prepare a *number of concrete questions and scenarios* as mental-methodological structures that challenge the design of the cap by putting it in different situations and environments, like in school or outdoors.

#### 4.5 Evaluation-Session with Lucas

Lucas has been diagnosed with autism and has been receiving Applied Behavioural Analysis Therapy since very young age. He was 8 years old during our collaboration and attending the third grade. At the beginning he interacted with us in a very shy and reserved way, but the more we gave him the feeling that we appreciate his ideas, the more he felt comfortable with his contributions. A strong relationship developed between Lucas and his Play Partner over the course of the sessions, providing him a secure and trustful space to play and work, as well as encouraging him to try out new activities like role playing or using finger paint. Because of his interests in movies and stories, we developed an object together with Lucas, L-Smart, that allows him to view and share trailers of upcoming movies and sequences of pictures to scaffold his storytelling. The following case study presents one of the last testing and evaluation sessions after Lucas had used his object and interacted with it during the summer holidays.

**Framing the creative space:** In previous sessions we had established that Lucas had *difficulties to express his opinion* directly. We therefore opted for a different approach and planned the evaluation session along *drama-based techniques* [32] as a methodological structure. We conceptualised the session within the narrative frame of Lucas’ current *favourite movie*<sup>4</sup>. By doing so we tried to reference mental structures to support the exploration of different emotions that might play a role in the interaction with his *smart object*. We intended to follow principles of “Chairwork Gestalt-Therapy” by Frederick ‘Fritz’ Perls [30] by placing five chairs in the middle of the room and sticking a picture of each emotion from the movie as well as a piece of cloth in the correlating colour. *The chairs, pictures and pieces of cloth* were prepared to provide physical structures for the evaluation. Lucas was supposed to literally put himself in place of an emotion using his smart object – through the chairs and the props he could do so spatially as well as mentally. Methodologically, we planned to ease him into this new and unknown activity by a *range of low-key warm up exercises that gradually increased in complexity*. Three realistic and *well-known situations were conceptualised* in which he would recreate his experiences with his smart object. Lucas would choose the situation and the emotion he associates himself with in that situation. *The Play Partner* as a social structure would also play a part in these

<sup>4</sup>*Inside Out*, Pixar, 2015

scenarios, showing Lucas that the activity was safe and enjoyable and encouraging him if he hesitated.

**Exploring pathways:** While Lucas was happy to see both researchers after a long break, during this session he seemed especially close to his Play Partner. They enjoyed performing the activities *the Active Observer assigned to them as a team* and ensured each others comfort during the session. The Active Observer also opened up free space to explore options by *constantly providing positive feedback*. Upon seeing the chairs, each with a character picture and a cloth attached to them, he curiously investigated the physical structures we provided and immediately used them as we had methodologically planned. This meant, we did not require warm up exercises and could rather provide more open space for *casual play between Lucas and his Play Partner*. When Lucas was *instructed to start the situational role play*, he was mildly confused at first, but picked up his task quickly after *the Play Partner started playing in the assigned role*. Lucas then had the freedom to carefully choose an emotion for each of the situations and through that choice and how he played it, he gave us feedback about his opinion of his smart object.

**Reflection:** *The Play Partner and the Active Observer provided the intended freedom* for Lucas to feel comfortable and relaxed. These structures were also well established, due to the evaluation being at the end of our collaboration. Our initial concerns of Lucas being potentially overwhelmed by drama techniques were unfounded. He increased the complexity of his acting *requiring only little guidance*. Tying the activity back into his *core interests* was a great motivation for Lucas. He happily explored the creative possibilities each emotion role offered him, based on what he knew about the movie. Especially by *drawing from the scenes* in the closing credits, where he learnt that core emotions are different in everyone, he was able to abstract them from the given characters in the movie and adapt them to the situations we provided. *The smart object* physically tied back to the overarching project and gave Lucas an anchor to orient himself on during the role playing activity.

## 5. DISCUSSION

The case studies above present examples of how a HSR can be created by framing structures and freedoms, how different these structures and freedoms can be, how the concept facilitates the exploration of individual pathways and reflection to inform subsequent work. Each creative process with each child was framed by the appropriate social, physical and methodological and mental structures to enable and motivate the child to interact, play and explore. Above all, the social structures we provided through consciously designing our own roles as Play Partner and Active Observer contributed to facilitating a creative process. The Play Partner opened secure and inspiring spaces that enabled the child to interact in a relaxed atmosphere and guided the child implicitly within the playful action, while on the other hand, the Active Observer provided more explicit and formal structure. As Thomas unpredictably refused to interact with us, the Play Partner took his side and joined his action, providing support and the feeling of not being on his own. While Lucas, when he was confused by a new drama exercise, the Play Partner created an inspiring playful atmosphere encouraging him to open up and to step forward into the unknown task without the fear of failure. In comparison, the Active Observer acted in a more explicit way, flexibly providing appropriate materials for Thomas and clarifying the rules for Lucas by suggesting possible ways of action in the unknown field. As discussed above, autistic children find it particularly difficult to be creative in physical environments that are shaped by and for non-autistic adults or children. We regard the physical structure of the

environment therefore as a significant frame that should be carefully created at the beginning of each collaboration. In our cases, the well-known environment at school reduced the children's anxieties, but at the same time they were often not geared towards creative work. In the case of Bruno, the initial room arrangement was impeding the possibility to freely move around and to play. Inside the (meta-)structure of the well-known environment we tried to break up existing structures like seating arrangements and work-places and created new ones, actively involving Bruno in the redesign of the environment. We also rearranged the environment with Holger and labelled it as a research lab, which opened a creative space where he felt like a scientist.

Alongside environmental structures, different materials offer physical structures, providing opportunities to explore and experiment, sometimes beyond the affordances first associated with them. For example, a pen triggered in Thomas the drawing activity and in combination with the replicated character of one of his previous drawings in different sizes, he added novel and original elements to each character. By combining a well-known activity with well-known, but slightly modified elements, he felt free to appropriate them in original ways. At other moments on the pathway through a HSR, it is the diversity of materials that unlock the creative potential. During prototyping, Holger selected explicitly open ended materials over others that suggested some sort of specific use, to be able to experiment with forms that would best embody his idea.

The special interests and strengths of the children, letters and writing for Bruno, drawing for Thomas, research and inventions for Holger and movies and stories for Lucas, were not only of importance for the development of ideas, but provided safe and motivating starting points for explorations, as individual pathways through HSR. They also serve as "tacit mental criteria" [28] in the sense that they subconsciously shape the choices made in creative spaces. Each individual pathway was molded through a continuous balance between freedom and structure. We gradually tested the boundaries of the creative potential by increasing or reducing the complexity of tasks or by adding well-known or new elements.

During our PD sessions, we gave the children a HSR to explore their own creative potentials, and based on our understanding of creativity, we have come to appreciate different and very personal moments of creativity in each child, similar to the ideas of "mini-C" creativity, "conventional creativity" and the "self awareness and acting" theory [1, 33, 38]. Composing words, redesigning drawings, choosing materials for prototyping, play-acting and particularly the ability to act and react, should be seen as creative actions. With an appropriate individual balance between structure and creative freedom and based on their individual strengths and interests, all children developed their own novel ideas for the technological objects, as unique contributions to the design of new technologies for autistic children, that non-autistic adults would not have been able to make in this form. As such, our approach has had a significant impact on the outcomes (for a detailed discussion see [21, 42]).

We recognise as a possible limitation of the concept of "HSR", that the creative moments and creative ideas of the participants need to be interpreted in order to become meaningful for the researchers who are developing a technology. This is even more pronounced for autistic children who might use non-verbal modes of communication.

The concept of "HSR" extends the scope of the "empowerment dimension" [34] of PD activities. This is the case not only in terms of the possibility for the participants to learn design-thinking skills and meaningfully contribute as co-designers, but also as a framework in which they can discover and experience their creativity.

We argue that the conscious framing of the two core concept components – structure and freedom – is crucial for the planning and customising of methods and conditions to create an individual creative space for each participant during the co-design activities.

In our current work we re-interpret digital fabrication and a makers approach [26] as co-design methods in which the concept of “HSR” offers us valuable guidance. We see that digital fabrication offers a wide spectrum of structures, as well as a variety of opportunities for action, but requires different conditions and collaboration methods, unlike the analog handicraft materials used in the case studies above.

## 6. CONCLUSION

In this paper we have introduced “Handlungsspielraum”(HSR), a concept that supports the planning and conducting of PD sessions, by framing the creative process through structures and freedoms, then balancing the structures and freedoms within these frames to discover individual pathways for each participant to unfold their creative potentials and culminating with a reflection on the whole process to complement the planning of the subsequent session with the gained insights. Being aware of the significance of creativity in context with PD, we were inspired and motivated by our work with autistic children in the OutsideTheBox project and by the common contradictory misconception between autism and creativity.

We have exemplified the concept and its application through four case studies of our PD practises, and to illustrate the broad spectrum of the individual requirements for structures and freedom of the participants, as well as to demonstrate the flexibility of “HSR” by means of this broad spectrum, each study represents one session with a different child at a different design stage.

We consciously conceived “HSR” as an open concept, because we are aware of how multifaceted different PD processes in all their aspects can be, e.g. their goals, their participants and their methods. The concept is a flexible and adaptable companion for designers. Creating, exploring and reflecting on HSR offers them a unique perspective into the creative processes driving the design process.

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