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AUTISM SPECTRUM EXPERIENCE CARDS (ASEC):

A CO-DESIGN TOOL TO REPRESENT A NEURODIVERSE USER SEGMENT

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OPSUMMERING

Dette master's projekt indenfor interaktionsdesign, omhandler at skabe et værktøj som i fremtiden kan bruges af professionelle indenfor IT-design industrien til at der i fremtiden kan skabes flere inklusive design løsninger som brugere med en Autisme Spektrum forstyrrelse kan føle sig repræsenteret af. ASD er normaltvist kendt som neurologisk udviklingsforstyrrelse, som i de seneste år har set en kæmpe stigning i antallet af diagnosticeret, hvilket giver anledning til et større behov for at teknologier og tjenester bliver mere inklusive. I denne udvikling har forskningsfeltet indenfor Human-computer interaktion (HCI) på det seneste vist deres interesse i at arbejde med særlig 'sårbare' brugere, hvori at mere forskning bliver udført. Dog blev det igennem dette projekt observeret at det meste fokus indenfor ASD-relateret research blev rettet mod at skabe digitale løsninger til børn, hvilket udlader voksne med ASD som mistænkes for at omfatte en markant større gruppe af mennesker. Derudover blev der set manglende dokumentation på værktøjer og metoder udvalgt af forskere og aktører fra HCI, til når der blev udført aktiviteter med ASD-deltagere, hvortil der bliver sat spørgsmål til deres evner og kompetencer til at facilitere disse aktiviteter til den grad at deltagerne kan relatere til udkommet af processen.

Under disse præmisser blev der i dette projekt skabt et Co-design værktøj, kaldet Autism Spectrum Experience Cards (ASEC) som benyttes i de tidlige design faser af et produkt under udvikling, hvor det kan bruges i aktiviteter for, til og med ASD brugere, for at sikre sig at de kan føle sig repræsenteret af udkommet for produktet. For at sikre sig at ASEC levere på sit formål er det blevet testet gennem et interview med en studiestøttegiver som til dagligt arbejder med diverse neurodiverse individer, for at sikre sit formål og sin brugskontekst, samt en række

evaluerings sessioner med repræsentanter for ASD for at få direkte feedback på kortenes indhold og om de kan relatere til deres hverdag. Mod slutningen af projektet blev det konkluderet, at udover at kortene kunne repræsentere brugere med ASD, at de også tillod en større egenskab til at reflektere og italesætte ens egen diagnose for bedre at kunne udtrykke ens behov og følelser. Dertil blev der fundet ud af, at ASEC kunne formentlig ligge fundament til en lang række design alternativer for design metoder kort, hvor at man kunne lave dem til grupper med andre typer af handicap.

Autism Spectrum Experience Cards (ASEC): A co-design tool to represent a neurodiverse user segment

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Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that, in recent years, has seen increased growth in the number of individuals to be diagnosed. The result of this development has caught the interest of the HCI community, from which a foundation for future research has been established. To this, most research efforts are well-regarded to design and develop inclusive solutions, which contributes to spreading awareness about ASD to change the public perception of the disorder. However, within these ASD-related studies, it is observed that the capability of HCI researchers and practitioners to facilitate collaborative activities with ASD participants is often questionable regarding developing solutions that the user segment can relate to. To resolve this uncertainty, this article presents a co-design tool in the form of design method cards called Autism Spectrum Experience Cards(ASEC), which can be used for, with and to ASD users that can be used in the early design phases of a design solution. Throughout the tool's development, an interview and a series of evaluation sessions were held with relevant stakeholders to ensure the understanding of ASEC and be representative of ASD users. By the end of the article, the findings showed that ASD representatives were able to relate to the card's contents and prompted their ability to self-reflect in association with their answers. Finally, the article concludes in regards to its contribution, in that there might be an opportunity to develop other design method cards with other user segments in mind.

Additional Key Words and Phrases: autism spectrum disorder, ASD, co-design, user collaboration, design method cards, inclusive design, neurodiversity

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1 INTRODUCTION

Autism Spectrum Disorder(ASD) is a diagnosis described as a neurodevelopmental disorder, where people of the spectrum experience symptoms that can affect their sensory, perceptual and cognitive senses on different levels. Besides autism, other disorders, such as Asperger's syndrome and ADHD, can share similar symptoms and are hence referred to as a spectrum disorder. Further, these types of people may encounter challenges in actively engaging in social activities with others, as they possess a distinctive perception of different situations than a neurotypical person would, in which they can have issues in communicating and expressing themselves. Furthermore, ASD people can have trouble with sudden and spontaneous situations where they actively seek structure from familiar and repetitive patterns to find comfort in [3]. However, while ASD people deal with the kinds of challenges in their life, it does not mean that they are incapable of overcoming them and can still have the ability to form deep and meaningful relationships with others, which

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is where the terms of High-functioning autism (HFA) and Low-functioning autism (LFA) can influence circumstances for the individual. Many people on the spectrum, however, show intelligent and creative behaviour and the ability to deeply immerse themselves in interests that some find odd or trivial, which in turn can become too obsessive but, for the most part, can be considered a strength [15]. Public attitudes toward ASD have in the past marginalized ASD for its difference, where attempts were made in trying to "fix" the demographic's diversity by conforming to the neurotypical perception of the world. However, fortunately, the paradigm of this perception has in recent years adopted a more accepting behaviour of the disorder, yet met with varied results in terms of only knowing what being an ASD person means on a general surface level or having made an effort to understand of what it means for the individual ASD person [4]. Finally, regarding the number of people diagnosed with ASD on an international basis, it is estimated by the Center for Disease Control and Prevention that about 1 % of the world's population has ASD, which is equivalent to affecting about 75000000 people. When accounting for the distribution of the disorder in terms of genders, research suggests that males are four times more likely to be diagnosed at an early age when comparing to females; however recent studies have created a resurgence on this matter and have enabled to early identification of the disorder for both genders [5].

In recent years, the field of HCI has shown an increasing interest in working users from considerably 'vulnerable' demographics who experienced some form of marginalization or detriment to their person, where this can be related to a diverse range of backgrounds, i.e. socially, culturally, financially or in regards to mental and physical health [16]. Among one of these demographics, individuals with an ASD diagnosis have been heavily researched in regards to experiencing challenges such as social isolation, complex issues regarding emotions and mental well-being, where general solutions often emphasise growth and learning aspects that contribute to creating empowerment and independence for the individual [16]. Moreover, Van Dijk et al. researched the increase in the development of assistive technology that presumably would "empower" cognitive and socially challenged individuals, in which they used different design artifacts to reframe the initial understanding of what empowerment means, at least for people on the spectrum. The results of their study showed that empowerment is not a question of practicality and simply 'doing things on your own', but it rather concerns a more profound question on having the feeling of being in control of one's life and that technology should provide this sensation. Van Dijk et al. elaborate by stating that: *"Technology should work in such as way as to foster the experience of doing things you intended, you initiated, and of doing them in the way that you feel is right"*, then following up by mentioning that *'interaction with these technologies should be a way of expressing ones' identity*. The statements refer to a general trend to create "one-size-fits-all"- solutions that are observed from the HCI community, where development efforts focus on a few particular generic traits rather than being concerned about individual traits [15]. While any research and development can be considered morally acceptable as it benefits the targeted demographic, it raises the question of how well the solutions from those studies work for an extended period of time in the individual's life, as well as questioning whether they can work with different subgroups of the user segment, e.g. differences in age and cultural background etc. Furthermore, it raises questions about the capabilities and competencies of the researchers and designers within the HCI community that conducts ASD-related research in regards to collaborating and encouraging their participants to research activities and how well they are executed to the degree that their users had influence and feel represented by the end of the process.

Based on the knowledge of ASD and the growing interest of HCI, this article presents a co-design tool in the form of design method cards that can be applied in collaborative activities for, with and to users with ASD by researchers and practitioners. Which purpose is to create more inclusive and representative design solutions for the future. To ensure that this contribution delivers on its assumption, the following research question has been established:

How can ASD experiences be represented in a co-design activities through the use of design method cards?

The outline of the article starts by establishing previous ASD-related contributions from HCI, followed by an overview of Co-design and its principles in regards to collaborating with ASD participants, along with a dedicated description about design method cards and why it is an appropriate design tool format for this project. Next, the article's main contribution is presented, namely called Autism Spectrum Experience Cards (ASEC), in which the sections specify the design philosophy behind the product as well as its contents and instructions for using them in practice. From there, the consecutive sections present the findings of ASEC regarding its purpose as a co-design tool and its ability to represent ASD users through its contents, which are based on the feedback provided by relevant stakeholders through an interview and a series of evaluation sessions. Furthermore, ASEC is discussed in terms of its contribution and the areas of its design that needs improvement, then describing what alternative directions can be created based on the original concept. Finally, the article concludes by answering the research question and reflecting on how this study provides a suggestion for future design efforts in terms of creating inclusive design solutions that appropriately represent specific user segments.

2 RELATED WORK

2.1 ASD and HCI

Regarding prior approaches to ASD-related research, Corlu et al. conducted a critical review of studies that involved people from the spectrum in order to reveal common practices and significant problems, which were created due to lacking experience in working with neurodiverse groups as well as reporting the studies within the HCI community. The first round of their findings, showed that ASD children were the most heavily researched at 47 % out of 173 studies, closely followed by 30.3 % with adolescents, then adults at 11.9% and preschoolers at 7.6 %. The results also showed that about 39 of the studies sought to create intervention regarding social interaction, followed by other studies (with 22 studies) regarding social anxiety, attention and routines. From just these results, it indicates that the field of HCI mainly contributes to the younger demographic of the autistic spectrum while focusing primarily on creating early intervention regarding social communication, presumably to adjust the ASD participants to follow the hidden social rules that are widely accepted behaviour among neurotypicals. First, while early intervention with ASD children does come with certain benefits long-term, the studies are not exclusively done with this particular subgroup as stakeholders, i.e. caretakers are likely to be involved and may take over specific roles as both participant and researcher, which in turn can make reporting of results unclear and harm the integrity of the study. Second and more importantly, neglecting adults with ASD leaves a presumably large group of users behind in terms of situations, behaviour and challenges that are more complex than that of a child and remain present and unexplored to this day. Further, it is unknown how many adults are diagnosed with ASD and remains a dark number. However, with more information emerging, it can be speculated that there is an increase that may exceed the younger demographic. In contrast, this comes at a cost to researchers, who is afraid to venture into seemingly unexplored opportunities for conducting groundbreaking research that could lay the foundation for a new field of study. Corlu et al. stated that *"given that autism is a lifelong condition, HCI should not neglect ASD adults and extend its focus to (1) including and (2) assisting ASD from all ages, not only the young"* . Third, the authors regarded social interaction as being the most prevalent topic within ASD-related research of HCI; it should be considered a problem that only those on the spectrum should deal with, but rather be approached with the intention of creating awareness regarding a neurodiverse perspective to the benefit of both ASD and neurotypical user [3].

This particular aspect of questioning the standardized neurotypical perspective to the benefit of the neurodiverse individual was referred to in an article from Chapko et al., in which researchers who themselves have varied learning disabilities conducted a study on the lived experiences of people with learning disabilities in contrast to the positive public attitudes on this segment that was seen. Moreover, in their study, they mention that the general assertion is that assistive technologies are designed with motor, visual and auditory impairments in mind, which overlooks the needs of neurodiverse individuals despite the fact that cognitive disabilities are one of the most prevalent disabilities seen in the world, such as being the second highest in the US. From that standpoint, the authors created an online survey that focused on asking meaningful and important questions to their participants, who were described as co-researchers, in a way that they feel represented given their lived experiences of public attitudes. Subsequently, the survey was designed in such a way that it included multiple ways of submitting answers, i.e. audio, pictures or video, as it was stated that while text-based is commonly utilized, it demands a lot in regards to cognitive efforts in terms of understanding literacy [4]. Reflecting on the findings of this article, when involving ASD individuals in research and design processes, it should be emphasized that it is paramount that the participants feel represented after providing their feedback and that they should be able to answer in a setting that is comfortable and tailored to their preference in order to create a solid empirical foundation.

Finally, an important insight was also made by Curlo et.al. at the end of their article, where they provided guidelines after they identified more than 50 problems concerning the following: the selected and included user sampling in the studies; the role of the actors involved as well as their capabilities to facilitate activities such as interviews and workshops; Environment, tools and materials in regards to habituation of the study environment and poor consideration of ergonomics when presenting physical materials; tasks, techniques and instructions in regards to selecting improper methods, i.e. think-aloud as a way of expressing and task mediation not being explicitly understandable and too complex in order to engage the ASD participant; and finally, data analysis in terms of researchers experiencing difficulties in extracting meaningful data that may be traced back to the inclusion criteria of the user sampling. For the most relevant guidelines provided on these problem areas, their guidelines on *'Know your users'* and *'Train the actors'* are most suitable for this paper. First, *'Know your users'* is described as *"individual, perceptual, cognitive and physical capacities by collaborating with their caregivers or directly interacting with them prior to conducting the study"* This suggests that as HCI researchers, taking time to do preliminary work in learning about our neurodiverse users' capabilities, routines, strengths and intolerance are worthwhile pursuits for avoiding future complications to manifest. Of course, this process will take time as each individual, ASD or not, has their own routine and acts differently than the other person, but in doing so, it creates meaning for the user and the feeling of being represented. Second, *"Train the actors"* is described as *"Present the product to the actors prior to the study, especially when they are to collect data"*. This indicates that any opportunity to let the ASD participants prepare themselves before the initial study takes place would provide more varied and in-depth answers to their knowledge and experience. Furthermore, it is mentioned that when conducting a study with a product that requires multiple sessions, it is essential to remind the users of the product's features. Also, if the product requires certain information in regards to the data collection, be explicit in what kind of data is wanted from the users [3].

2.2 ASD and Co-design

Co-design is defined as the collective creativity of both designers and non-designers or 'end-users' by Sanders and Stappers, where the basis of doing it is to collaborate on different situations in which a design can take place to solve a problem within the context of the scenario. During the collaborative process, there are opportunities for exploring new

possible ventures while gaining insights about the user segment, which can be used to understand the degree to which the design can impact. At the end of the process, design alternatives and new challenges may emerge from the initial design, making the user scenario more nuanced and the design solution more complex [11]. The premise of general co-design is that it emphasizes visual, creative, expressive and physical as well as tangible mediums, which contribute to a general design narrative while keeping it playful, fun and ambiguous to engage participants and facilitators alike in the process. Moreover, the process should also be personal and reflective of the user to feel represented in the design. Meanwhile, the facilitating researchers or designers should be objective about the outcome of the design process. In the end, it assists the user in their behaviour and actions. Any interaction that is made during the process between facilitator and participant is considered to be a way of connecting tacit and latent knowledge. However, this also depends on the willingness and the goals set by the involved parties [12]. Finally, Co-design can take place in five distinct phases as defined by Sanders and Stappers, which are as follows: 1) Pre-design, 2) Discovery, 3) Design, 4) Making and 5) Marketing. In short, each phase is described as pre-design: research is conducted in order to establish the context of use for the design to solve an experienced problem; Problem Discovery: opportunities for new ventures are identified, and transitions from research over to the initial design phase of the process; Design: continues to explore potential design alternatives while developing on a refined design solution; Making: producing or manufacture the final specified concept to the degree that it is fit for a future release; Marketing: emphasises the implementation of the concept into the given market, where efforts are being made in regards to monetization, sales and distribution[12].

In terms of previously mentioned mediums used in the design activities, they are referred to as 'Make tools' by Sanders and Stappers, also sometimes referred to as 'Co-design tools', and are created in a 2D or 3D format, and examples of them can be channelled into mediums such as photographs, symbolic shapes and other pictorial shapes. In terms of what tool is appropriate to use in the design process can depend on varying factors such as time, budget and the context of use etc., but also on what particular purpose are they meant to adopt, i.e. for eliciting emotions from past experiences or more cognitively in terms elaborating on relationships between ideas or components of the design solution [11]. In a related study, Ravn conducted a literature review on what problem domains were most researched within ASD-related studies with adults within HCI, as well as what tools and techniques were that were commonly utilized in those studies, where principles of co-design principles were used as a lens throughout the review. From the results of 8 conference papers out of 267, it was possible to identify that the most utilized tools and techniques within co-design were observations, interviews and then make tools. The first two techniques were regarded as generally supportive of each other and excellent in their own right, although observations have more diversity to be used in other formats such as workshops and be a research approach on its own. However, it was debatable whether or not these formats truly embodied co-design as a practice as observations do not directly involve any form of collaborative activities and interviews while engaging with the user is primarily used as a foundation to create an initial understanding of the user demographic, but becomes obscure in regards to if those participants are further involved in future design activities. As described previously, 'Make tools' is an acknowledged part of co-design, and where the article proceeds to further examine the types of tool formats that were then utilized in the studies with adolescent or adult ASD participants, in which different types of tools such as sketches, playdoh, pipe cleaners and 3DP 'sensor mimics' [14]. However, none of the studies disclosed their choice of these tools except partially from the study of Hong et al., who utilized "life skill cards" that were composed of pictures with descriptive text to explain specific situations for their ASD participants in order to create reflection on their developing prototype. While sadly, the authors did not further elaborate with further details on the features and use of this tool, it poses an uncanny resemblance to design method cards, which is a well-known tool in the HCI community [7]. Based on this reflection, it inspired the idea of creating a set of design

method cards that were specifically designed for users on the ASD spectrum along with researchers and designers that could be used to create solutions for, with and to people on the spectrum. More on this will be explained further in section 3 [10].

2.2.1 Design method cards as a tool. Design method cards have been a popular tool due to their simplicity and making the design process more visible and tangible for the design team and sometimes users. There exist multiple card formats, such as Inspiration workshop cards by Halskov and Dalsgaard for cooperatively generating ideas with designers and users, and AI ideation cards that specifically focus on explaining considerations for the development of artificial intelligence [6, 8]. A general principle of design cards is that they prompt the practitioners' creative idea-generating capabilities, which can be used in a broad and general setting or more specific and niche. However, finding a fitting set can be more troublesome as there exist multiple examples of design card decks, and each comes with its own unique purpose, system, formal qualities and features. A quote from John Zimmerman states that *"Design methods are like toothbrushes everyone uses them, but no one like to use someone else's"*, which points out that design methods like method cards are designed for a specific purpose and therefore challenging to choose a specific method that suits one's own needs in research, hence most designers goes on to create their own method. Nevertheless, in the case of navigating the landscape of design card formats' strengths and weaknesses, Merrit and Wölfel have established five design dimensions to gain an overview of the similarities and differences between each set. The dimensions are as follows: 1) intended purpose and scope; 2) Duration of use and placement in the design process 3) System or methodology of use; 4) Customization and 5) formal qualities. Each dimension also comes with several graduations, which provide different nuances to the given set of design cards and differentiates how they are used compared to other decks [17].

In terms of why design method cards can be of particular use in ASD-related research and design process, it is partially argued by Hong et al. that states *"Visual support is particularly beneficial to individuals with autism because it helps make abstract concepts concrete and capitalizes on their inherent visual learning strengths"*. With this philosophy in mind, design cards as a general should be able to provide a more accessible and tangible approach for collaborative activities and encourage engagement in the process[7]. However, this does not necessarily imply that all card formats are applicable for the ASD demographic, as some may still find it too ambiguous in terms of its design. Another aspect of utilizing design cards is that they adopt the element known as the common third, a pedagogical method in which an object stands as a focal point for a conversation directed at growth and learning. Inadvertently this theory of the common third comes as a benefit to the ASD individual to be more participatory, as it alleviates the tension of being in an unknown setting and expected to take part in intimidating activities while providing feedback that may take much effort in order to recall previous experiences[7] [1]. With design cards, the subject of what to collaborate on is set and can serve as the primary focus throughout the session or as a starting point to initiate a conversation with the participant.

3 AUTISM SPECTRUM EXPERIENCE CARDS (ASEC)

Autism Spectrum Experience Cards (ASEC) are design method cards that are aimed to provide designers and researchers with a tool that can be used in co-design activities with, for and to people diagnosed with ASD in order to create more inclusive design solutions in which users of this segment feel more represented. The cards are intended to be used in the pre-design and discovery phases as established by Sanders and Stappers, as the contents of cards provide tangible insights on the spectrum and appropriate supportive methods to be later incorporated into the design solution. [11]. All cards were based on various kinds of established sources i.e. concrete research and theories, but also lived

experiences and statements from reliable sources such as forums and other types of media i.e. a comedy or a drama series found that depicts the life of an ASD individual in high school or at their workplace to observe their behaviour when exposed to different kinds of situations and environments, all taken with a grain of salt in regards to what is considered entertainment and what aspects resembles reality for an ASD individual[9] [13]. The following sections describe the contents of ASEC in regards to introducing the suggested mindset to employ when using the cards, the features and some of the contents of the cards, as well as the different rules and procedures for using them.

3.1 Design Philosophy

Subsequent to the cards, there is provided a range of suggesting guidelines prior to starting the process to assist the facilitator towards the intended mindset. These guidelines are as follows: *No diagnosis is the same, Engagement to action is important, Limit design for other stakeholders, Use of general concepts* and *Flip the microscope*. No diagnosis is the same - emphasises the previous statement about the cards that no diagnosis is the same despite the fact that some individuals may share some generic traits but still have a different perception of things than another person on the spectrum would. Engagement to action is important - is intended to provoke the practitioner in the direction to actively pursue design solutions tailored to specific contexts that are of relevance to the ASD person, as while these cards provide some general insight into ASD, their contents should not be limited to just be treated as secondhand knowledge but used to make an impact to spread awareness and acceptance of the spectrum. Limit design for other stakeholders - brings attention to the presence of stakeholders that may take part and play a role in the expected design solution but is advised to be generally reflected back to the ASD individual in question. Use of general concepts - the cards employ general themes, areas and subjects that are not exclusively a part of ASD, such as keeping a sufficient time schedule, but it should be understood that the perception of an ASD individual differs from what a neurotypical person would experience. In addition, this guideline also highlights that these cards do not include everything that is known about ASD but at least approaches it on a surface level, where if the facilitator feels that there is a card missing, they are suggested to make a proxy for the sake of progress. Flip the microscope - borrows from the established study of Chapko et al. in regards to shifting the perception of ASD individuals to "fit in" to the environment dictated by neurotypical social rules, but instead make efforts in terms of neurotypical people who need to change their look on how they are treating neurodiversity in general [4].

3.2 Cards

The ASEC cards consist of three different card categories: Problem domain, Traits and Support Methods, where the total amount of cards is 54 cards and the distribution and the distribution is 5 cards for Problem domain, 31 cards for Traits and 18 for support methods. Examples of the cards can be seen in figure 1, and all of them can be referred to in the appendix A-F. Problem domain cards include general problem areas that start as an initial point of conversation in which the ASD has experienced situations within one or more of these areas and that they can recall. To elaborate, an example of a domain card could be *'Practical Challenges'*, seen in figure 1 or Appendix A, which entails circumstances where the ASD individual has experienced some challenges with trivial tasks such as shopping for groceries, cleaning their room or more demanding tasks such as maintaining a sufficient schedule. Traits are unique characteristics that can be composed differently and vary in terms of their significance for each ASD individual, i.e. some individuals may be more comfortable with eye contact than others. The traits bring more detail to the problem domain in that it vocalizes different parts of the ASD diagnosis that becomes more apparent when exposed to given circumstances. Finally, the support cards are different kinds of methods, strategies and materials that assist in overcoming the challenges, which

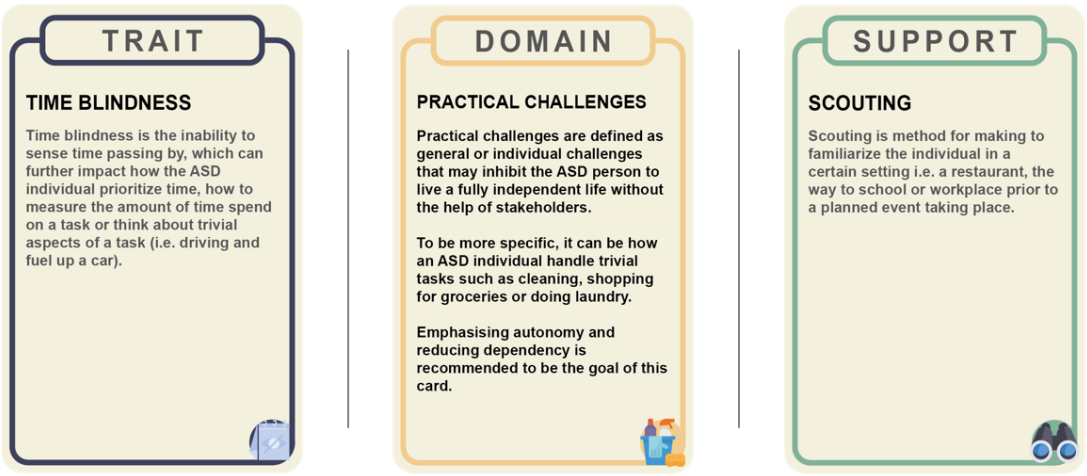

Fig. 1. Shows three ASEC card examples from each domain, namely *'Time Blindness'* (Trait), *'Practical Challenges'* (Domain) and *Scouting* (Support).

are dictated by the problem domain and the affecting traits that come into play to describe the situation further. When used together, the cards indirectly compose a setting and an ASD user persona as an inspiration source for a potential design solution to be further ideated and refined while representing the intended user group.

3.3 Play formats

Along with the cards is a playmat with the dimensions to be printed on A3 paper, which includes placeholders for the placement of the different cards, as well as a text field for documenting thoughts and ideas while used in a co-design activity, which can be seen in figure 2. The playmat and the cards are intended to be used within one of two different formats that each provide a different purpose and procedure in how these cards are used. Both formats share the same amount of players, that being three, and the same starting point in the process, in which the participants discuss and select among the domain cards to guide the conversation towards a design solution. After a domain has been selected, the players select and play the traits and support cards to identify and specify different scenarios of an ASD individual's experience and explore possible ways to provide assistance. The first format is **ASEC Brainstorm**, which can be referred to in Appendix G, and is used for quickly brainstorming different design ideas in the shortest amount of time, where each player gets three trait cards, and two support cards to select among that fits within the confines of the domain card. This game format concludes when each player has played one of each type and then documents the initial ideas of the round by writing on the playmat's text field and repeating the process as needed. The format is mainly intended for designers and researchers who seek to explore the field and perception of the ASD community before involving participants from the segment. The second format is **ASEC Roleplay**, referred to in Appendix H, which is used for more refined idea generation and provides a change of perception, where at least one player adopts the role of an ASD individual and is assigned the trait cards, and another player adopts the role of a caregiver and is assigned the support cards. The third player may alternate between the two roles in terms of what seems most sensible for the group.

The process of this format is that the ASD individual(s) selects two trait cards that may represent a challenge within the given domain. Afterwards, the caregiver will play one or two support cards that they believe will assist their client(s) in overcoming the challenge. From there, the caregiver and their client(s) can further elaborate on how to incorporate the support methods into their routine, e.g. by developing a given technology or ways to form healthy habits, where the process concludes when a more refined idea for a solution has been reached and can be archived by taking a picture of the cards and make a note of the initial thoughts. This format requires much effort in regards to being immersed in one's assigned role meanwhile shuffling through and selecting appropriate cards for the dictated direction of the design. Alternatively, recruiting an ASD participant may be an invaluable approach to a session of this format in that they can provide a detailed and lived experience that can be more easily represented in the design solution. Furthermore, a caregiver as a participant may also provide more suitable methods and strategies to support the ASD individual that may extend further than the cards' contents. By the end of the session, the designer or researcher is left with a more concrete idea for a potential design, which from here can be refined and ideated further over the coming development process.

4 INTERVIEW WITH A CAREGIVER

After an initial version of ASEC was created, an interview was held with a caregiver where the focus was on getting feedback on the overall idea of creating a co-design tool in the form of cards for a specific neurodiverse group, as well as what a researcher or designer should be aware of when collaborating with ASD people. The following sections describe the participant's background, the method and the observed findings that were found based on their answers.

4.1 Method

The involved caregiver was female at about +50 years old and works from a private company called Olivia Danmark, which specializes in providing assistance and support arrangements for people dealing with a neurological handicap, i.e. ASD, ADHD and PTSD, where the caregiver's work focused on providing help for university students at about the age of +20 years. The caregiver had worked with the company for about a year but has been in various teaching positions for the last +10 years, e.g. at an elementary school, high school, jail, and worked with foster children and vulnerable teens, where they have had experienced multiple interactions with neurodiversity firsthand[2].

For the interview itself, the caregiver was asked about themselves, their background, experience and insights on ASD, then after providing feedback on the ASEC cards regarding the idea behind them and their assumed impact they would have when used with ASD individuals. Prior to the interview, the caregiver would receive the cards with a small introduction to then shuffle through and examine to make any notes if some of the contents they liked or did not like in particular. Furthermore, the interview was conducted over Microsoft teams and took about two hours, which were also recorded with the verbal consent of the caregiver.

4.2 Findings

In general, the caregiver's overall interpretation of the initial version of ASEC was positively received, where on multiple occasions, there was a sense of excitement and versatility in what these cards could potentially provide to both the caregiver's work environment, their clients and to other professions. When they asked about how they thought of having different traits, problem domains and support methods presented on cards in comparison to other formats, they replied with the following: *"Cards works a 100 times better than something like a PowerPoint presentation, just by having something tangible and having a reminder at times on what I am working on and being aware of uncertain reaction patterns*

that at times would repeat". From this statement, the caregiver could very much see themselves using the cards in their line of work, where she would frame the way she would use the cards by sitting down with her clients that would presumably experience some problem that could be explained in a card, in which she would present them a related card to show them that their problems can be common and that there are ways to solve them. Moreover, it was mentioned by the caregiver that the cards would provide what is known as the common third, which has been described in the related work section, to help lessen the intimidation of eye contact and support the conversation with their client [1].

At the beginning of the interview, the caregiver would discuss their interpretation of what it meant to be on the spectrum where it was stated that: *"Due to the degree of ASD, some are more exposed and others are more higher functioning, but in order to be high functioning means that you know your own diagnosis and how you react in certain situations"*, where this topic of self-reflection became a recurring throughout the interview. As previously established, most ASD individuals strive to live an independent life without the need for assistance but are often hindered by their disorder under different circumstances. An example that was observed by the caregiver was that their clients could, at times, be the victim of their obsession. This was described as if the ASD individual had been working on something for an extended period of time. At some point, they would meet some resistance that has previously been experienced but does not recall how they should react, which then leads them to work harder and become mentally exhausted. It was also explained by the caregiver that the ability to self-reflect could play a vital role when it came to understanding the ASEC cards themselves, especially for those who may be incapable of doing so, where they elaborated by saying: *"...Those who are mostly challenged would not be able to relate to these cards, i.e. because of the amount of self-insight it would require"*. Based on this quote, although self-reflection seems like an impossible challenge, it can serve as a long-term goal for the future of the ASEC cards as it has been brought to attention that while many users would presumably gain from its contents, some may not find them suitable to describe their needs.

4.2.1 Format of the Cards. When asked about how the contents of the cards were presented in regards to text and images, the caregiver answered that they liked that the images could initially be used as a guiding source for the ASD individual to express how they felt, then read further into the text afterwards to elaborate on their thoughts and emotions. The caregiver further asked about the design by having one side only being text, then the backside of the card being an image, to be more recognizable and be easier to shuffle through the rest of the cards. However, this feedback was kindly disregarded as it was observed that, at this point, the interest of the designer/researcher and focusing on the caregiver would diverge in terms of the general design of the ASEC cards. Specifically, a caregiver would probably benefit more from the suggested design to quickly initiate conversation in a therapy session, whereas for designers being unaware of which cards you get leaves a challenging aspect that prompts their design thinking capabilities, hence the design of the cards was not changed.

Regarding the categories of the ASEC cards, the caregiver thought that the separation of different topics made sense for their context of use. For the domain cards, they mentioned: *"They serve as a good foundation, yet it depends on the individual what they think, but they are good for exploring an area"*, which aligns with the intention of what this category purpose. In terms of the trait cards, while they found all of them helpful in their own way, they did not understand them all right away. They elaborated: *"It was not necessarily all them that I knew the term for, but when I read them, I started to recognize what they meant"*. From this statement, it was reflected that while some of the cards may be confusing at the start, their contents are understandable. Furthermore, this statement may also refer to the learning process of using the ASEC cards in that it takes time to fully understand each card before it is selected and elaborated upon. Lastly, the

caregiver did not provide any feedback on the support cards other than that while some had edge case usage, it was good to have options to choose among.

4.2.2 Changing the perspective. A question was asked in regards to what a common misconception in working with ASD individuals was, where the caregiver replied with *"Instead of thinking about them as a diagnosis, think about them as an average person whose behaviour is expressed differently when overwhelmed*, which supports in subverting the previous HCI perspective of people with ASD being a particularly hard user segment to work with if approached properly. Next, when asked how to best help or assist these kinds of individuals, the caregiver would continue by saying *"You could know everything there was about ASD, but that would not mean much, whereas knowing how to act based on that knowledge is much more critical*, which would emphasize that those who seek to contribute with solutions for this demographic should pay attention on how they are received by the individual user's behaviour, rather than simply developing based on generic traits. By the end of the interview, while many of the topics had been focused on different challenges and issues experienced by ASD, the interviewer and the caregiver used some additional time to discuss some of the strengths that are seemingly common with ASD. Some of the mentioned assets were things such as being more observant of things that others do not see, being able to find new ways to do things and critically point out things that do not work in the current structure, as well as finding interest in uncommon subjects, themes and theories that others would turn down. However, during this talk, it was mentioned that while some of these perks can seem admirable and may perceive that an ASD individual can become a sort of "super machine", the reality is that only a few possess these capabilities and for those who do lacks in other fundamental areas of their cognitive and perception. Furthermore, it was reflected that if the individual has gathered this kind of admiration from others, they only see the result but do not understand the efforts of self-development it may have taken to get this level of confidence. Both of these remarks were referring to providing proper individual intervention and highlighting the efforts ASD individuals put into working on themselves, which serves as takeaways that can significantly contribute to empowering people with ASD, which consecutively could benefit researchers and designers from HCI to show which areas of ASD would gain from research efforts.

5 EVALUATING CARDS WITH ASD REPRESENTATIVES

After having settled the idea of ASEC's purpose as a co-design tool, as well as adjusting and adding new cards to the set, it was ready to be evaluated by ASD individuals in order to ensure that the cards would adequately represent the user segment. Three evaluation sessions were held with three ASD individuals to go through each of the 52 ASEC cards that were created at this point in the process to ensure the representational aspect. Furthermore, asking these representatives of the user segment about their thoughts on using these cards and what they felt is important for researchers and practitioners from HCI when co-designing with ASD users, which is described in the following sections.

5.1 Method

The included representatives were all danish university master degree students from Aalborg University from different educational backgrounds, and all had been diagnosed with a certified ASD diagnosis by a psychiatrist. Prior to the conduction of the sessions, all representatives would receive the ASEC cards to review and make any relevant notes, along with a questionnaire with information regarding the evaluation process as well as to fill out relevant information to the evaluation, such as their identified gender, age, name of education and time diagnosed with ASD, which are all

Representative Nr.	Gender	Age	Education	Duration of ASD diagnosis
R1	Male	24	Mathematics	~18 years
R2	Female	26	Sociology	~5 years
R3	Non-binary	27	Computer Science	~1 year

shown in the following table. Along with this information, each representative has been assigned a number from R1-R3 to uphold anonymity when being cited in the findings section.

While providing their feedback on the cards, the representatives were urged to give their honest opinion on the cards if they found a card confusing or dissatisfying in its presentation, in which the specific card would either be changed or excluded entirely from the rest of the set based on their answers. All evaluation sessions were held individually and physically at various locations, such as one of the buildings of Aalborg University, in an office room provided by Olivia and at the interviewer's home. Finally, the sessions with representatives were recorded and filmed for further analysis, in which they gave their verbal consent to permit so [2].

5.2 Findings

Along with the questions regarding the relevant information in the questionnaire, the representatives were asked an optional question regarding their own view of their diagnosis, where two of the representatives answered the following:

R1:"I experience my diagnosis as a challenge in relation to structuring my day, as I have a strong tendency to immerse myself in my work and forget the world around me"

R2:"The challenges that I have as follow from my diagnosis I have to work with them, which is like everyone else who has to work on their own weaknesses. The biggest between mine and "others" is that i use much more energy to be social. Hence, I have the need for taking breaks and charge up"

Both of these quotes reflect the representatives' ability to self-reflect and point out specific shortcomings that they struggle with regularly, yet further explain what they experience when dealing with these issues. R1's answer elaborates on what it means to lack structure and how it is perceived through their eyes, whereas R2's makes a prompt analogy between ASD individuals and neurotypicals in regards to how their individual challenges are not necessarily so different from each other but are just experienced different where they use a typical example of how they respond to social situations.

Going into the evaluation sessions, the representatives showed some hesitancy toward the cards in terms of what their purpose was and how they would be used. However, as they went over the cards with the facilitator, they became more reassured and showed more interest in what the cards could provide. One example of this was provided by R2, where they had said *"When we wrote to each other* (prior to the evaluation) *I feared that they* (the cards) *would be something uncommunicative, but when looking at them now I think they are great for looking at one own's strengths"*. R2 further elaborated that they thought the cards could help them by finding different traits related to a problem within the domain cards, then following it up by looking through the support cards to find ways to help themselves. Their response illustrated a possible way for the ASD individual to use the cards on their own, where it was later suggested by R1 that they presumably could use them to express themselves more clearly.

Relating and representation refer to the ASD representative's ability to reflect on the contents of the cards in a way that, which by the end they could feel represented in. Throughout the evaluation sessions, when going through each of the cards, the representatives would on multiple occasions recall a personal experience which was related to a specific card, where these conversations were brought in from different perspectives, e.g. the representative themselves, a family

member or friend who were also diagnosed with ASD or an encounter in the public in which a distinct trait of their diagnosis would emerge.

As an example of this, one noticeable card that was observed to prompt one of these recollections was the *'Masking'* card (Trait), which elaborates on the ASD individual's need to hide their diagnosis in order to avoid prejudice as can be referred to in Appendix B. R3's elaborated on this card by telling: *"I think I am masking a lot and have encountered problems that relates to it, but I do not know how to do it differently and there is not a part of my personality that does not mask*. R1 also commented on the specific card by saying: *"It is how I exist, and I have felt it has been necessary to get through the day... it is just that you are afraid of what people think, right? Better give them something ordinary and make them believe in something that is optimistic*. Both of these quotes illustrate a gruesome picture of public attitudes towards ASD individuals that is present even to this day despite efforts to make the world more inclusive, where it is experienced by these representatives that they are essentially denied to embrace their diagnosis and thereby also rejecting parts of their personality to appeal to the expectation of a neurotypical society. More of the ASEC cards would further detail what these kinds of expectations would entail, such as the *'Savant Syndrome'* card (Trait) referred to in Appendix C, where R2 mentioned that ASD individuals are expected to show their unique skills in fields such as mathematics, e.g. to recite most numbers of the constant of Pi. However, as established previously in the article, it is the fewest ASD individuals that possess these types of unique abilities. Moreover, in regards to those who are also diagnosed with savant syndrome on top of their ASD diagnosis are often hindered in more fundamental areas, as also mentioned by the caregiver in the previous section.

Despite that some of these conversations were quite shocking and taxing on the representatives to explain, they reflected on the ASEC cards in appreciation in that they existed and that they were able to articulate their thoughts on themselves and provide these exchanges of expression through the use of the cards. R3 expanded on this by commenting: *"I am glad that these cards exist, and that it has been managed to describe a lot of things in a small space in which only few would know about.*

5.3 Mediation and presentation

Mediation and presentation would refer to the ASD representatives' ability to understand each of the ASEC cards and would provide their feedback in regards to how the card itself. When asked about the formal presentation of the contents of the cards, i.e. the texts, the language, and the use of images/icons, which were, in general, received positively. However, some flaws became apparent when talking about each card, such as that some cards were seen as duplicates of each other, i.e. *'Personal Well-being'* (Domain) and *'Increased tendency for other disorders'* (Trait) referred to in Appendix A and B. Further, it was pointed by the representatives out that some cards could only be used within a specific domain, e.g. *'Checklists'* (Support) card, seen in Appendix E, could presumably only be used in the *Practical Challenges* (Domain), seen in figure 1 or Appendix A, in order to list different tasks, which is not necessarily appropriate to the other domain cards of the set. However, the representatives did not mind having these duplicate cards and did not want any changes to them, as they mentioned that it would provide options to start a dialogue. In terms of understanding the cards, a couple were a bit confusing for the representatives to begin with, but when discussed, they would later acknowledge their contents and go on to the next one. However, this was not the case for two cards called *'Social Stories'* (Support) and *'Intense World Theory'* (Trait), which would ultimately get excluded from the rest of the ASEC cards due to too complex card descriptions. In short, the idea of *'Social Stories'* was to have a fictional narrative about another ASD individual who would go through a specific scenario from which the practising ASD user could

learn from, whereas *'Intense World Theory* were described in terms of some individuals with ASD perceiving the world to be very intimidating place in general, where methods to introduce them to how everything works in smaller efforts.

Regarding the card categories, the representatives did not necessarily understand the meaning of them prior to the evaluation, where in particular, the 'Domain'- cards category was to some degree confusing by its name, also when comparing it to the 'Trait'-cards category. R1 elaborated by mentioning: *"I thought that the name of Domain was a little too broad in its meaning because there are collected some wide-ranging items in that category, however, I do not know if it is too broad and if there exist a better name to assign it to?"*. Following this statement, the name of 'Domain' of what this category contained was discussed with the representative, yet no improvements were found, hence the name stuck. Furthermore, when it came to the overall differences between the card categories, all of the representatives mentioned that they made sense once they were explained, referring to the learning curve of using the ASEC cards.

In terms of the use of images/icons, R3 made an observation (to my surprise) that some cards utilized icons of puzzle pieces, i.e. the *'Coordination training'* (Support) card, see Appendix E, and previously the *'Pattern thinking and recognition'* (Trait) card, see Appendix C, in which they expressed their dissatisfaction of being included. To elaborate, the representative stated that: *"There exist this company, who advocates for ASD individuals that in recent years has been facing with major backlash on multiple accounts for not being inclusive to their clients, where they have been using a puzzle piece as a brand"*. They further elaborated that a puzzle piece could falsely be interpreted as the ASD individual missing a piece of their personality. Based on their feedback, the images used were either changed or removed.

5.4 Suggestions for use

Towards the end of the evaluation sessions, each representative was asked if they had any ideas regarding additions to the ASEC set that was not included, which led to four additional cards being added, bringing the total and final amount to 54. These specific cards were *Communities* (Support), *'Sticky notes'* (Support), *'Trauma'* (Trait) and *'Sense of Humor'* (Trait), which are all described and referred to in Appendix C, D, E, and F. Afterwards, they were asked whether or not there should be more focus developing on neurodiverse solutions as general, i.e. being technologies, products or services, in which R1 stated: *"Yes and nonetheless it would spread awareness to an audience who would gain insights about ASD through these products, also I cannot imagine that organizations would not have a personal interest in learning more about their users"*, this further answered a question regarding if the representatives thought it would benefit professionals such as designers. R1 elaborated that by designing and developing these products, it would expand the understanding and the acceptance of ASD to the general public, which still has misconceptions about the diagnosed individuals, as has been established previously.

Related to professionals using the ASEC cards in their design process, the representatives were questioned if they were confident enough with the cards that they could potentially represent them without including a user on the spectrum? Their united verdict on the question was that the cards could, to some degree stand in for an ASD user in the early phases while researching and exploring the target group, yet they heavily suggested that at some point in the development should console a user on the spectrum. R2 emphasized the meaning and quality that a product can have by involving a representative user, where she said: *"I think it would be a significant advantage to have an (ASD) person included as the processes you talk about can become really nuanced, also talking to these people can be quite invaluable, otherwise you may quickly abandon somebody you want to entice"*. Although the instructions of the ASEC set have ways to work around not involving an ASD user, it is explicitly detailed that involving users with ASD is suggested as referred to in Appendix H, albeit the consequences of not doing so have not been described as it depends on the context

of use. However, as expressed from the feedback of representatives, it further supports the implication that it requires the involvement of an ASD user in order to ensure a representative product.

To conclude the evaluation of the ASEC cards, the representatives were asked a final question regarding what they would say to people who either do not know anything about ASD or at least would try to understand the diagnosis? To this, R1's answer encapsulated the unanimous assurance of the other representatives' responses, in which they stated: *"Be open-minded and ask questions to understand the context, we are not sick just challenged on certain areas and can exceed in others... It is easy for people to presume where you are on the spectrum when you tell them about your diagnosis instead of just asking, where this would be better so that you can say exactly how you feel"* . They further elaborated that if an ASD person were being denied to express themselves, then their behaviour could be interpreted as weird, as if they are being too reliant on their diagnosis to not being aware of what is going on a daily basis. In addition, R3 mentioned that *"you can still function in many common contexts*, which exemplifies that ASD individuals are not entirely hopeless and can still adapt to different situations.

6 DISCUSSION

This article has presented a co-design tool in the form of design method cards called ASEC, which can be used in the early design phase by researchers and designers with users diagnosed with ASD. The goal is to ensure inclusive design solutions in which the users from the same segment can feel represented and find useful. The following sections discuss the general idea and design choices behind ASEC as a co-design tool, the different design dimensions that the format posses, suggestions for use and finally, reflections on how to further improve the design as well as possible alternatives that might be created from the original design concept.

6.1 ASEC as a co-design tool

It was described that ASD individuals have an inherent strength in visual learning when provided with objects to prompt this state of mind, in which abstract concepts become more tangible by hong et al. [7]. When comparing this criteria to the contents of ASEC, this has been achieved by exploring different nuances of the diagnosis, i.e. the traits cards and common problematic themes and situations through the domain cards. From the evaluation sessions, it was observed how the ASD representatives would pick a card up, take their time to understand it, and then use it as a proxy to support the conversation. From the sessions with ASD representatives and the interview with the caregiver, it further acknowledged the uses of ASEC as a co-design tool in its ability to mediate self-reflection and insights about ASD, in which ASD individuals and neurotypicals would potentially gain from this information. When comparing ASEC to other design method card formats, as far as this article concerns, it is the only type of design method card specifically designed with an intended user segment in mind. In contrast, other formats are generally focused on promoting general idea generation, as can be seen with the Inspiration Card workshop by Halskov and Dalsgaard or focus on utilizing specific technologies, i.e. AI ideation cards [6, 8].

Although these complementary findings support the claim that ASEC is ready to be used by practitioners for collaborative activities with ASD users, there are parts of its design that are still unresolved to guarantee its practicality and its promise to deliver inclusive and representative design for adult users with ASD. First and foremost, through its evaluation, the cards have only been tested to be representing the ASD user segment but have not been proven in regards to whether or not a suitable design solution for the outcome of its activities. This correlates to ASEC's play formats, which can be referred to in Appendix G-H, which remains uncertain in its instructions on what the expected outcome of the processes is when using the cards. Moreover, it was the intention to test the play formats in regards

to the estimated time each process takes to execute to consider the amount of resources practitioners possess, where the aim for doing these tests is to confirm that **ASEC Brainstorm** leans itself to iterative and rapid design nature for approximately 15-20 minutes, whereas **ASEC Roleplay** is assumed to be more considerate and thorough for its outcome that would approximately +45 minutes at least. In the future, to resolve the ambiguity of the ASEC card's promise and the process of its play formats, further evaluations with the collaboration of design professionals have been considered to be a reasonable approach. A second area that the ASEC design method card format would gain from is more evaluations with ASD representatives. As ASD is a spectrum, it has certain complexities and nuances that should be understood on an individual level, as confirmed by the caregiver and the ASD representatives. Granted, for ASEC's format to stay relevant and represent the ASD user segment, its contents have to draw upon sources that have empirically backed claims as well as lived experiences from other diagnosed ASD representatives than just university students in order to produce insights that can be seemingly interpreted as generic even though it is not. However, given this study's contribution, it has been accounted that three ASD representatives are sufficient for ASEC's current iteration.

6.2 ASEC's design dimensions

When relating ASEC to the design card dimensions established in the related work section by Wölfel and Merrit. For the first dimension in regards to *Intended Purpose and Scope*. ASEC aims to inspire designers and researchers to create more inclusive products and services in which ASD users feel represented in the design solution. Regarding the scope of ASEC, as mentioned earlier, the cards are intended to be used early in the design process prior to establishing any contact with the user segment, until about the start of the initial design and prototyping phases. For graduations of this dimension, ASEC primarily employs being a *Context/Agenda-drive* system as the cards are specifically designed to focus on people with ASD. However, the other graduations can be applied as well to the set, where ASEC employs the *General/repository* graduation in its provided contents to be able to archive and recall previous ideas, whereas with *Participatory Design* it depends on if the facilitators involve a participant from the segment, i.e. in the usage of ASEC roleplay. For the second dimension of *Duration of use/When in use* with two use formats, the time frame differ as it is assumed that ASEC Brainstorm requires less time to execute than ASEC Roleplay as it requires the participants to be more acquainted with the contents of the cards. Moreover, ASEC is viewed to follow a *as needed* graduation, as ASEC can be used for early exploration of the field of ASD related research and design, further being a supportive tool during workshops and interviews with ASD participants as well as objectives that can be referred back to when evaluating an initial prototype. In terms of *Methodology of Use* for the third dimension, with ASEC's two play formats, it would imply that the cards need to be used within at least one of them. However, it is expected that the cards can have multiple different contexts of use and, therefore, should not be restricted, which relates to the *suggestion of use* graduation. Regarding the *Customization* dimension, ASEC provides *Trivial customization* in that the contents of the existing cards cannot be changed but merely grouped together. Nevertheless, it is encouraged to pursue *Optional customization* if the facilitators judge that certain cards are missing, which can be connected to the static nature of the cards by only including what is currently known of ASD at the time of its design. Finally, for*Formal qualities* ASEC provides both *Texts & Images* and *Categories* in terms of the presentation of the cards contents and regarding they related to each other in their individual use [17].

6.3 Co-designing with ASD

Although this article's main contribution has focused on creating a representative co-design tool for HCI researchers and practitioners, who wish to conduct collaborative activities with ASD users to create inclusive and representative design solutions, yet does not deliberately assist in how to facilitate activities with these kinds of users. However, through selecting a few distinct cards and combining them with the feedback provided by the caregiver and the ASD representatives, it is possible to gather some implications on what to consider to create an appropriate setting. The first factor is the environmental impact that ASD individuals may experience, in which the *'Physical Environment'* (Domain) and *'Sensory Issues'* (Trait) cards can be applicable, as seen in Appendix A and C. From the comments of the ASD representatives, R2 and R3 reported that they were especially susceptible to loud, high pitched, and sudden sounds as well as being hypersensitive to strong lights, whereas R1 also would add their under-sensitivity (also called hypo-sensitivity) to cold temperatures. Based on these responses, it suggests that the physical environment of conducting the activities should be appropriately lit, i.e. with natural lighting and be relatively quiet to outside noises. Alternatively, it is suggested to consider doing the study in an environment that the ASD participants can control, e.g. their own home. Second, in consideration of the *'Need for predictability'* (Trait) and *'Transtioning'* (Trait) cards, seen in Appendix C and D, as well as the established work of Corlu et al. with *'Know your users'* and *'Train the actors'*, the next step for facilitating collaboration should be focused on how to mediate instructions to their ASD participants [3]. To this, facilitators should be very explicit about what is going to happen throughout the day, explain simply what they want their participants to do, and in terms of what kind of feedback they are expected to provide, in this sense, facilitators should be aware with using metaphors as some individuals may find them confusing. Keep the number of tasks within a reasonable range so that they are straightforward and understandable in order to not overload the ASD participant with information, if needed it is recommended to do a test study prior to the actual one so that the participant can become more familiar with the environment, the facilitators and tasks, which principles leans itself to the *'Scouting'* (Support) card, referred to in Appendix F. Additionally, if a prototype is involved that the ASD participants are required to interact with, a good practice is to let them explore all of its features and ask questions afterwards, as methods such as 'think-aloud' can be too demanding for some individuals. In regards to lengthy activity sessions such as workshops, the importance of taking breaks cannot be emphasized enough in order to get consistent feedback and not aggravate the ASD participant to the point of exhaustion. To this, it may be necessary to verbalize that they have the right to take a break on their own accord and should not be met with repercussions for doing so, which is described in the *'Time-out'* (Support) card, seen in Appendix F. Thirdly, a critical element is to promote a setting that accepts diversity and facilitates mutual understanding of different perspectives, where here the *'Social acceptance'* (Domain) are in effect, seen in Appendix A. The ASD participants should not be ridiculed for being quote on quote "differences" and should feel comfortable in the setting they are in, where this case, the contents of *'Customizing Requirements'* (Support), refer to Appendix E, to more appropriately meet the needs of the individual ASD participant in order for them to provide detailed and presumably personal feedback on questions. Furthermore, the *'Self-education'* (Support), seen in Appendix F, may also be applicable here to some degree in terms of when the ASD participant is asked questions or interacts with a prototype, as some aspects of their personality or their diagnosis they will be more prevalent learn in the process. Also, as a reminder, it should be emphasized that ASD individuals' personality is different from their diagnosis, which is only more prevalent in situations where they are overwhelmed or stressed. Regarding this, the ASD individual should not be feeling as if they are being talked down to as if they are "broken" or an "inferior" type of person, but rather should be treated with the same kind of respect as any other neurotypical would. Finally, the purpose of facilitating

these collaborative activities with ASD participants is to contribute to creating acceptance, provide information and change perspective on how the ASD diagnosis is interpreted in today's society, which also aligns with the contents of the ASEC card under the same name *'Avoiding Bias'*, seen in Appendix A. As established in the introduction and related work sections, more information has been published in recent years to change the mistreatment and the perception of ASD individuals regarding the understanding of public attitudes. Any research efforts that seek to contribute to this change are seen as progression to a more inclusive and accepting society in general.

6.4 Future work

As mentioned in the above sections, the ASEC cards themselves have to be tested out in order to strengthen them and be considered as a fleshed-out co-design tool that can be used in collaborative activities with ASD individuals. In this regard, it is pertinent to ensure further that different types of ASD participants, i.e. LFA, ADHD, Asperger's and so on, can relate to the cards, as it was mentioned by the caregiver that some of their most exposed clients would have difficulties understanding the current iteration of ASEC cards. Furthermore, the play formats also require to be tested and then assessed in terms of overall procedure and the time consumption that they take to secure that HCI researchers and practitioners can utilize the cards for their research. As a follow-up to these refinements, ASEC should be in a position where the cards can allow for studies that explore creating appropriate settings for collaborative activities with ASD individuals. Subsequently, as more information becomes available about the ASD disorder, the card could potentially be updated to maintain its relevance to the user segment. Additionally, through the development process of the ASEC on various accounts, there were mentioned ways that the cards could improve and be adopted to be used in different settings than what was initially intended. For instance, during the interview with the caregiver, they mentioned how they could presumably use the ASEC cards with their clients who have experienced some related problem that is described in one of the cards. This was further brought into question by the ASD representatives, who were asked whether or not they could think on different contexts of use for the ASEC cards? Where R2 replied with *"Yes, I think that these cards could be an excellent place to start with in conversations with my psychologist.* From the feedback of the caregiver and R2, the idea of creating an entirely new play format for ASEC that focuses specifically on settings with the ASD individual and their psychologist/caregiver seems like a reasonable opportunity to improve the cards for the future, yet would also require its own individual study assess if the psychologist/therapist would find the cards viable to use with their different clients. Moreover, when reflecting on the contents of the cards, it became evident that they are capable of informing the practitioners about the nuances of ASD and potentially be more accepting of recipients' neurodiversity. To this degree, it would require the recruitment of neurotypical users from various backgrounds and of different ages who either do not know anything about ASD or wants know to more about the disorder in order to change their perception. The motivation behind these users could be that they have recently been diagnosed or knows of a close acquaintance who has and wishes to support them. From this study, it may be interesting to examine if certain groups are more objective in accepting neurodiversity and then explore which cultural factors are applicable for them to resist the idea.

7 CONCLUSION

This article has presented the ASEC design method cards as its main contribution, which is described as a co-design tool that can be used by researchers and practitioners of the field of HCI to support collaborative activities to develop inclusive and representative design solutions for, with and to individuals diagnosed with ASD. In accordance, this contribution was established based on the research question, which was described as the following:

How can ASD experiences be represented in a co-design activities through the use of design method cards?

To answer this question, an interview and a series of evaluations were conducted to ensure that ASEC's purpose as a co-design tool and that it would be able to represent ASD users appropriately. Based on the findings from feedback, it was established by representatives of the user segment that they could relate to the cards. However, it was further observed that they were able to self-reflect on their contents in order to provide deep and personal descriptions of how their diagnosis would be prevalent in certain situations. From the findings, it was shown that ASEC qualifies as a representative co-design tool to be used in collaborative activities with ASD individuals, yet remains to be tested and assessed on specific aspects of its design, such as the provided instructions to use the cards and the outcome of the process. To conclude, in regards to ASEC being able to represent a user group through the use of design cards, it was reflected that it might be possible to create different types of cards for other disorders and handicaps in order to set out more inclusive design solutions into the world.

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REFERENCES

[1] [n.d.].

[2] [n.d.].

[3] Doăa Çorlu, Şeyma Taşel, Semra Gülce Turan, Athanasios Gatos, and Asim Evren Yantaç. 2017. Involving Autistics in User Experience Studies: A Critical Review. In *Proceedings of the 2017 Conference on Designing Interactive Systems* (Edinburgh, United Kingdom) *(DIS '17)*. Association for Computing Machinery, New York, NY, USA, 43–55. https://doi.org/10.1145/3064663.3064771

[4] Dorota Chapko, Pino Frumiento, Nalini Edwards, Lizzie Emeh, Donald Kennedy, David McNicholas, Michaela Overton, Mark Snead, Robyn Steward, Jenny M. Sutton, Evie Jeffreys, Catherine Long, Jess Croll-Knight, Ben Connors, Sam Castell-Ward, David Coke, Bethany McPeake, William Renel, Chris McGinley, Anna Remington, Dora Whittuck, John Kieffer, Sarah Ewans, Mark Williams, and Mick Grierson. 2020. *"We Have Been Magnified for Years - Now You Are under the Microscope!": Co-Researchers with Learning Disabilities Created an Online Survey to Challenge Public Understanding of Learning Disabilities.* Association for Computing Machinery, New York, NY, USA, 1–17. https://doi.org/10.1145/3313831.3376278

[5] Center for Diseases Control and Prevention. 2021. Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2018. https://www.cdc.gov/mmwr/volumes/70/ss/ss7011a1.htm?s_cid=ss7011a1_w

[6] Kim Halskov and Peter Dalsgård. 2006. Inspiration Card Workshops. In *Proceedings of the 6th Conference on Designing Interactive Systems* (University Park, PA, USA) *(DIS '06)*. Association for Computing Machinery, New York, NY, USA, 2–11. https://doi.org/10.1145/1142405.1142409

[7] Hwajung Hong, Jennifer G. Kim, Gregory D. Abowd, and Rosa I. Arriaga. 2012. Designing a Social Network to Support the Independence of Young Adults with Autism. In *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work* (Seattle, Washington, USA) *(CSCW '12)*. Association for Computing Machinery, New York, NY, USA, 627–636. https://doi.org/10.1145/2145204.2145300

[8] Nadia Piet. 2019. Ai ideation cards. https://www.aixdesign.co/shop

[9] Robia Rashid. 2017. Atypical. https://www.imdb.com/title/tt6315640/

[10] Jacob Hjulskov Ravn. 2022. Co-designing with adult people with ASD: A review on applied tools and techniques. https://projekter.aau.dk/projekter/da/studentthesis/codesigning-with-adult-people-with-asd-a-review-on-applied-tools-and-techniques(87fe369e-d2d1-48eb-a5f4-feb1bd268ce3).html

[11] EBN Sanders and PJ Stappers. 2012. *Convivial toolbox: Generative research for the front end of design.* Bis, Amsterdam, Netherlands.

[12] Elizabeth B.-N. Sanders and Pieter Jan Stappers. 2008. Co-creation and the new landscapes of design. *CoDesign* 4, 1 (2008), 5–18. https://doi.org/10.1080/15710880701875068 arXiv:https://doi.org/10.1080/15710880701875068

[13] David Shore. 2017. The good doctor. https://www.imdb.com/title/tt6470478/

[14] Will Simm, Maria Angela Ferrario, Adrian Gradinar, Marcia Tavares Smith, Stephen Forshaw, Ian Smith, and Jon Whittle. 2016. Anxiety and Autism: Towards Personalized Digital Health. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '16)*. Association for Computing Machinery, New York, NY, USA, 1270–1281. https://doi.org/10.1145/2858036.2858259

[15] Jelle van Dijk, Melina Kopke, Niels van Huizen, Loes van Uffelen, and Laura Beunk. 2019. Empowering young adults on the autistic spectrum: Reframing assistive technology through design. In *4th RTD Conference: Design United*. RTD2019, Rotterdam, Netherlands, 1–14. http://researchthroughdesign.org/2019/ 4th RTD Conference: Design United, RTD 2019 ; Conference date: 19-03-2019 Through 22-03-2019.

[16] Jenny Waycott, Greg Wadley, Stefan Schutt, Arthur Stabolidis, and Reeva Lederman. 2015. The Challenge of Technology Research in Sensitive Settings: Case Studies in 'Ensitive HCI'. In *Proceedings of the Annual Meeting of the Australian Special Interest Group for Computer Human Interaction* (Parkville, VIC, Australia) *(OzCHI '15)*. Association for Computing Machinery, New York, NY, USA, 240–249. https://doi.org/10.1145/2838739.2838773

[17] Christiane Wölfel and Timothy Merritt. 2013. Method Card Design Dimensions: A Survey of Card-Based Design Tools. In *Human-Computer Interaction – INTERACT 2013*, Paula Kotzé, Gary Marsden, Gitte Lindgaard, Janet Wesson, and Marco Winckler (Eds.). Springer Berlin Heidelberg, Berlin, Heidelberg, 479–486.

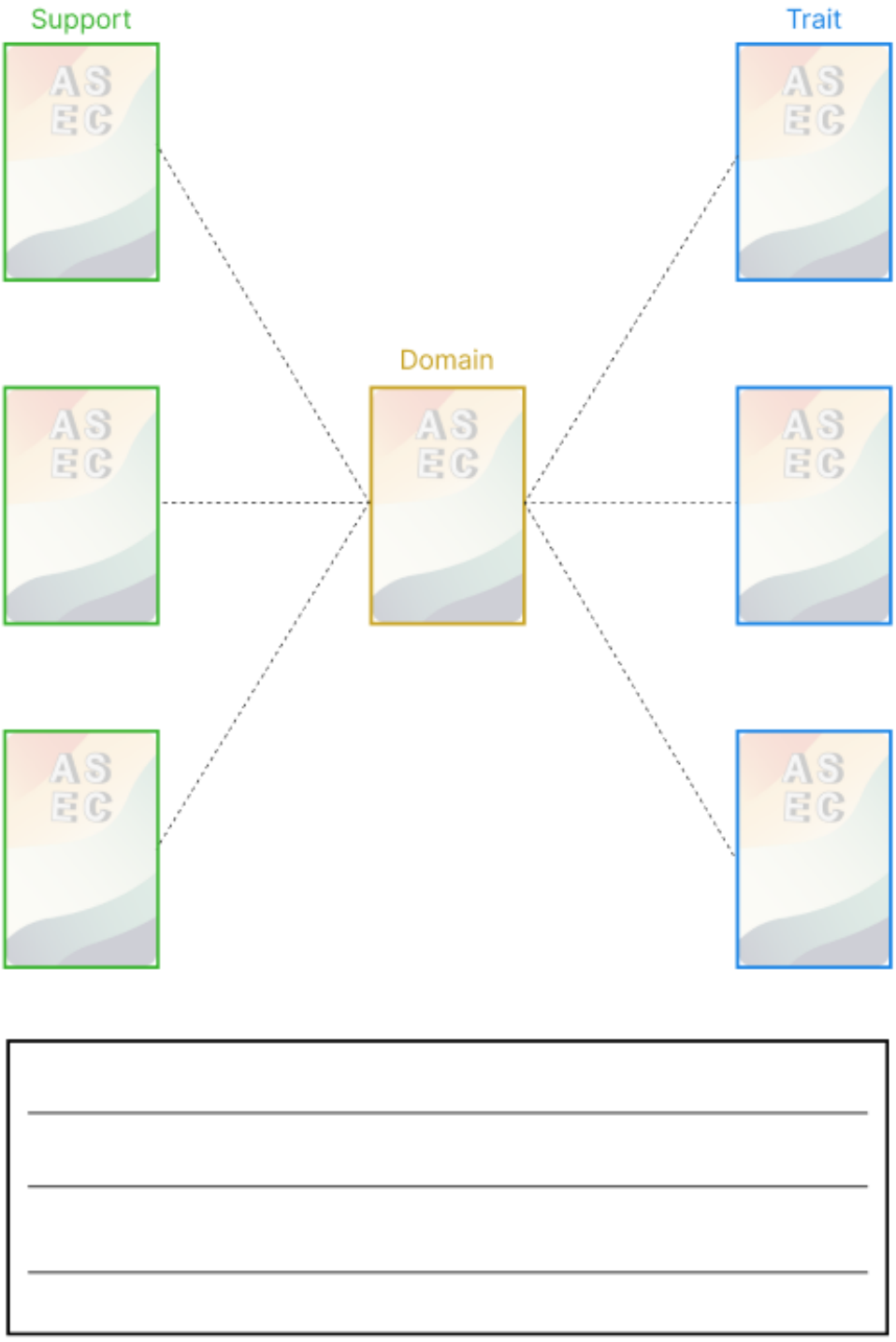

Fig. 2. Shows the ASEC playmat that are used with the cards, which consist of seven place holders, one for a domain card, three for trait cards and three for support cards, as well as a text field to document the idea

Fig. 3. Facilitator together with ASD representatives giving feedback on the ASEC cards