When Life Gives You Lemons

Designing a Game **With** and **For** Autistic Girls

Master Thesis

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Abstract.

Autism (also ''Autism Spectrum Condition") is a lifelong neurodevelopmental condition that is characterized by differences in verbal and non-verbal social communication, behavioural patterns and sensory differences – ultimately affecting how an individual experiences the world surrounding them and their interactions with their social environment [30, 8, 51, 12, 4, 64]. Perhaps because they are often able to blend in to their social environment and use ''masking" behaviours to obscure typical autistic traits [36, 74, 57, 66, 55], autism seems to be under-diagnosed in girls[74, 57]. Although there is now an increasing pool of knowledge on girls with autism, tailored interventions for them are still missing. It is clear that girls still face similar difficulties as autistic boys and are often marginalized by their peers [14, 6, 37], so there is a need for support that fits their wants and needs.

In recent years, applied computer games (also ''serious games") have gained popularity as ''autism interventions" that aim to support young autistic people in developing their social and emotional skills [121, 113, 84, 59, 56, 40**?**], although there seem to be no such games specifically made for autistic girls. Computer games are suggested to be a helpful learning medium, as autistic individuals often prefer predictable environments (which games provide) and they can exploit the high competency and experience with technology and games that many young people (including autistic ones) already have. Games also seem to provide opportunities in a pedagogical sense, because they typically incorporate principles that drive motivation and enjoyment with increasing levels of difficulty and challenge [121]. While computer games are unlikely to replace therapy or real-life learning, they may provide an affordable, accessible and flexible way to offer additional support.

In my thesis, I investigate how we can design an applied computer game to support autistic girls (10-16y.) in their socio-emotional development. An important factor was to treat the game like a training/experimentation environment, where girls can safely experience, live through and learn coping strategies for difficult social situations and emotions that they may face in real life. The project employed a user-centric approach by involving autism experts, practitioners and autistic girls from within the target group to co-design parts of the game. A central concern was hereby to ensure that the game objectives are in the best interest of autistic girls and are not only reflective of what (non-autistic) researchers believe requires change/adaptation. The thesis therefore produced two main outcomes: a proposal for a game design and a playable game prototype (with insights from two preliminary

play-test sessions). Additionally, insights on the active involvement of autistic girls as co-designers were gathered.

2 Terminology

2.1 Acronyms

- ABA - Applied Behaviour Analysis
- ANT - Actor Network Theory
- ARM - Autism Rights Movement
- ASC - Autism Spectrum Condition
- ASD - Autism Spectrum Disorder
- D&D - "Dungeons and Dragons"
- IS - Interactive Storytelling
- ND - Neurodivergent
- NPC - Non-Player Character
- NT - Neurotypical
- PD - Participatory Design
- RPG - Role Play Game
- TD - Typically developed/developing
- UI - User Interface

2.2 Further clarifications

In this thesis, the term "applied game" is used synonymous to the more popular term "serious game".

Furthermore, the term "neurotypical" is used to refer to people who have a "*style of neurocognitive functioning that falls within the dominant societal standards of "normal"*" [119], similarly to "typically developed/developing". It is not synonymous to the term "non-autistic", which also covers non-autistic, neurodivergent individuals. Both terms are often used in contrast to "autistic".

Concerning methodology, the term "co-design" will, for the purpose of this project, be used interchangeably with participatory design and inclusive

design (although they are not exactly synonymous when adapting a more nuanced view).

Chapters 3, 4 and 5 contain paragraphs/are adapted versions of their corresponding chapters in the research topics report, which was graded previous to the start of this thesis.

Contents

3 Introduction

Autism is characterized by a number of cognitive, sensory and behavioural differences that can have a negative impact on an individual's ability to successfully connect with their social environment and create difficulties in daily social life [30, 8, 51, 12, 4, 64]. For autistic girls, who are diagnosed less commonly [74, 57] and are often able to hide superficial differences in an effort to be accepted by their peers [36, 74, 57, 66, 55], these difficulties can be amplified during adolescence, as social dynamics become more complex and relationships with peers gain relevance [14]. As they also seem to face a lack of support tailored to their needs[1], **this thesis aims to design such a support for autistic girls in the form of an applied computer game**.

3.1 Autism

> *"(T)he need for meaningful social connection, and the pain we feel without it, are defining characteristics of our species."* - Cacioppo and Patrick (2008) [23, p. 7]

Autism (also ''Autism Spectrum Condition") is a lifelong neurodevelopmental condition that is characterized by differences in verbal and non-verbal social communication, behavioural patterns and sensory differences [2].

These differences often lead to difficulties in the daily social life of autistic people. Frequently reported difficulties in the academic literature include initiating and maintaining conversations [30, 8, 51],interpreting verbal/non-verbal behaviour leading to misunderstandings of others' intentions [30, 8, 51], spontaneously interacting with peers [12], making eye contact [34], attending to faces [111] and self-regulating emotions, which can lead to aggressive and/or withdrawn behaviours that stand in the way of interpersonal communication [64]. Ultimately, these difficulties frequently cause autistic individuals to become disconnected from their social environment, facing exclusion by peers, harassment and bullying [4, 86, 88, 11, 64, 96, 117]. They also tend to have fewer, less reciprocal friendships that do not generally center around emotional bonding [88, 86]. And failing to form and maintain relationships may lead to social fragmentation [4].

[1] We noticed this while looking for related computerized applications/interventions.

[2] The diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders, DSM-5, by the American Psychiatric Association, 2013 are verbal and non-verbal social communication impairments, sensory abnormalities and restrictive interests.

As the quote above illustrates, humans struggle when they lack meaningful social connection [23] and this is also true for autistic people, who do not necessarily crave to feel a sense of belonging, connection, intimacy, trust and friendship any less than non-autistic people [13, 32, 97, 10]. Indeed, it may be as a cause of not being able to fulfill these needs, autistic individuals are prone to the development of unhealthy coping mechanisms and mental health problems [11, 64, 96, 117].

Autistic, adolescent girls are particularly affected by these difficulties with fitting into their social environment and currently lack sufficient, tailored support. Different to many autistic boys, girls often appear to blend in with their social environment by suppressing autistic behaviours, monitoring that of others and their own and copying what is perceived as normal or desirable behaviour - these compensatory behaviours are often referred to as "masking" or "social camouflaging" [36, 74, 57, 66, 55]. However, what seems like adaptation can actually have destructive effects on their mental health (it is associated with anxiety and depression), drain their energy and affect their sense of self [71, 24, 70]. Especially the development of harmful internalizing symptoms appears to be more likely for autistic girls than autistic boys or typically developing children and adolescents [103].

Furthermore, it is also suggested that especially during adolescence, masking is not sufficient to navigate the increasingly rapid and nuanced communication and attention to feelings that underlies (often female) friendships [14]. Indeed, while some studies suggest that they have better interpersonal skills [66, 55], autistic girls and boys still encounter similar problems with social interactions, e.g. not easily being socially accepted and lacking reciprocal friendships [37]. Differently to boys, who tend to be rejected openly, girls are more likely to be overlooked and neglected [6, 37]. This provides more opportunities to interact with peers, but they still face barriers in successfully engaging with them, as there is a breakdown in communication.

Perhaps as a consequence of superficially "blending in", autism in girls remains under-diagnosed (in comparison to boys with similar autistic traits) [38] and there is a lack of support that specifically caters to autistic girls. However, such support is necessary to help engagement with peers and forming sustainable and reciprocal relationships [36], but also to help mitigate risks of employing self-destructive coping strategies and their consequences [36, 74].

3.2 Applied Games

In recent years there have been various projects exploring applied games (also: "serious games") and gamified, computerized interventions with therapeutic goals[3] for autistic children and adolescents. A big part of these efforts have been focused on teaching social skills [121, 113, 84] and related abilities such as emotion recognition [59, 56, 40, 2].

Applied Games

Games that aim to train, educate, inform [65] or change behaviour [9]. Another definition states that they "foster learning of targeted skills that are particularly difficult or not rewarding"[121][a]. Importantly, the central goal is that in-game learning can be generalized (transferred) to real life. In contrast to entertainment games, their main purpose is not entertainment, but serious games still take advantage of video game design principles that create an immersive, enjoyable environment. To achieve central educational or therapeutic goals, serious game design is also grounded in theories related to learning and development, e.g. social cognitive theory [121].

[a] In the spirit of neurodiversity, the definition may be adapted to provide more room for games that do not aim to change behaviour or teach skills against the player's inherent will to do so.

Gamification

Refers to the use of game elements in a non-game context. In the case of autism interventions, a software (etc.) may not be considered a game as a whole, but integrates e.g. reward systems or levels[123] (typical game elements) in therapeutic exercises with the aim of increasing enjoyment and motivation [73].

Existing computerized gam(e/ified) autism "interventions" differ in several aspects, such as the specific skill they aim to train, the amount of game design elements/gamification incorporated in the product, whether it is single- or multiplayer, the technology that is used and the intended setting in which it will be used (e.g. with or without supervision by therapists and teachers). A more in-depth analysis of related work in the field will be presented in the chapter on "Related Work". Notably, none of these studies

[3] This also includes a large body of applications with the objective of behavioural change, which is a controversial goal in the context of the autism rights movement (ARM).

proposed a solution tailored for autistic girls.

3.3 The Design Lens: Framing Autism

Before starting to design a game to support autistic girls, it is helpful to be aware of the "design lens" through which the project will be carried out. In this case, we found it important to emphasize that **autism is not a disease, but it is characterized by differences that can be disabling in a societal context**, when it does not meet autistic needs and runs on the expectations and norms set by non-autistic people [72]. This is not the only view on autism, so the the two central, contrasting views are briefly presented to illustrate the context in which this project exists.

The traditional (and still widespread) "medical" view on autism pathologizes it (hence the term "ASD" = Autism Spectrum *Disorder*) and consequentially there have been many efforts to "treat" it by attempting to cancel autistic traits and essentially make autistic individuals be *less autistic and more normal*. Furthermore, autistic people have often been reduced to being patients and research subjects rather than being viewed as human beings with equal rights (e.g. for autonomy) to non-autistic people and therefore a large chunk of scientific research on autism has failed to take into account the perspective of autistic people [42, ch.2].

> *When I am in an environment I feel comfortable in, with people who are kind and tolerant, and doing things I enjoy, then I am as happy as the next person. It is when people tell me I should think, speak or behave differently that I start to feel different, upset, isolated and worthless. So surely the problem is a lack of fit with the environment rather than something inside my brain that needs to be fixed?* - Victoria, 'Are You Taking Something for It?', issue 76, 12; cited in [78].

The medical view on autism has been criticized and rejected by members of the autism community and supporters of the autism rights movement (ARM, as part of the general disability rights movement) causing a **paradigm shift to the "social" or "neurodivergence" lens** [42, ch.2]. "ASD is an outdated term", says Lees [115]. Similarly to the Podcast "Two Sides of the Spectrum" [85], she starts by introducing appropriate, identity-affirming language: Being autistic is part of a multi-faceted identity and not a disease, so instead of saying a person "has autism", they "are autistic". Words like "deficit", "disorder", "symptoms", "impairments" and the

idea of "treating autism" set autistic people up for a life of low self-esteem, when we should really be trying to remove barriers and accept autism as different (perhaps like a different culture[4]) and not less. Indeed, autistic advocates, community leaders and scholars - within a wider movement towards disability rights - have been working towards replacing the clinical (medical) model of autism with the social or neurodiversity model, both of which ultimately aim to create a social environment that enables and accepts autistic people without forcing them to conform to all norms set by the mainstream majority [42]. Importantly, Fletcher-Watson and Happé point out that **"adopting a neurodiversity stance does not preclude providing support to people in need, nor does it deny the very real challenges experienced by many autistic people and their families."** [42] (ch 2).

Autism is like being a foreigner in every country - Enrico Bianco[7]

Lees, an autistic speech and language therapist, explains that autistic behaviours and communication strategies are often misunderstood by therapists and educators and attempts to fix them mindlessly can be damaging [115]: What can be perceived as a child throwing a tantrum is often not an intentional behaviour, but an uncontrollable release of built-up anxiety and overstimulation (e.g. as a result of masking). Avoidance and refusal of demands is often not a sign of stubbornness or wanting to push boundaries, but an attempt to seek control as response to anxiety from feeling overwhelmed with daily life. Teaching a child to maintain eye-contact is often inappropriate, as it can cause physical discomfort and pain [115]. Milton, an autistic researcher, also points out that there are some double-standards in what is categorized as appropriate social behaviour: A commonly named deficit of autistic people is turn-taking, but what is perceived as "normal" group conversation dynamic often seems like a competition of who can talk the loudest and can dominate the conversation (i.e. an "accepted" violation of turn-taking rules) [85].

I like the comparison to Vulcans in StarTrek [...] they feel more strongly than humans, they just don't show it - Kirsten [58]

In response to the now outdated claim that autistic people lack empathy, Milton introduced the **"Double Empathy Problem"** which proposes that

[4]Indeed, there are a few parallels between inter-cultural and autism-related communication differences. Lees points out that e.g. social norms of keeping eye contact in a conversation differ across cultures[115]. Cross-culture communication can be equally difficult considering different (non-verbal) social cues and how intentions are expressed, e.g. use of gestures and facial expressions [85, 22].

the breakdown in communication between autistic and non-autistic individuals is not caused by deficits of the autistic person, but rather by differences in language and perspective [79, 80, 27] and a lack of shared cultural meanings and symbols [77]. Indeed, the idea that the difficulties are bidirectional is supported by evidence that non-autistic people also fail to understand autistic individuals' behavioural reactions [99], prefer to engage with non-autistic, rather than autistic individuals and rate them less favourably [95] and had difficulties understanding whether an autistic conversation partner liked them or not [116]. Meanwhile, there seem to be fewer "signs of impairment" and a higher understanding among autistic people when they interact with each other, rather than with non-autistic individuals [109]. Similarly, Chown observed a greater affinity between autistic people [27] and insights from the autism community suggest that interacting and forming friendships with another autistic person may come easier and be more comfortable than those with a non-autistic person [85, 33, 101, 26, 115].

Of course, the opinions in the field are much more nuanced than just two opposing sides and a lot of the medical terminology has become so embedded in the scientific vocabulary that it is sometimes used regardless of the actual views underlying the research.

This work supports the social/neurodiversity lens, aiming to empower and include members of the autism community to actively take part in shaping the research process and its result and embed their own values in it. This paper also aims to use identity-affirming language [85, 115], also avoiding terms like "high-functioning" and "low-functioning", as they do not appropriately recognize the relevance of environment and other contextual factors (e.g. time-frames) that can influence whether certain autistic traits make an individual able or unable to function[115] [5].

3.4 Aim of the project and project scope

This study aims to design an applied computer game for adolescent autistic girls. The purpose of the game is to provide a support in the girls' social-emotional development by attempting to improve their ability to deal with stressful real-life social interactions and emotions - hopefully also mitigating

[5]Lees points out that these labels may be especially unhelpful when a person is considered "high-functioning" and is consequentially offered less support, even though they may still need it in a different context than the diagnosis was considering. However, the intricacies of an autism diagnosis and issues around labelling are not the focus of this work and will therefore not be discussed in further detail.

harmful consequences like unhealthy coping mechanisms and mental health problems in the long run.

The central design problem is therefore (how) to provide an accessible and safe, computer-game environment for girls to autonomously explore, "rehearse" and better understand social interactions and emotions. The central outcome of this work is the design of such a game (i.e. a description of all design decisions, content and features that make up the game - I will refer to this as the "game concept" in the future) and the development of a playable game prototype for preliminary testing.

Additionally, this study also aims to actively include the target group (besides advice from subject matter experts), i.e. adolescent autistic girls, as co-designers. As further explained in the chapter on co-design, the central motivation for this sub-goal is to empower them to shape their own support-tool and make it desirable and relevant for them. Therefore, the following three questions emerge:

1. What exactly are difficulties (faced by the target group) that the game can provide support for?
2. How should the game be designed to provide such support for the target group (also considering the type of game they might find desirable) ?
3. When and how can the target group be meaningfully involved as co-designers?

A note on scope: Given that this study was confined by limited time and resources, the "final" game prototype is not meant to be a complete and exact representation of the game concept, but it allows testing central features to provide useful insights for future work and development plans. This work also does not aim to prove the effectiveness of the proposed game, which will be a subject for follow-up studies in which a completed game can be tested with participants over a longer time period.

3.5 Thesis overview and report structure

The research and design process in this study was inherently iterative (see ch. "Game Design Methodology"), so steps will not be reported in chronological order. The paper is structured as follows:

1. **Related Work: Applied Games for Autism.** A look at a number of existing computerized interventions for young autistic people are examined and common criticism, as well as recommendations are highlighted.

2. **Towards an Applied Game for Autistic Girls**

   (a) **Game Design Methodology.** Explaining the approach taken towards the given research/design problem and how different experts were included (excluding co-design with the target group, see dedicated ch. "Co-design with Autistic Girls").

   (b) **(Requirements) Game Content and Learning Goals.** A more detailed look at the difficulties faced by the target group, presenting the results of literature/media research, discussions with experts and co-design workshops. In other words: "What should the game be about?"

   (c) **(Requirements) Applied Game Design Elements and Features.** Given the game content and learning goals identified previously, findings from related work on applied games in the context of autism, expert recommendations and input from the target group are used to formulate requirements on what the game should be like and which features it should contain.

   (d) **Result: Description of Designed Game and Playable Prototype.** The concrete design choices resulting from the previously identified requirements, explaining all game features, game architecture and chosen contents. Finally, the playable (technical) prototype for this game is presented.

3. **Co-designing with Autistic Girls.** An introduction to co-design and its relevance for this study, how the target group was involved (co-design methodology) and the impact on the designed game.

4. **Preliminary Play-Test Results and Summary of Expert Feedback.** The key results of feedback obtained from experts and target group throughout the study, as well as final (but preliminary) play-test sessions with two autistic co-design participants (target group).

5. **Discussion and Recommendations for Future Work** A discussion of the proposed game design and prototype, as well as a reflection on the process of co-designing it with autistic girls. Finally, recommendations and directions for future work are highlighted.

4 Related Work

4.1 Applied Games

Similar to entertainment games, applied games should follow a set of design principles that have been highlighted by several authors (with slight differences in terminology and grouping). There also seems to be a consensus that the effectiveness of applied games positively correlates with how many of these principles were applied [121, 112], or how high the "conceptual complexity" of the game is [50] (effectively also referring to the appropriate use of game design principles).

Whyte et al. (2015) propose a design framework based on principles for serious game design originally mentioned by Baranowski (2008) [9] and Kapp (2012) [61] with the following six design elements [121]: *immersive storyline, goals directed around targeted skills, rewards and feedback about goal progress, increasing levels of difficulty, individualised training and provision of choice.*

Grossard et al. (2017) uses the design elements from Yussof's conceptual serious game design framework (2010) [125] that contribute to the conceptual complexity of autism games (training social sills) [50]. This framework is based on behavioural, cognitive and constructivist theories and lists the following twelve criteria for serious games [125]: *incremental learning, linearity, attention span, scaffolding, transfer of learning skills, interaction, learner control, practice and drill, intermittent feedback, reward, situated and authentic learning and accommodating the learner.*

These frameworks, among suggestions from other related work and input from experts and young autistic people, were summarized in a more recent literature survey by Tang et al. (2019) resulting in five criteria (and a more detailed scoring system to determine to which extent criteria are implemented) [112] - see Table 1. *These criteria (1) were used to compare existing autism games in related work (ch. 4.2) and (2) will be revisited in ch.5.3 to formulate requirements for the game proposed in this paper.*

Table 1: Summary of of criteria (with different levels of execution) for applied games (also used as "scoring system" used to colour tables 2 and 3). Criteria 1-5 are from Tang et al. (2019)[112]; the last criterion was mentioned by Yusoff (2010) [125] and Whyte et al. (2015) [121].

Criteria		***Level of execution***
Storyline	***Yes***	Focuses on achieving long term goal, is fully embedded throughout entire game, players engage in purposeful interactions with game characters
	Some	No clear long-term game goal, either not fully embedded or players can not meaningfully engage with characters
	Themed	Content is themed, but there is no storyline
	None	Game focus on explicit skill training
Goals	***Long***	Clear long-term goal achieved through short and medium-term goals
	Medium	No long-term goal, medium term goal achieved through short tasks or short-term goals
	Short	Only smaller, targeted and isolated individual tasks and learning goals
Rewards and feedback	***Reward***	Inclusion of systems for immediate reinforcement through visual/auditory stimuli or collectables
	Feedback	Player performance feedback helps towards achieving goals
	None	No reward and/or feedback features
Increasing levels of difficulty	***Yes***	Different contexts and stimuli are used to increase difficulty of achieving goals in steps and/or there are individual starting points
	Some	Either different contexts/stimuli or increased level of difficulty
	None	Consistent difficulty

Table 1 continued from previous page

Difficulty individualised for players	***Yes***	Automatic generation of individualised starting point and adaptation of difficulty depending on game performance of the player
	Facilitator	External individualisation, player chooses difficulty level for tasks up-front
	None	No individualisation
Learner control/ provision of choice	***Yes*** / ***None***	Player feels autonomous in creating their own trajectory through the game (e.g. exploration, self-discovery, learning through experimentation...)

4.2 Applied Games for Autism

Surprisingly, among the existing applied computer games for young autistic people there seemed to be none specifically designed with girls in mind and autistic girls were rarely included in the user groups to test existing games. Therefore, this section will review a number of computer games (or gamified applications) for young autistic people in general, which target socio-emotional skills and are not multi-player games[6].

This chapter will provide an overview of the related work by comparing the game's learning goals (i.e. targeted skills), their use of applied game criteria mentioned in table 1 and the (reported) involvement of stakeholders and end-users in the design process. A more detailed overview of all mentioned games and their comparison can be found in tables 2 and 3, which the following sections will refer to.

[6]There are many more publications on applied games designed to be played as a group or pair, but they were less relevant for the present study.

Table 2: Serious Games for Emotion Recognition and Production

Game	Targeted Skills	Support (media/ technology)	Storyline	Goals	Reward or Feedback	Increasi difficulty	Individualisation (reg. difficulty)	Learner control/choice/ autonomy	Co-design or input from experts/users influencing design
Aprende con zapo [75]	Facial recognition with and without context, ToM	Drawings, Photos	None	Medium	(Not described)	Some (levels per task)	No	No	Design process not reported, no co-design mentioned
CMotion [41]	Facial expression and emotion recognition in context	Animated virtual characters in 3D	Some	Short/ Medium	Feedback (some, intermittent)	Yes	No	Yes	No co-design, consultation with experts on autism
Computer-based program [19]	Identifying basic facial emotions	Photos	None	Short	Reward	Some	Yes	No	No co-design reported
CopyMe [110, 54]	Mimicking facial expressions from model	Photos, real-time augmentation of player face-view with visual feedback	No	Medium	Both	Some	Choice	No	Design process not reported, no mention of co-design
Emotion Trainer [100]	Recognise and predict emotions with and without context	Photos, animations (as rewards)	None	Short	Both	Some	None	No	Design process not reported, no mention of co-design
Emotiplay [45]	Teach emotion recognition (cross-culturally): faces, voices, body language and integration in context	Computer 2d game with animations and avatar. Mini-games involve photos, videos and animations	Some (user is explorer researching human expression, but tasks are mini-games not fully embedded in story)	Short	Reward	Some	None	Yes	Involvement of experts mentioned, but no mention of co-design methods
FaceSay [56]	Discriminating and recognising facial expressions, joint attention	Photos and drawings	Themed	Medium	Reward	Some	Choice	No	Design process not reported, no co-design
Facial expression recognition serious game [28]	Recognise basic emotions with and without context	Photos, Kinect for motion input	None	Medium	Reward	Some	No	No	No co-design mentioned, largely theory driven.
JEMImE [35]	Producing adequate facial expressions (with and without context)	Computer game with avatar-model, AI based facial recognition	Some (in the second phase player has to act within a social scene, but this isn't connected to a larger storyline)	Medium	Both	Some	Yes (thresholds for success automatically adjusted to progress of player)	No (consequence of player choosing not to agree in social scenario unclear)	Design process not reported, no mention of co-design
JeStiMulE [98]	Recognise emotions with or without context	Computer game in 3D/VR with avatars and pictures of real-life characters, (social) cut-scenes of avatars, play with mouse or joystick, multisensory	Some	Long	Both	Yes	Yes	Yes	Design process not reported, no mention of co-design
Let's face it [111]	Face recognition	Photos	Themed	Medium	Reward	Some	Choice	Some	Design process not reported, no mention of co-design
LifeISGame [40, 3]	Recognising and producing facial emotions with and without context	Cartoon with 3D avatar on computer	No	Short	Reward	None	Choice	Yes	Preference study for childrens' character preferences and validation of facial expressions on game characters, suggestions from therapists were incorporated
Mind Reading [47]	Recognizing emotions from face and voice, with and without context	Films, recordings and written examples of situations	None	Short	Reward	Some	Yes	Yes	Design process not reported, no mention of co-design
SmileMaze [29]	Recognizing and producing facial emotions	Smileys, (computer recognition of) smiling. SmileMaze is a training program within "Let's Face it!"	Some (Task of smiling is integrated in gameplay by acting as mechanic for moving through maze)	Short	Both (reward is progression in maze, feedback by visualizing "Smile-O-Meter" filling)	No	No	Some	Design process not reported, no co-design mentioned

Table 3: Serious Games for General Social Skills (and Other Related)

Game	Targeted Skills	Support (media/ technology)	Storyline	Goals	Reward or Feedback	Increasing difficulty	Individualisation (reg. difficulty)	Learner control/ choice/ autonomy	Co-design or input from experts users influencing design
New Horizon [25]	Reducing stress and anxiety	Mobile 2D game app with drawings, animations and audio	Yes/Some (background story explains game elements and goals for mini-games)	Short	Reward	No	Choice	Yes	Close collaboration with specialise therapists
A SUNNY DAY [123]	Concentration, imaging capacity, communication skills	I-pad interface, click interact with objects/game characters	Some (some purposeful interaction with game character, tasks related to real life and daytime)	Short	Reward	No	No	Some (choice of minigame)	Interviews with institutions who wo with autism to inform game desig observation of treatment methods, i terviews with parents, teachers a children to inform integration of goa in application, adjustments mad through play-testing with children
Computer-assisted instructions [17]	Social problem solving	Question-answer format	No	Short	Reward	Some	None	Some (production of novel ideas was encouraged)	Design process not reported and n mention of co-design. Collaboratio with computer firm for developmen mentioned.
ECHOES [18]	Joint attention and symbol use (meaning and intentions expressed through gestures/words etc.)	2-dimensional "sensory garden" + autonomous virtual agent as credible social partner, multitouch LCD display with eye-gaze tracking	Some (no overarching storyline, activities in meaningful context)	Medium	Reward	None	None (maybe Some: through autonomous virtual agent as facilitator)	Yes	Participatory design workshops wit children, workshops with practitione and older autistic children/adolescen as consultants (11-18) e.g. storyboard ing
Job interview simulator [108]	Job interview skills (eye contact, appropriate language. . .)	Interaction with a real person through Virtual Reality	Yes (context of interview scene and their role)	n/a	Feedback during practice session and after test session, none during test session	Some (interviewer is supportive in practice session, but neutral during test)	Yes (preparation session to determine goals)	Yes	No co-design mentioned, environmen not designed specifically for this sim ulation (basic office environment fro "Venugen" platform)
Junior Detective Program/ Secret Agent Society [16, 15, 102]	Recognizing Emotions, social skills training in context	Computer game in 3D with real scenarios	Yes (Futuristic/ Detective theme)	Long	Reward	Yes	None	Yes	Collaboration with multimedia stu dents, design process not reported
PECS-based Serious game [84]	Improve communication and social skills	Computer game, 2d animated, from single to multi-player (collaboration)	Themed/ Some (no overarching plot, minigame plot not integrated)	Medium	Both	Yes	Yes (proportional increase with game level)	No	Requirements and suggestions fro users and experts were taken into a count
Pico's Adventures [73]	Social initiation	Kinect-based, 3D animation	Yes (helping an alien with building a spaceship)	Long	Reward	None	None	Yes	Inclusive design approach is central t the project: Co-design with autist children and different experts.
TeachTown [120]	social and emotional skills, language arts, language dev., adaptive skills, cognitive skills, maths	Pictures, photos, videos	None	Short/ Medium (unclear)	Reward	Some	Choice (by teacher, based on rank placement questionnaire)	Some	Design process not reported, no co design mentioned
Virtual Café [87, 81]	Social skills in context	VR Game, virtual characters	Some (context of scene, but no real narrative)	Medium (several tasks to finish a level)	Feedback (awareness of complete vs. incomplete tasks throughout level)	Yes (adding complexity)	Yes (difficulty increases with levels, preparation in training phase)	Yes	No co-design mentioned, application specific user studies (before gam design) to e.g. investigate understand ing of Virtual Reality as representa tional (i.e. virtual people = not re people but representing real people)
Virtual Reality in Second Life [60]	Emotion recognition, ToM, Conversational skills in context	Interaction with other avatars in 3D virtual environment (Second Life is a general-purpose game, not specifically for autism)	Some (prompt given for each role-play session)	n/a	Feedback after session	(Yes, given by the platform)	Yes (preparation session, observe performance and pick appropriate objectives)	Yes	Existing software, no indication of co design in designing role-play scenario

4.2.1 Targeted skills in related work

There are several different learning targets among autism interventions for "social skills training". One category of games specifically aim to train **recognition and production of emotions** (for an overview see Table 2). For example "FaceSay" uses realistic avatars to train attending to eye gaze, discriminating and recognizing facial expressions and emotions [56]. Similarly, "LifeISGame" uses the animated face of a three-dimensional, virtual avatar and players are asked to perform different tasks and challenges that involve manipulating the virtual face and copying its facial expressions [40, 2]. The approach of asking users to copy facial expressions can also be found in "CopyMe", although based on pictures of real people and not an animated character [54, 110]. "Let's Face it!" is comprised of different games where players have to correctly label the facial emotion that a person is displaying on a photograph [111]. With a bit more situational context and integrated in a bigger story-line, the "Junior Detective Training Program" (renamed to "Secret Agent Society" or SAS) also contains recognizing emotions of other game characters or of people in videoclips as one of several learning goals [16, 15, 102]. Other games or gamified interventions teaching facial emotions with or without context include "Aprende con Zapo"[75], "CMotion"[41], "Emotion Trainer"[100], "JeStimule"[98], "Mind Reading"[47] and "SmileMaze"[29] (among others).

Table 3 provides an overview of other autism serious games that target a range of skills related to social interaction: The "Junior Detective Training Program"/"SAS" aims to **improve social-emotional functioning through lessons on identifying emotions in oneself and others from verbal and non-verbal behaviour and physiological signals, reading and dealing with situations that provoke anger and anxiety and dealing with a variety of social situations** [16, 15, 102]. "A SUNNY DAY" trains **communication skills** [123] and "Teach Town" [120] targets **social and emotional skills, e.g. with lessons on joint attention and social engagement**. "AScapeD"[7] teaches **cooperation and communication** [113]. "ECHOES" focuses on **joint attention and symbol use as social interaction skills** [18] and "Pico's Adventure" promotes **social initiation** [73]. Some games, especially those using Virtual Reality (VR), specific scenarios are simulated: E.g. to provide support in aspects of **social understanding**, players of "Virtual Cafè" need to perform a series of typical tasks while navigating a virtual cafè environment (e.g. finding a place

[7]This game has the format of a multiplayer virtual escape room, which is less relevant to the game proposed in the current study, so it was excluded from the tabular overview.

to sit)[81, 87]. The "Job interview simulator" helps, as the name suggests, **preparing autistic people for job interviews** [108]. While not directly related to social skills, "New Horizon" should perhaps get a special mention as example for a serious game that aims to **reduce stress and anxiety** in autistic children by integrating techniques from cognitive behaviour therapy [25].

4.2.2 Use of applied game criteria in related work

Firstly, it is important to note that not all of the mentioned applications are best described as games, but rather as "social interaction simulation" [121], because they contain few to no game elements. This form of intervention can provide a controlled (hence safe), but somewhat ecologically valid, virtual version of a real-life space/situation. The idea is that players may find it easier to generalize this virtual experience to real life, especially when they can experience it immersively in first person and in virtual reality (VR) [81]. More than a stand-alone training program, this type of environment or simulation is typically used as tool to facilitate the interaction between the autistic individual and their therapist (or other) in real time [121], e.g. to simulate a job interview [108] or as described by Kandalaft et al. by reciting scripted role-play scenarios through their virtual characters within the online multi-player platform "Second Life" [60].

Tables 2 and 3 provide an overview of the extent to which different autism interventions make use of the applied game design elements introduced in the previous section (a darker green indicates a more complex use of the element). Comparing the games with these criteria, a few observations are possible: There is a lot of variation in the use of serious game elements and several games use very few (e.g. "Aprende con zapo"). The use of long or medium-term (game) goals seems to be fairly rare (e.g. when tasks are disjoint and short-term goals do not help achieving longer-term goals within the game). While rewards (especially extrinsic ones, e.g. a sensory stimulus or collectable token) are very common, few games provide feedback on overall player progress. The use of overarching narratives or story-lines that contextualise game tasks is not common, especially among games targeting emotion recognition and production. As a result, they often do not properly integrate the serious content in game-play. For most games training "social skills", there is also a lack of consideration for elements that make players feel in control and give them a sense of autonomy.

Examples of serious games that have received positive attention were e.g. "JeStimulE", as it employs relatively complex gamification strategies [112] and "SAS" or "Pico's Adventure" for their use of narratives and contextualised learning [112, 121]. For example, in "SAS" children play as secret agents in a futuristic detective agency [15], while in "Pico's Adventure" they are tasked with helping an alien fix its spaceship [73]. Interestingly, autistic youth participating in a study on preferences for autism serious games highlighted a "motivating storyline" as a very important element, while professionals emphasized the importance of generalisation of skills to everyday contexts and that serious games should contain "goal directed learning"[112]. In this regard "SAS" especially has, through several studies, been shown to be effective for the generalisation of skills learned within the game to real life, although it is important to mention that the training program goes beyond the virtual game itself and includes materials to be used by facilitators, small group programs etc.[16, 15, 102, 121].

4.2.3 Stakeholder involvement and co-design in related work

The majority of the, especially older, academic literature concerned with designing applied (computer) games for young autistic people does not describe the involvement of experts and target group - especially as co-designers - in detail or at all (see Tables 2 and 3)[8]. In most cases, only subject matter experts are involved as advisors through interviews or brainstorm sessions in which e.g. game objectives are decided on [73] or information on treatment methods and general knowledge on autism is provided [123].

For the design of "ECHOES", which involved interactions between player and virtual agent, therapists and teachers were involved in storyboarding workshops. To come up with scenarios of how the child might interact with the virtual agent, participants were provided with a basic set-up of the game setting and props that would exist in the game. They were then asked to role-play interactions using the props. The role-playing element was specifically used to reveal which behaviours would be needed for the virtual agent in detail, as verbalizing or drawing an interaction may miss out on conveying small or subconscious, but important actions [18, 44].

[8]While this is not necessarily true for studies on different types of applications or non-computer games (not examined in this thesis), it is possible that research and design teams in charge of making a computer game find it especially challenging to involve participants without technical or design expertise, as Khaled et al. (2014a, 2014b) suggested [63, 62].

Yan et al. also report conducting observations of practitioners and children in a care institution to gain information on common practices and childrens' everyday life, as well as conducting interviews with parents, teachers and children [123].

4.2.4 Critique and Gaps in the Literature

Many applied games fail to provide a coherent and enjoyable gaming experience. When considering gamified interventions and applied games, there is a difference between gamifying specific elements of the intervention, for example by using reward systems for therapeutic tasks, or making a game that is designed to provide a good gaming experience [114] and is based on serious game design principles that promote learning, but also enjoyment and a coherent experience [121]. Indeed, a common weakness in existing "game" interventions that combine game elements and therapeutic tasks, but fail to fulfill the objectives, seems to be poor game design and a lack of a coherent experience (fidelity dissonance [65]) [73, 121, 112]. In a survey of autism game interventions related to social skills training, Grossard et al. (2017) found that **most studies paid no attention to accessibility and enjoyment and did not design games with characteristics of a video game, but like exercises with only therapeutic objectives in mind** [50]. Whyte et al. (2015) found that **not making use of established game design principles known to stimulate engagement, motivation and learning coincided with ineffectiveness of game intervention solutions** [121]. These findings were recently validated in a systematic review of computer-based interventions to improve social emotional skills in autistic individuals, suggesting that generalisation outcomes are indeed positively affected by a greater integration of serious game design elements, but existing interventions only used a few of them on average [112].

There is a lack of user-centered design practices. According to Malinverni et al. (2017), a major pitfall is the failure to use inclusive design approaches to properly integrate knowledge from clinical experts, game designers and the childrens' own interests, resulting in a lack of understanding of game design strategies and player engagement [73].

> "In many cases the serious part of serious games seems to justify the sacrifice of fun, entertainment and aesthetics in order to achieve a desired goal by the player. An often-observed phenomenon is that despite rules and guidelines, efforts in making serious games don't result in a good game, mostly because the

unique motivational features of games are lost in the process." [65] (p.240)

Besides undermining success in achieving therapeutic goals, a poor game experience will not help gaining interest from children and adolescents when they are used to playing very well designed video games on the market [73]. While it may be unfair to consider commercial games for enjoyment as direct competition, it is hard to deny that they will influence the players' expectations and motivation to voluntarily spend their time playing a game with a therapeutic goal - especially if enjoyment was not considered as a significant design factor.

In regards to autistic self-advocacy and more modern views of autism, it is also evident that most of the reviewed literature fails to involve autistic individuals in the design process and continues to view autistic end-users as "patients" (i.e. through the medical lens). Some of the games' goals, perhaps as a consequence, seem to conflict with what the autism rights movement stands for, e.g. reinforcing mindless "copying" of non-autistic behaviours and encouraging eye-contact regardless of potentially harmful consequences for the autistic player.

Lack of standardised procedures and testing and reporting of designs. Grossard et al. (2017) point out that there is a lack of standardised procedures and controlled, randomized clinical trials to evaluate the effectiveness of proposed designs (especially in the long-term) [50], therefore making a comparison of quality not straight-forward. The lack of standardised procedure also becomes clear in the reporting of design methods and even description of games in research papers, which is often insufficient to clearly understand what and whose insights design decisions were based on. This also makes it difficult to extract helpful information to inform future work.

No games for adolescent autistic girls and missing information on games' target audiences. None of the existing applications were specifically tailored for autistic girls. Papers often do not report characteristics of the intended target-user group sufficiently and most games therefore seem to be "unisex", but participants included in the research are usually younger boys [112]. In regards to age, as visible in Figure 1, the games occupy a wide range - although, again, details on target groups are not always reported, which makes it difficult to take full advantage of their findings. It is notable that, aside from games that claim to be playable for children and adolescents

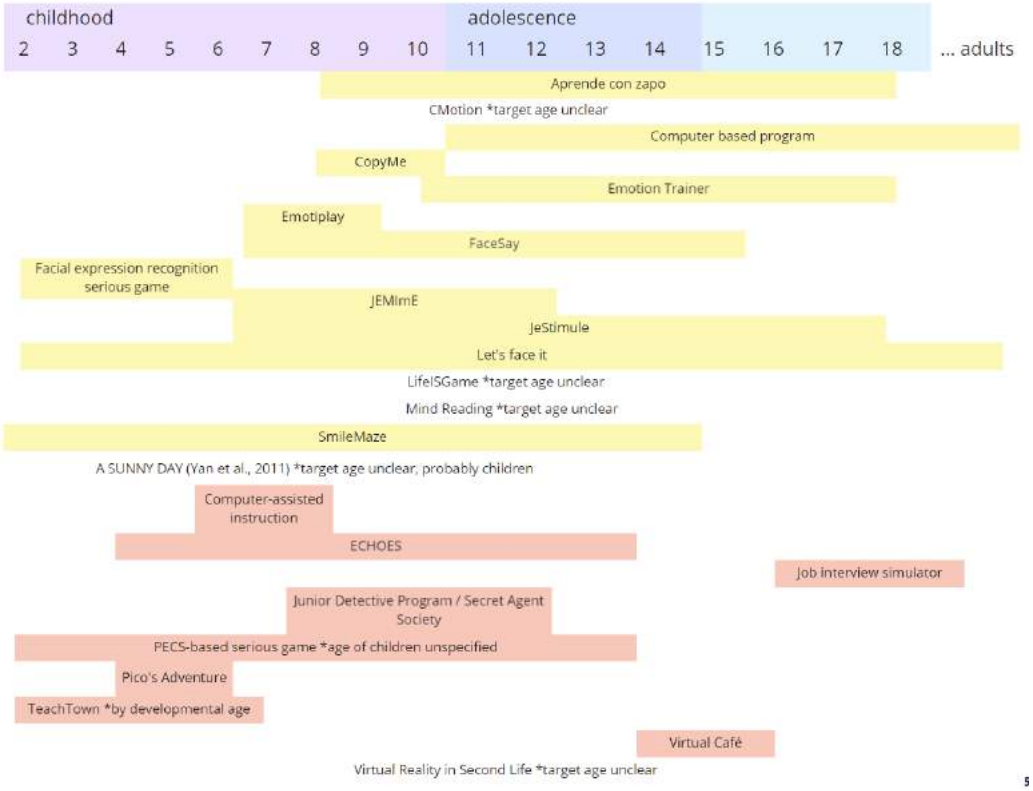


Figure 1: Related Autism Serious Games with Target Age Group

"in general", no application covers the range between 10 and 16 years of age (the target group for this study).

4.3 Conclusion

The recommendations and critique following existing, related work have the following implications for this study:

- The effectiveness of an applied game is suggested to heavily rely on how engaging it is to the player, and how coherently therapeutic objectives are integrated in game play.
- To achieve an engaging and coherent game, it appears that the game should (1) make use of game design principles that are known to drive motivation and engagement and (2) employ user-centered design practices by involving various experts and target users as co-designers to integrate knowledge, interests and suggestions on game features.

- Finally, the choice of target group for this study is supported by the lack of existing games for adolescent autistic girls (10-16 years) at the time of this analysis.
- (While not immediately applicable due to the scope of this project, it is advisable to use standardised procedures and controlled, randomized clinical trials to evaluate the proposed game once it is developed.)

5 Towards an Applied Game for Autistic Girls

5.1 Game Design Methodology

5.1.1 A short preface: Applied game design is a "Wicked Problem"

Designing solutions to the problems currently faced by autistic people can be viewed as "wicked problem" [43], a term first introduced by Rittel and Webber in 1973 to describe highly complex dilemmas that require thinking in a bigger picture and have no single, correct solution [93].

If we recall the differences in assumptions made by the medical and the societal model of autism, the central issue seems to be a disagreement in framing the "problem" at hand: Assuming that "not being normal" is the problem, then it is logical to create solutions to make people "more normal". But, as Madrigal points out in a broader discussion around disabilities, normalcy is defined by history, circumstance and culture. For autism (and disabilities in a wider sense), the problem is therefore re-framed as a mismatch of what people need and the the system surrounding them [72].

While, in the case of non-wicked problems, getting a consensus of their nature is fairly easy and "the task [of devising a solution] could be assigned to the technically skilled, who in turn could be trusted to accomplish the simplified end-in-view" (Rittel and Webber, 1973, p.158)[93], ignoring the complexity of problems surrounding autism is not appropriate. "We have been learning to ask whether what we are doing is the right thing to do" (Rittel and Webber, 1973, p.159). **Designing a good applied game for autism then is not only a matter of finding the correct methods to achieve established "therapeutic goals", but also of questioning these goals and involving autistic people themselves in defining the problems they face**.

This project also requires questioning the position of the designer themselves: Madrigal suggests that **we should ask "who are we and how can we relate (if at all) to this topic in a respectful way** that would allow us to fulfill the project without falling into patterns of paternalism and privilege. In short — how could we immerse ourselves into the problem without becoming part of it?"[72]

The central conclusion of this small thought excursion comes in the form of the decision to place a heavy emphasis on co-design with autistic people as design methodology. This aspect is presented in detail in ch. 6.

5.1.2 Design Strategy and Process

With the goal to meaningfully involve experts and autistic people throughout the game design process, the methodology was influenced by the "game design thinking" approach [5] (see Fig. 2), which describes the involvement of stakeholders at each different stages. It is important to emphasize here that, as also highlighted by Terlouw et al. (2020), the whole design process should be considered as *iterative*, in order to properly integrate various perspectives and goals that may not all be known at the start of the project [113].

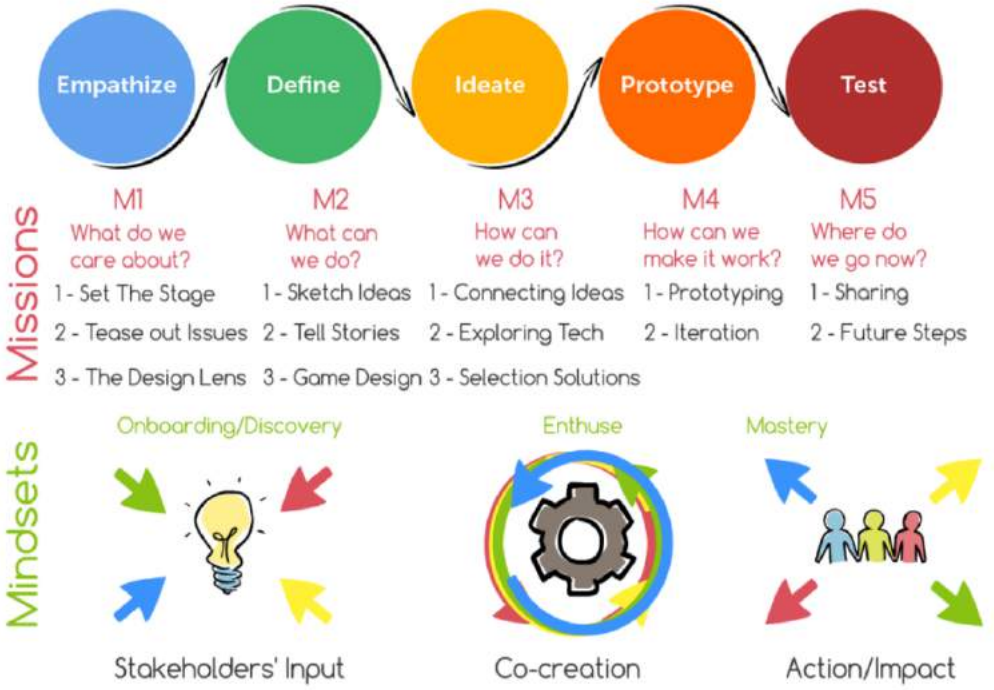


Figure 2: Game Design Thinking approach. Image from [5]

These more detailed phases can also be summarized in terms of *who is involved* and *which aspects of the game are worked out* - more or less corresponding to the three "mindsets" (Fig.2): Two useful systems that were combined and applied in this study were proposed by Winn (2009) [122] ("Design, Play, Experience" model for applied games in general) and Malverini et al. (2017) [73] (specifically related to the co-design of an applied game for autism):

1. **Setting goals and "serious" content**: Starting with the central and least flexible aspect, the learning objectives, designers should focus on

domain content and how to integrate it with pedagogical theories in the game design [122]. Experts should be involved to set requirements and therapeutic goals, as well as the structure of the (game) experience and therapeutic techniques to be integrated and autistic children should be involved to identify their interests, motivations and preferences [73]. *(See ch.5.2)*

2. **Further specification of game design**: Based on the learning objectives, appropriate game settings, characters and narratives should be devised and the content needs to be made playable by coming up with suitable game mechanics - the game interface is the final aspect [122]. Designers should devise these mechanics, game elements and the gameplay experience in order to bind together input from experts and children [73]. *(See ch.5.3)*

3. Finally, autistic children should be involved to evaluate how suitable the game is for them. There is an "explorative" element to this step, suggesting that the process may be iterative and involve alteration and experimentation [73]. *(See ch. 7)*

5.1.3 Involving Stakeholders

It is helpful to briefly reflect on the roles that different stakeholders can each take as contributors to the project, given their different backgrounds and expertise. To do this, we can borrow a concept from social theory: *"Designing things together has become [...] a label to identify this overlap between co-design and ANT and to support a shared agenda towards technical democracy that helps us to further 'unpack' the co- in co-design."* [107, p.149] *ANT* in this case stands for Latour's "Actor Network Theory" [68], which is based on the central principle that both human and non-human actors (e.g. literature or infrastructure) constantly influence and co-evolve with each other. According to Storni, a key element in applying ANT to co-design is agnosticism:

> *"the design process must be considered as plural and open-ended with no a-priori distinction as to whose knowledge should inform the design and its evaluation. [...] one ought to collect as many viewpoints as possible, with no a-priori assumption about which knowledge is more relevant or superior to informing or evaluating a design (this does not mean that all types of knowledge are equal)"*[106, p. 174]

In relation to this project, this idea has important implications on autistic girls as equal contributors to the design process rather than passive recipients of a product (see ch. 6 on co-design). Additionally, **the designer's role is re-defined as someone who must enable different actors to shape the course and outcome of the design. It is also important that the design process remains flexible in allowing additions or replacements from different stakeholders and being open to different views (acknowledging that this means to take some risks).**

In the current project, the design was shaped by the following "actors" (based on ANT):

- **Lifeworld**: Autistic girls (and parents, autism community). Their expertise is related to the lived experience of autism and difficulties encountered in everyday life. They take an interest as "end users".
- **Scientific experts and practitioners:** Therapists and psychologists. Their expertise is comprised of scientifically derived, and generalisable knowledge on autism, theories, research methodologies and therapy practices for autism, as well as expertise in working with autistic people. They take an interest in the game as a tool for research, measuring and understanding its effectiveness and as tool to integrate in therapeutic practice.
- **Designers** Experts on (applied) game design and co-design (with and for autistic people). Their expertise relates to design methodologies and principles. They take an interest in the effectiveness of methodologies and the design (co-design) process itself.
- **Theory Actors** Scientific literature (autism, serious games, ...) and (mixed media) insights from the autism community. Other examples of (applied) games and storytelling. Prototypes and design objects emerging from the process. Their role is not purely passive, as they influence and are influenced by the design lens and design objects are created through, but also basis for discussion and experimentation.

To involve experts, practitioners and designers, a series of more or less structured meetings, Q&A-style exchanges and feedback sessions were scheduled. This included e.g. a structured interview/brainstorm with a practitioner (see Appendix A.4 for session protocol), e-mail Q&A with an autistic speech and language therapist, regular meetings with core stakeholders and experts (therapists, researchers, designers) to discuss the progressing concept

or certain aspects of it, as well as an interview with an expert on applied games to teach emotions. Besides professionals, there were also instances where members of the autism community reached out to share their experiences, ideas and provide feedback on the project through semi-structured (online) interviews.

5.1.4 Inspiration

As hinted in the description of "Theory Actors", the game design was also influenced by media that was not immediately related to autism, such as other (entertainment) games and examples of storytelling, e.g. in animated series. Such sources of inspiration, e.g. for game style or the implementation of certain features, were documented in the shape of mood-boards. Finding games of a certain type or on a certain topic of interest was done by browsing "Steam", a popular digital video game distribution service[9]. An example of a mood-board containing media that had an influence on the product of this project is depicted in fig. 3.

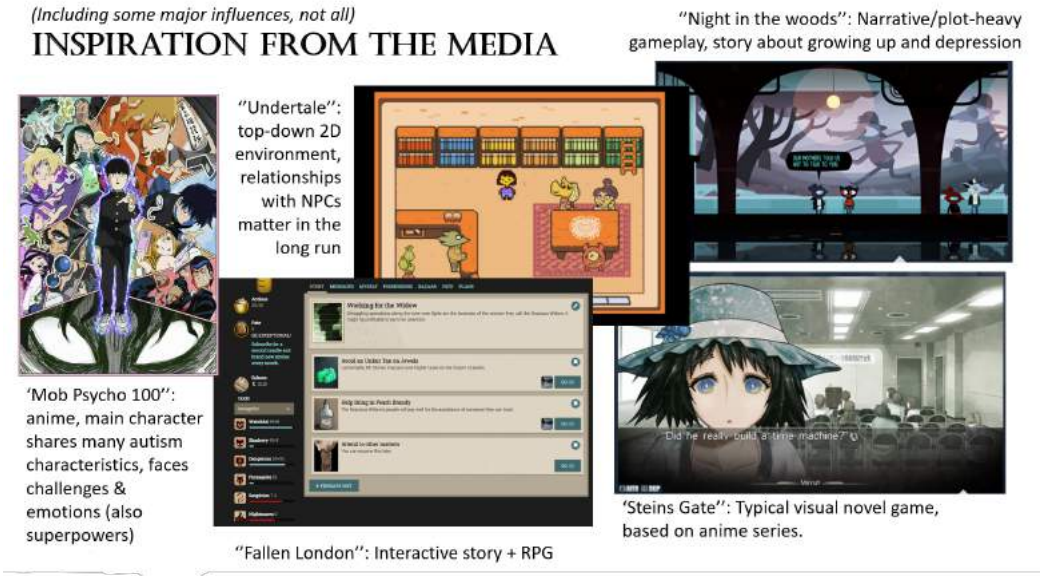


Figure 3: "Mood board" compiling aspects of non-autism related media that influenced the game design.

To better understand which type of media is usually consumed and enjoyed specifically by the target group, we also conducted an initial **survey**

[9] `https://store.steampowered.com/`

about their interests and favourite media (books, films, games etc.)[10]. Additionally, the co-design phase was also an opportunity for participants to share which games they like playing and what about them they like, so that it can be taken into consideration to design the current game such that it will be familiar and enjoyable. The findings are included in ch. 5.3.

5.1.5 Concept development, ideation and (low-/medium-fidelity) prototyping

As a video game has a strong visual component, the concept development, ideation and prototyping in this project was usually done by creating visual representations of ideas, e.g. in the form of sketches, storyboards (for interaction sequences), wireframes and paper prototypes.

Starting with a simple sketch of a game feature or an in-game situation to

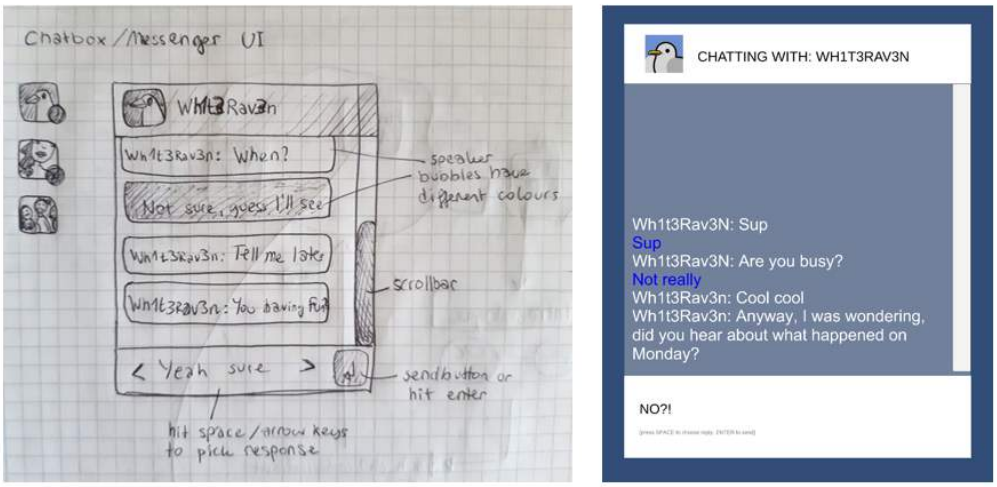


Figure 4: From sketch to technical prototype: Chat UI (user interface). The sketch presents a visual example and highlights a few features of the idea. The partial prototype still does not connect the feature to a complex, underlying dialogue system, but allows testing the "playability" and more detailed options and implications of the interaction design.

present to stakeholders was useful, as it can clearly convey the idea, but at the same time not suggesting that a lot of work was put into it, which would discourage from negative feedback and suggestions for improvement (or completely replacing the idea). Ideas that "survived" initial feedback could then be considered in the next phase, when searching for a technological solution

[10]Ethical clearance was obtained. The survey questions can be found in Appendix A.5

for higher-fidelity prototyping - i.e. making it "playable", which offers more opportunities for feedback. An example for a sketch turned into a partial technical prototype (with Unity, see ch. 5.1.6) is shown in Fig. 4).

5.1.6 Technical (high-fidelity) prototype

Unity[11] was used as game engine to create all technical, and finally a high-fidelity prototype of the whole game system to be used as "boundary object" (this is explained in ch. 6.2.1) in the workshops and later be extended with "real" content and used as proof of concept prototype.

A part that this project did not focus on was to create game art, so most aspects of the game environment, characters, user interface (UI) elements etc. were assembled using available art assets found online[12].

To avoid building the whole game from scratch, a central aspect - dialogue between player and characters - was implemented using an existing tool called "Yarn Spinner"[13] for creating branching narrative and dialogue in games. During a technological exploration phase, several other tools were explored for this purpose, including "Ink"[14] and "Fungus"[15], as well as the "Ink-Fungus-Gateway" for Unity[16], none of which ended up being suitable for the specific demands in this project (e.g. being easy to extend and integrate in an RPG-like setting). The top-down 2D game environment were implemented using Unity's Tilemap feature[17]. Most of the code written for this project is original and some was adapted from the Yarn Spinner tutorial for an RPG-style game by *Twin-Stick*[18].

[11] https://unity.com/

[12] As not all assets were open-source, it will be important to replace them, if the prototype should be shared openly. Currently, it was only shared with play-test participants using a private web-link.

[13] `https://yarnspinner.dev/`

[14] `https://www.inklestudios.com/ink/`

[15] `https://assetstore.unity.com/packages/tools/game-toolkits/fungus-34184`

[16] `https://assetstore.unity.com/packages/tools/integration/ink-fungus-gateway-168147`

[17] `https://docs.unity3d.com/Manual/class-Tilemap.html`

[18] Github:`https://github.com/Twin-Stick/YarnSpinner-Example`

5.2 (Requirements) Game Content and Learning Goals

One of the original ideas from stakeholders was to help the player learn to live through emotions and deal with conflict by including many mini-games that they would play with an NPC (non-player character, i.e. not a real person). This game-based interaction could then elicit emotions and create a source of conflict, so the player can experiment with ways to deal with them in a safe environment. While the idea to present the player with social scenarios and conflict persisted, specifically researching and co-designing with autistic girls revealed that perhaps focusing on mini-games as situational context for these experiences may not be as relevant as **providing a "training ground" for other situations that (girl-)friendships are typically based on - friendships being a major theme throughout the research**. This chapter will summarize the information gathered from literature, experts and autistic girls during the co-design activities and explain how the game content and learning goals were decided as a consequence of these insights.

5.2.1 Initial overview of the chosen game objectives and theme of game situations

The four game objectives (i.e. learning goals) were chosen to be in the areas of **"emotions", "perspective taking", "staying safe" (also: "health") and "self-advocacy"** (see fig. 5). The overarching theme for in-game situations was chosen to be **making and keeping friends**, which incorporates challenges across all of these areas and was found to be a central concern for the target group through co-design workshops and ("friendship support") was previously mentioned e.g. by Yeoh (2018) as an important area to provide support in [124]. Table 4 summarises areas of difficulty that were brought up and discussed during the co-design phase and, in part, thematized during the interactive storytelling session (see ch. 6).

Figure 5: The four game objectives.

Table 4: Difficulties of adolescent autistic girls emerging from co-design workshops, grouped by theme.

Theme	**Mentioned difficulties**
Social connection	Making new friends / getting along with classmates Dealing with arguments / fights Having fun at school (school is the "enemy") Keeping friends long-term
Being overwhelmed	Keeping a schedule Dealing with loud noise / noisy environments, busy environments Autistic burnout / meltdown (avoiding and understanding sensory overload) Dealing with stress (mostly related to exams in school) Coping with being increasingly emotional/hormonal (during adolescence) Being unprepared (e.g. in a supermarket)
Ambiguous (social) signals	Interpreting people's expressions in a nuanced way (how are they feeling?) Dealing with unclear instructions Touching / invading someone's personal space When to respond to people (when are they talking to me?)
Feeling inadequate	Noticing that others will get annoyed / stop talking to me if I (react inadequately)
Questions of identity and appearance	Dressing "like a girl" or "like a boy" and dealing with how people react to it
Communicating needs	Others misunderstand what you need and/or want Setting boundaries / telling others you need a break
Dealing with uncertainty	Transition to high-school environment (more complicated relationships, more stress/pressure, less predictable structure, more expectations and implicit social rules)

The rest of this chapter provides a more in-depth summary of findings and game content chosen in relation to game goals and girls' concerns.

5.2.2 "Emotion" in the game

Learning how to deal with emotions or down-regulating emotional over-arousal was part of the initially discussed game goal and, together with finding it hard to infer the emotional state of other people, is frequently found as an area of difficulty for autistic people (e.g. [20]) - as also highlighted by autism experts during the course of this study. This area is therefore concerned with 1) working towards teaching emotional self-regulation and 2) dealing with the problem of understanding how others are feeling.

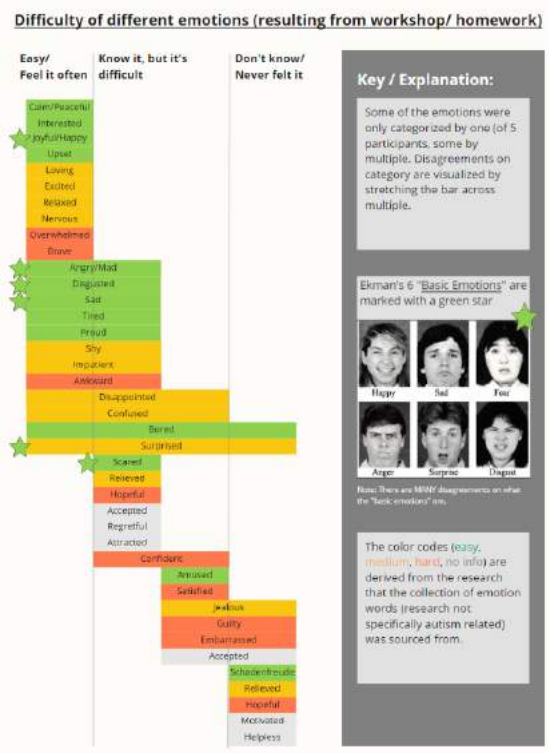


Figure 6: Participants ranked different emotion words according to perceived difficulty/familiarity.

Not being able to self-regulate emotions (also: "Emotion Self-Control" or ESR [76]) means that the initial (and instinctual) physiological arousal as reaction to an event is not controlled and re-evaluated on a cognitive level to produce an appropriate response in the given environment and within societal "rules". Responding inappropriately (given these rules) can have implications on one's social life, especially after childhood, when emotional outbursts are less tolerated [67, 91]. Especially given that the target group in this study is more likely to use masking strategies and internalize emotions, at least in public [36, 74, 57, 66, 55], a relevant issue is worrying and "rumination", as well as the frequent experience of negative emotions like anger, fear and sadness [20]. Especially during adolescence, when peers start to play a more important role in life, daily problems and worries may be caused by an awareness of being socially disconnected. Worrying

and rumination then often lead to depression, anxiety and somatic complaints [20]. An autistic YouTube personality under the name of "Purple Ella" describes that she will often experience a "massive catastrophying spiral", where she will feel a negative emotion and increasingly obsess over it, trying to think of a problem that could have caused it (even if the real cause is not identified) and then try to fix it and get more and more overstimulated while magnifying the problem [89]. We also know that frequently experiencing negative mood states affects the way one approaches new situations and negatively impacts basic cognitive processes [46] that are necessary to, in turn, regulate emotions[49].

Common theories and coaching strategies regarding ESR are based on the idea that emotion awareness is the key to regulate levels of emotional arousal and better select productive coping mechanisms [48, 67]. As suggested by experts, autistic players might find it helpful if the game helps them build an extended vocabulary of emotions (labelling), while clearly providing a context for these labels - e.g. social situations. It would also be helpful to prompt players to reflect on their own emotions to apply these labels and become more aware of their intensity and "how they feel", as well as (later in the game) addressing more difficult scenarios, such as feeling multiple emotions at once (especially those of opposing valence, e.g. happy and sad). An interview with a researcher experienced in teaching emotions, summarised that they ultimately need to be learnt in all their components: the label (language), expression and behaviour (facial, body-language, voice tone), bodily awareness ("how you feel it", e.g. a hot face or a racing heart) and what triggered them/what they are trying to tell you (e.g. a need for some kind of change).

As suggested by Lees, the topic of self-regulating emotions should be approached by starting with labelling and understanding them better in context[115]. Therefore, a list of a range of more or less complex emotions was compiled with the help of a subject matter expert and presented to participants during the co-design phase to collaboratively sort them according to familiarity/difficulty and "order of appearance" in the game (see results in Fig. 13).

5.2.3 "Perspective" in the game

An established theory in the autism literature is the "Theory of Mind" (ToM) deficit, which is an inability to represent and attribute mental states and is said to be a cause of autism-typical difficulties communicating, socializing

and imagining hypothetical (or not directly experienced) scenarios [53]. To research ToM in autism, Happé compiled a set of "strange stories" with questions that can test whether an autistic person was able to interpret a situation that requires ToM to understand by identifying a character's motivation for their action [53].

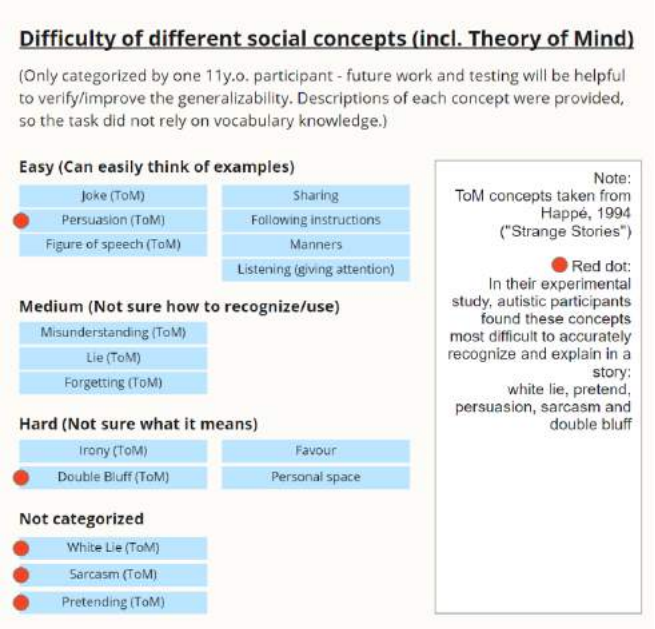


Figure 7: Participants ranked a number of social concepts, including those related to Theory of Mind (ToM) according to perceived difficulty/familiarity.

As also reinforced by expert suggestions during this study, an idea was that the game, to address the "perspective" (or perspective taking / understanding neurotypical behaviour) goal, could both **explicitly provide explanations and advice for ToM concepts** and **incorporate them in the narrative (similar to the "strange stories") to give players a lot of different examples of ToM to experiment with different interpretations**. Ultimately, the hope would be that players learn to better recognise and deal with situations that require "putting oneself in someone else's shoes" - whether it be by actually developing strategies that enhance understanding or to simply increase their awareness of why ToM plays a role in social communication. For example, it might help to recognise the value of a "white lie" to make a friend feel good about their dress choice, even if you do not agree with it. The goal is not, however, to prescribe an appropriate behaviour - e.g. "You should use a white lie when someone asks you how they look". Thinking "like a neurotypical" should be like learning a second language and seen as simply getting more options for how (and with whom) to communicate [7].

The ToM concepts mentioned by Happé [53] **and a set of other notions typically related to social interactions that came up during**

co-design (e.g. "personal space") and through expert interviews (e.g. "turn-taking" and "waiting") were presented to participants, so that they could be sorted according to familiarity and difficulty. This was done to determine in which order they should be presented to the player in the game, aiming to present easier ones first and then build up to those that are less familiar or harder to understand (result in Fig. 7)[19].

5.2.4 "Self-Advocacy" and "Staying Safe (/Healthy)" in the game

Especially through conversation with members of the autism community and research on the lived experience of young autistic people, it became clear that there is not just a need to teach "social skills" or "emotions", but to teach them mindfully, while also reinforcing the player's self-acceptance and sense of identity [115]. *"I overthink to compensate for not understanding social consequences"*, an autistic boy explains in an episode of the "Spectrum Gaming Podcast" as they discuss the positives and negatives of autism [1]. Especially considering that the target group in this study likely already uses masking, and perhaps in an unhealthy way that damages their sense of identity and mental health [103, 36, 71, 24, 57, 74], the game should emphasize: "it's not because there's anything wrong with them, but that other people may not understand their experiences of the world" (Lees, in an e-mail). Autism is lifelong, so **understanding and respecting it as a part of themselves was frequently mentioned as something that should not be treated as an after-thought**. One co-design participant also pointed out that especially just after being diagnosed, if this was unexpected, one might feel very troubled and it would be important to include parts of the game that can make players realise that there are many positive sides. Autism is *"a chaotic cluster of brilliance, creativity and, of course, social anxiety"*[1].

In a more classical sense of "self-advocacy", it is therefore also important to teach the player **ways in which they can effectively communicate their needs to the people around them**. There are things that no level of social and emotional skills will help with, but that one can sometimes change either by getting out of a situation, or by influencing the environment and teaching others to respect their needs. This could be related to avoiding sensory overload or dealing with *"being treated as if you can't function"*[1]. One co-design participant remarked that they wish the game would raise awareness about mental health and the dangers of camouflaging and

[19]Due to a lack of time, only one participant contributed to this task outside of a group session.

becoming overstimulated to the point of shutting down, because people often "don't teach about the danger of sensory overload", even though the resulting pain is preventable "if you handle things better".

But to take steps to stay safe and communicate ones needs, they must first be understood. One autistic advisor remembers herself "stimming" (a self-stimulatory behaviour done to manage emotions and to cope with overwhelming situations), without knowing what it was and constantly being told off for it. She points out that knowing what it was and why she was doing it would have been helpful to reduce the sense of shame and inadequacy she felt as a consequence and she could have been able to better communicate her need for it to e.g. her mother. She also points out that it would help to be able to explore healthy ways to cope and stim to prevent and raise awareness of methods that could be harmful (e.g. banging ones head)[20]. She also suggested to explore coping mechanisms relating to uncomfortable, but avoidable situations: If one knows they are sensitive to smells, they might pick a perfume they like and concentrate on that when they have to interact with others in public. And in a stressful situation like driving a car, one could - if aware - prepare a list of music to listen to while driving to stay calm.

Finally, it was discussed that the game should touch upon topics of dangerous (social) situations that autistic girls may be faced with during adolescence and could be especially harmful, if they have not been properly explained to them: For example, an autistic woman in an interview mentions that there is an increased danger of date-rape, if this type of topic and *what's OK and what isn't* is never discussed explicitly due to social taboos [58]. The game might therefore contain certain scenarios where characters face dangerous situations and the player can be supported in understanding them, while in a safe space.

5.2.5 "Friendships" as an overarching theme

Making new friends and maintaining friends over a longer term (making "real" friends) was a common goal mentioned by participants throughout the co-design workshops, regardless of whether they were outgoing or shy. The interest in social life was also evident through the responses to survey (full report of results in Appendix A.6), which indicated that younger girls (10-13y.o.) are more interested in media related to platonic friendships and

[20]Given that the game primarily targets diagnosed girls, it is likely that many of them have learned about stimming already. However, one (also diagnosed) participant was not familiar with the idea, demonstrating that there might indeed still be a benefit in creating a means to explore autism-specific needs and coping strategies in a safe space.

school, while older girls (14-16y.o.) were also interested in topics like romance and dating.

It also became clear that there was a real question about how to achieve friendships and how to deal with disagreements and conflicts (or, as Lees suggests: how to manage communication breakdowns and misunderstandings). Indeed, providing a way for the player to experience and explore such situations was also part of the initial game goals, but the question remained on what kind of situation exactly would cause them. Two qualitative studies that looked at autism and female friendships during adolescence (by Sedgewick et al. (2019) [97] and Yeoh (2018) [124]) were used as a basis to further inform different kinds of "friendship training situations" for the game.

One reason why it seems to be especially hard for autistic girls to transition from childhood to adolescence is that girl friendships tend to undergo some changes during that time and have increasingly complex social dynamics and rules, as well as increasingly nuanced "relational aggression"[97, 124]. This relational aggression exhibits itself in various forms, such as gossiping, the "silent treatment" or eye-rolling, that are often difficult to understand for autistic girls[97]. Wanting to "look cool" and subtly competing among each other to be popular further contributes to the increase in complexity of social relationships during adolescence, also considering additional rules of e.g. online interactions with their own set of obligations (liking someone's picture etc.) [97].

Furthermore, it becomes difficult to understand who is and isn't really a friend, as bullying may "disguised" as jokes or subtle behaviours like telling others to collectively avoid and marginalize a peer, so building a more flexible understanding of friendship is helpful [97][21]. For autistic girls, it is also often difficult to maintain more than one friendship at a time, which results in these friendships becoming very intense, as well as fights being devastating (since there is no one else to go to)[97, 124]. **Fights and conflicts, which tend to arise from changing group dynamics, gossip and friendship insecurity, can easily end or deteriorate friendships for autistic girls, as they tend to either blame themselves or their friend fully (black and white)**, instead of using typical NT strategies of joint problem-solving ("sitting down to talk") and using a wider social support network to negotiate, mediate and analyse the situation [97].

[21]For this purpose, the game also includes a feature to show the player's relationship status towards different NPCs, but using a more nuanced vocabulary to show that there are different ways to be friends or acquaintances etc.

These insights were used to create situations in the game where conflict among the player and an NPC arises due to e.g. changing social dynamics and the player is faced with different options regarding conflict resolution or avoidance (also including taking or giving the blame). Using such situations as a basis for social simulation also allowed thematizing all four of the chosen game objectives and "skill areas".

5.3 (Requirements) Applied Game Design Elements and Features

As concluded in chapter 4.3, a central recommendation from analyses on existing applied games for autism was to **make use of game design principles to achieve an engaging and coherent game**. In this study, the previously presented table on applied game features 1 was used as a general guideline for requirements. To summarize, the game should have:

- a (motivating) storyline that is fully embedded throughout the game, focuses on game goals and lets players engage with game characters in a meaningful way
- long- and short-term goals
- rewards (immediate reinforcement and/or collectables) and feedback (on performance, to help towards achieving goals)
- increasing levels of difficulty and difficulty individualised for players (either through factors that increase difficulty throughout gameplay or to set difficulty at game-start)
- learner control/provision of choice/player autonomy (by giving the player options and alternative solution paths etc.)

Tang et al. (2019) also produced a concrete set of more in-depth recommendations on how these criteria can be addressed. A summary of these suggestions is shown in fig. 8, which also highlights (bold text) the elements that this study incorporated into the game design.

5.3.1 Requirement: Social Simulation

There are many ways in which content can be conveyed to the player, but in this study the chosen solution was to provide a "training environment" for social situations and conflict, that simulates certain aspects of real life. Rieffe et al. suggest that a central dilemma for autistic individuals ultimately lies in having limited access to their social world, as this - regardless of (dis)abilities - removes opportunity for social learning [90], which may also diminish opportunities to practice emotion control and contribute to the formation of comorbid symptomatology[22] [20]. As suggested by autism experts involved in the project, **a repeated, autonomous experience and subsequent**

[22]Comorbidity is the presence of one or more additional conditions often co-occurring with a primary condition.

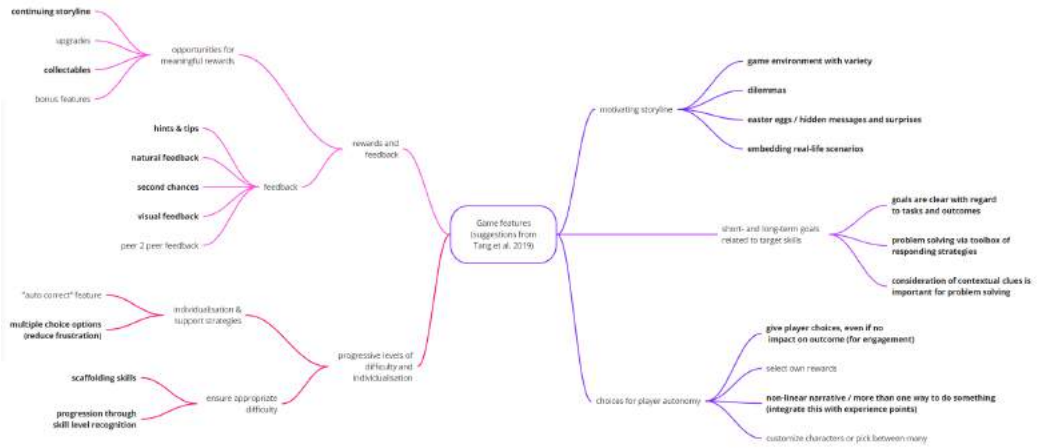


Figure 8: Mind-map of game features suggested by autism experts and young autistic people in a study on applied games for autism by Tang et al. (2018) [112]. The bold text highlights elements that were incorporated in the game concept proposed in this study.

normalisation of social situations and emotional arousal could make what is scary and confusing more predictable and less daunting. A report on a game with a similar rationale - although in virtual reality - by Mitchell et al. also reported (tentatively, from qualitative reports) that their participants felt that simulations of daily life situations were helpful to gradually become more confident [81]. Therefore:

- The game should contain simulations of different social situations (given conclusions from the last chapter, within the "theme" of friendships and the unique challenges faced by adolescent girls)
- The situations should elicit emotional arousal in the player, while still feeling safe (to counteract negative associations)
- There should be different action/response options with positive and negative outcomes, so the player can experiment and explore possible consequences.
- The player should be able to repeat a situation to reinforce their learning and try out multiple option paths.
- A single scenario should not be too lengthy, as players would likely find it satisfying to complete tasks.
- The player's understanding of the situation should be supported throughout it, to avoid "mindless" decisions

- Repetitions of a situation or different situations could be quite similar, only changing small details to stimulate transfer of knowledge (e.g. there is a different character, but you can still use the same way to introduce yourself)

To fulfill these requirements, the game was designed to be largely story-driven and contain branching narratives (i.e. options with different story outcomes). To increase the potential for emotional "immersion", the relationships with characters are given an importance for the story-line in the game, such that decisions on how to solve a conflict can have an impact on the fictional relationships built in the game. To allow for repetition of scenarios, a "time-travel" feature was introduced that allows the player to go back and change the course of an interaction. This allows exploring multiple option paths, some of which are further constraint by requiring a certain number of experience points (as explained later).

5.3.2 Requirement: Suitable (accessible) technology

Discussion with stakeholders also revealed a preference for a game that

- can be played by girls "in their own time" and without constant supervision or facilitation during play.

This had implications on the type of technology that could be used to build the game. For example, virtual reality (VR) is highly immersive and lends itself to realistic social simulations, but it is also not suitable to be used by children without supervision and typically requires a facilitator to "play" a virtual social partner [60, 81, 108]. To suit the requirements for a single-player game that a girl between 10-16 years can play autonomously, we chose to design the game to be played on a computer with mouse and keyboard, which is a familiar and accessible tool that does not require learning new interaction patterns, and with few immersive features to ensure comfort and safety.

5.3.3 Requirement: Feedback and rewards do not mindlessly reinforce copying NT behaviour

As previously mentioned, it is not advisable to mindlessly enforce a change in behaviour or train young autistic people to suppress their natural behavioural tendencies[115, 74, 71, 71, 24] and this is not just relevant to choose game content: As suggested by autistic SLT[23] Emily Lees, the game should be

[23]Speech and Language Therapist

designed in a way that can show what neurotypical social skills “look” like, but without implying that this is the only correct way to be. This has implications on the way in which rewards, feedback and learning goals are communicated to the player:

- The game's reward system should not mindlessly reinforce copying neurotypical behaviours
- The game should be built in a way that encourages the player to explore neurotypical behaviours, but without using them as a measure for what would be a "correct" way to be.

The solution to this problem was to have players work towards the collection of experiences, rather than "successful actions". Players are rewarded for making any choice and exploring different action paths by encountering collectables (experience cards[24], as explained later) and progressing the story. Instead of punishing or rewarding NT behaviour, the course of the interaction with an NPC provides natural feedback on a chosen action or response. To reward the successful "in-depth" reflection on a certain experience and the related skill area, the game also provides a way for players to request a skill quiz that does have a correct or false answer (where they can gain experience points upon success). In this case, the game does not reward choosing one behaviour over another, but successfully analysing a situation to gain feedback on the player's progress in understanding.

5.3.4 Requirement: Autonomy and a Safe Space

For the game to provide a safe space, it was determined (with the help of experts) as important:

- the player has a lot of control over when they start an interaction with another character and with which character
- to start by habituating the player to the environment without forcing them into any conflict and allowing them to explore the basic game functions freely
- to introduce new characters gradually

[24]After being introduced to experts, the skill cards relating to the four learning goals were also seen as a potential opportunity to be taken "out of the game", e.g. by printing and collecting them. This was not a direction that was followed further in the current study.

- to use features that increase predictability for the player and help to guide them through the game (although not necessarily within a social situation)
- to add a helper character that can provide support

To increase autonomy and reduce the anxiety of anything unexpected happening, the game was designed such that the player can freely move on an environment map and starts (most) interactions by actively pressing a key and giving them the control. To increase predictability and give an element of guidance, the game prompts the player to build a to-do list with their ambitions. By avoiding to prescribe a course or order of activities the player is still given the freedom to pursue what they want to do. However, they are not in a position of "too much" freedom where it is unclear how to proceed or what is a possible action and potentially cause confusion and stress.

5.3.5 Further suggestions from co-designers and experts regarding game features

Figure 9: Screenshot of Stardew Valley (game) by Reddit user "FlashShifter"

While not immediately related to the learning objectives, participants in co-design sessions were generally very keen on customizability and environment exploration, e.g. to extend the island with more land, build things and pick different outfits for the character. The general idea of crossing branching narratives with RPG-like features that allow for character development and exploration was met with excitement and one participant also pointed out that there were a lot of similarities to her favourite game "Stardew Valley" (see Fig. 9). Regarding the setting, the proposed island/village theme seemed to resonate with the target audience, although it was also pointed out that "most of my problems come from school". Agreeing that the game should not be set in school (as also suggested by one of the practitioners, who were involved) to reduce negative associations and enjoyment, she suggested that school situations could be included by "going into the character's memory". Further suggestions were related to giving a lot of positive feedback, regardless of player performance, and providing helpful advice outside of dialogues, e.g. as a "pop-up" when a player enters a crowded area.

The next chapter presents each feature of the game in more detail.

5.4 Result: Description of Designed Game and Playable Prototype

5.4.1 Game Concept

Game tags: *Top-down 2D, RPG, story-driven, visual novel, social simulation, single-player*

The game combines a few popular themes and concepts, both in the sense of storytelling for children/adolescents and in terms of different game types. The player, and protagonist of the game, starts their adventure on a boat towards an island, where she will spend her summer holidays away from her family and her best friend, who she had a fight with before leaving home (this plot element is gradually revealed, opening up the opportunity to try investigating the source of the conflict and solving it - or not). Choosing a **real-world setting** here creates opportunities to very clearly link characters and situations to the player's real life experience (little abstraction is required to recognise that the game's supermarket situation might apply to a real-life supermarket situation).

However, real-life does not generally have such a thing as "experience points" (xp) for social skills, emotions, health-awareness and self-advocacy - which, in this case, would be a good tool to set clear learning goals and provide feedback for the player. Introducing such a point system without motivation might feel artificial and inelegant, so **the game integrates a second storytelling device: magic!** While waiting to reach the island, the protagonist is surprised by the appearance of a magical spirit in the shape of a cat, who reveals that she has been chosen to train her hidden powers (indeed, the learning goals) under the guidance of the island's four spirit guardians. The cat explains that developing these powers is said to bring great abilities like time travel and only

Figure 10: The player is tasked with awakening and strengthening their four powers (emotion, perspective, health and self-advocacy).

requires her to make many memories on the island. (Unlike most parts of the game, there is no choice but to accept this mission.)

This "secret hero in a real world" trope is quite typical (whether you think of superheroes like "Spiderman" or animated cartoons/anime such as "Code Lyoko" and "Pretty Cure"[25]) and likely a familiar concept for the target audience.

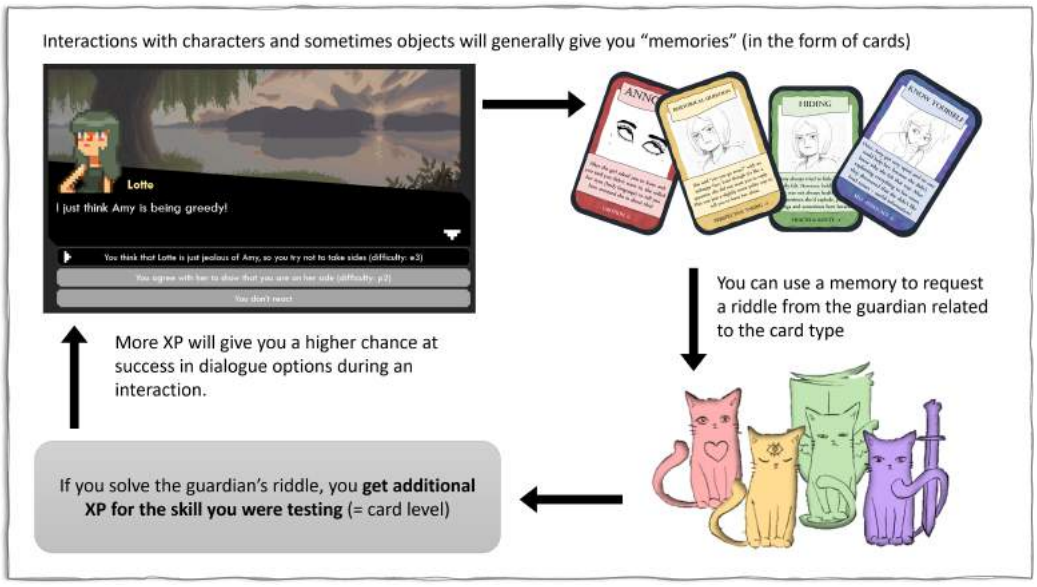


Figure 11: Flowchart describing the game mechanics related to the reward system, spanning a few different aspects of the game: choice-based dialogue, collectables, skill-checks and experience points that explicitly relate to game objectives.

In terms of game type, the game combines two genres: branching narratives / story-based games and role-play games (RPGs). The former is characterized by gameplay that mostly centers on the progression of a story-line, depending on player choices. A sub-category of this genre are "visual novels", which use few visuals and heavily rely on text-based narrative - similar to an interactive novel. In the proposed game, this genre influenced the **"dialogue-based" interactions with the game world**.

RPGs (a classical "pen-and-paper" example would be "Dungeons & Dragons"), on the other hand, tend to focus on player self-development through the

[25]Admittedly, these three were quite influential in my own childhood and adolescence. However, the survey and co-design with autistic girls confirmed that they likely have similar interests.

building of skills and collection of items. Players grow these skills and acquire more resources by facing challenges (typically defeating an enemy) and can often find (or avoid) them in a freely explorable "open-world" environment. Many RPGs also heavily use some central story or narrative that the player can explore, as well as multiple "side-quests" that don't have to contribute to the larger goal, but can help to build skills. As the previous description hinted at, the proposed game is **heavily inspired by RPGs in its xp-based point and reward system, skill checks, open world and emphasis on player self-development**.

5.4.2 Overview of Game Features

Opportunities for meaningful rewards (reward system): Fig. 14 illustrates the logic behind the reward system and how it connects to storyline and target skills (game objectives: emotion, perspective, health, self-advocacy). There are three central components:

- The player sets short-term goals in the form of completing certain interactions with NPCs, e.g. "resolve conflict with Jessica". Regardless of the outcome, they are rewarded with context and skill-related xp cards.
- The intermediate/long-term goal (besides story progression and developing relationships) is always to advance the player's four "powers" - i.e. the target skills.
- This is done by using the short-term rewards (xp cards) to request challenges from the magical "guardians" of the island, which relate to those cards (and therefore, in-game experiences). Upon success, the reward is a power-up (i.e. skill-related xps)
- The skill xps themselves can be considered an intermediate goal as, similarly to real life, skills are there to be used: they increase your options in dealing with character interactions, e.g. by uncovering more hints and action possibilities. This "skill check" is shown in fig. 16. Ultimately, this feeds into the other long-term goal of advancing storyline and relationships by uncovering new dialogue branches.

(The skill check is implemented by calculating a player's probability of success, as shown in fig. 14. The formula is based on the one used in the text-based RPG "Fallen London"[26].

[26] `https://fallenlondon.wiki/wiki/Broad_difficulty`

Figure 12: Helper character, energy loss and skill-point display during an interaction sequence (for feedback).

Feedback (and second chances):
Being able to uncover multiple dialogue branches has little "explorative" value, if a situation can only be played once. While not currently implemented in the prototype, the idea is that the player will at some point in the beginning of the game obtain the ability to time-travel back to situations that they have already experienced. The only trade-off is that they lose any relationship progress that was caused or influenced by this interaction.
Feedback during "social simulations" is currently given through NPC reactions (in text form), i. e. "natural feedback". The player also loses energy (more for options that require a skill check) and needs to recharge it by certain in-game actions, which affects their performance during skill checks and completely interrupts their game-play if energy reaches 0. The game gives visual feedback to indicate energy loss, see fig. 12. The helper character provides support and hints throughout interaction sequences, but players can ignore the feature if no help is required.

Figure 13: Chat conversation with the player's friend, who they are currently in a conflict with.

Motivating storyline and autonomy: The game environment has various locations and a number of NPCs with distinct personalities, as well as "decorative" elements (e.g. being able to watch a TV programme or petting a cat) for fun and to encourage exploration (see fig. 18). Dilemmas faced by the player are fully embed-

ded in the storyline, as they emerge from interactions with NPCs and player choices ultimately affect relationships with those NPCs and story outcomes. As the types of social situations and settings are based on real life and research into the target group's lived experience, the scenarios are meant to be related to real-life. Figure 13 shows a chat-conversation with an NPC that the player was friends with, setting up a conflict that needs to be solved.

Probability of success = (scaler) * (skill xp) / (difficulty)

Scaler
Energy acts as a scaler. At full energy (30 units = 100% in the game), success is guaranteed if the skill level matches or surpasses the difficulty. At 0 energy, the scaler = 70% (the chance of success is never reduced more than this).
scaler = (100 - (30 - energy level)) / 100

Skill xp
The probability is always calculated for an attempt to use one of the four skills. Therefore, skill xp is literally the number of xp the player has for the given skill.

Difficulty
This variable is set by the game and should depend on the specific challenge. It's basically the minimum number of skill xp required to get a 100% chance of success at full energy. Considering that the player is rarely at full energy, the difficulty should never be too high. Difficulty and required skill are always communicated to the player with the option.

Example:
- *Player skill xp for emotion = 3*
- *Challenge is related to emotion, difficulty = 4 (Option says "difficulty 4 e-xp")*
- *Energy level is 20, so scaler = (100 – (30 – 20)) / 100 = 0.8*

*Probability of success = 0.8 * 3 / 4 = 0.6 (60% -> The average number of attempts to succeed would then be 1/0.6)*

Figure 14: The calculation of the probability of success if a dialogue option requires a skill check.

Short- and long-term goals related to target skills:
As mentioned in relation to the reward-system, the game has short- and long-term goals, both of which are very explicitly related to the target skills (game objectives). Cards are recognisable as belonging to one of the four skills through colour and inscription. The long-term goal of gaining these powers is explicitly presented to the player in the introduction sequence. The collected xp cards can be treated as a "toolbox" of explanations and (coping-) strategies. The cards can be accessed through the inventory 15.

Progressive levels of difficulty and individuation: As there is no real "right and wrong" in story-line progression, difficulty in the sense of potential for failure is present only in two ways: If a player didn't get enough xp to succeed in their desired dialogue option, they are merely forced to take a different path or do not receive as many hints. Secondly, if a player goes

Figure 15: Inventory, where collected xp cards can be viewed (as well as starting point for all phone interactions and location of the note-pad, where the player can add coping strategies when prompted through the game.

to a guardian to test their skills and fails the challenge, they will not receive the xps (but they may repeat it). It is also worth noting that more difficult and complex interactions naturally follow initial, "easy" ones as relationships with NPCs progress.
A design choice that was made to reduce any potential frustration was to give the player multiple choice options in the dialogue. While there was an attempt to scaffold skills according to difficulty (e.g. more familiar emotions and social concepts first, more complex ones later), it is likely not very effective due to the high variance of pre-existing knowledge in the target audience.

Figure 16: Skill-check options in a dialogue: The player needs to have enough energy and skill-points to have a chance at succeeding with their preferred option.

Choices and Player Autonomy:
The dialogue is completely driven by player choices, not all of which are consequential. The narrative is not linear and there are different short-term outcomes for a scenario, although this only affects NPC specific relationships

and not the game world as a whole. The player has a choice in which NPCs to interact with, which relationships to build and which short-term goals to chose (by being prompted to add them to a task-list with the option not to do so, see fig. 17). Player movement on the map and the order in which they do tasks is also not constrained for the most part.

5.4.3 The Prototype

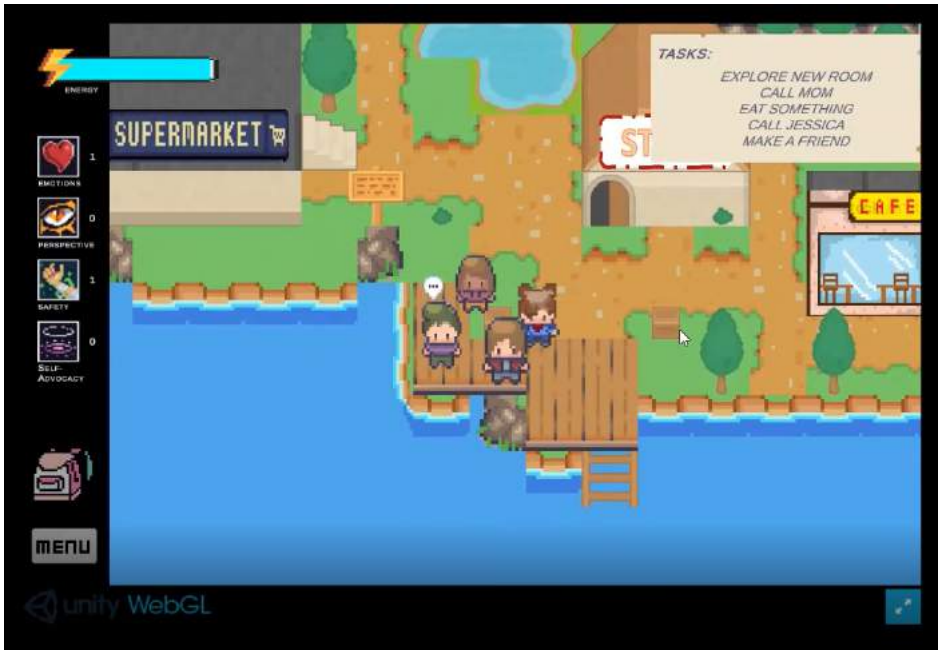


Figure 17: Screenshot of the prototype: The player is about to interact with one of the NPCs and the player's "stats" - i.e. experience points and energy are visible. In the top right corner, the task list customized by the player is visible.

The game prototype is a playable version of the game with some of its features and takes ca. 30-60min to play through completely. It consists of an introductory interaction that acts like a tutorial for the game objectives and experience points, as well as prompting the player to build a list of goals or tasks to complete when "arriving on the island". A number of skill cards from all areas are collectable through dialogue and can be viewed in the inventory.

Some of the dialogues contain skill checks that are currently very easy to succeed at, as the difficulty is low. Since the prototype essentially "sets up" the gameplay, there is not yet a significant progression in difficulty and the

feature to test your skills with the guardians is not yet implemented. The player can choose between a number of interactions with NPCs with which they can build relationships.

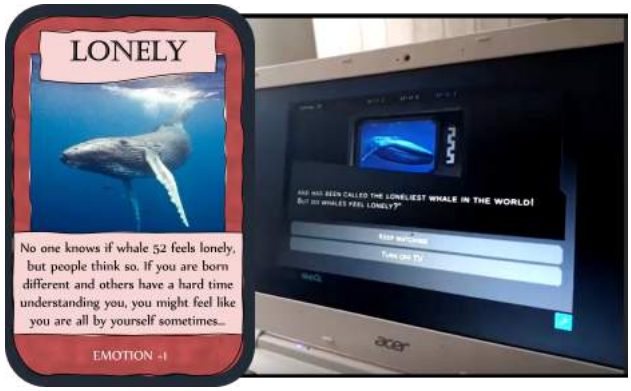


Figure 18: No character interaction necessary to build up first skill points and find collectables, e.g. with TV

The interactions cover different topics from dealing with a conflict (a chat dialogue with an old friend, although this is merely setting up the conflict and not yet asking the player to solve it) and introductions with new people either in a 1:1 or small group setting. None of the interactions are meant to elicit strong emotions from players yet, as the prototype only focuses on setting up relationships with NPCs as a prerequisite to build up to meaningful conflicts that can be resolved.

Code and Prototype Access: The code and a guide on custom game features can be found on the github repository `https://github.com/AIessa/WhenLifeGivesYouLemons`. The playable web-version of the game prototype is accessible via a private itch.io link (can be requested from author).

6 Co-designing with Autistic Girls

> *"The practice of co-design allows users to become active participants in the design process by facilitating their direct input into the creation of solutions that meet their needs, rather than limiting users to the role of research subjects or consultants."* (Def. from: The Inclusive Design Guide[27])

6.1 Relevance of co-design for this study

As mentioned several times throughout the previous chapters, co-design (e.g. as defined in the quote above) was considered as a central aspect of this study. Not only was the need for an inclusive design approach highlighted by Malinverni et al. (2017), who pointed out that a failure to do so would be a "major pitfall" (specifically in relation to designing applied games for autism) [73]. It is also clear that asking the target group to participate in the design process

1. facilitates the creation of a game concept and features that meet their needs and

2. is valuable in empowering a group of people that is traditionally treated as less autonomous and "able" [42] to meaningfully contribute to a tool that might impacted them and their community in the future.

Actively involving autistic people in influencing how their problems are framed in the first place is also a possible answer to Madrigal's question (in the context of wicked problems, see ch. 5.1.1) on how the designer can relate to the topic (of disability, but in this case autism) in a respectful way [72]. This also relates back to Storni's comment on agnosticism in co-design (see ch. 5.1.3), who claims that the designer should not make a-priori assumptions about which stakeholder or source of information is superior or more valuable and take into account as many perspectives as possible [106]. To flip the argument: if autistic girls were not given an equal chance to influence the design or treated as an "after-thought", we would implicitly be assuming that their insights are less valuable.

6.2 An introduction to co-designing applied games

Integrating co-design[28] in the applied game design process can be challenging: Game design inherently requires translating domain knowledge and

[27] `https://guide.inclusivedesign.ca/practices/practicecodesign`

[28] Co-design is here used synonymously to participatory design.

persuasive intentions into game systems (a complex tasks that can be more easily done by experts, as they are familiar with the concepts). In contrast, co-design is characterized by reciprocal design activities, where users co-create a product without being required to have specific domain knowledge (or, in this case, understanding how game systems work) [62, 63]. The integration of co-design further raises questions on the role of power dynamics, when stakeholders have different levels or types of expertise, how to deal with stakeholder input that is not "game friendly", value dilemmas between stakeholders and how to empower users and avoid tokenism[29] [62].

6.2.1 Introducing the "Boundary Object"

An important concept and theoretical tool to introduce for co-design is the "boundary object", as originally introduced by Star and Griesemer in 1989 [104] when analysing cooperative working practices. As the quote (below) shows, a boundary object is an entity that is both flexible in that different parties can relate to it and it keeps the thinking space around it open and flexible, but also presents a constraint to keep everyone within certain set boundaries. Essentially, it allows different people to cooperate by creating a shared space [69].

> *"Boundary objects are objects which are both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites."* [104, p. 393]

In co-design, these boundary objects can take on different shapes, such as low fidelity prototypes, role-playing games or sketches [118, 83]. Their purpose is to help designers and non-designers (i.e. actors with different backgrounds, skill-sets, levels of pre-existing domain and technical knowledge, literacy etc.) navigate a problem space [63] by providing enough knowledge to keep everyone on the same page, e.g. so the ideas are within the scope of a product, but also leave room for imagination to create novelty.

6.2.2 Insights on co-design with young people

> *"Children are typically involved in the design of technology to test designs and their stake in design decisions is marginal."* [44, p.3]

[29] Tokenism refers to the symbolic involvement of target users to essentially "check a box", but without involving them in a meaningful way or actually giving weight to their contributions.

This is likely a consequence of the additional practical hurdles that come with involving children and adolescents and perhaps an (assumed) lower level of expertise. However, as e.g. Khaled and Vasalou (2014) conclude, many children especially - as they actually play video games - have a high degree of game literacy and the ability to think procedurally, which makes them very suited to participate in game design if this skill and experience is leveraged [63].

In their case-study on co-designing a serious game called "Village Voices" with children (aged 10y.), Khaled and Vasalou discuss the use of a basic prototype game system as boundary object ("transformational approach"), based on which participants can reason about e.g. character interactions, player progress, game rules etc. They suggest that the best stage to involve children is therefore later in the design process, when a sufficiently specific boundary object exists. Attempting to involve children earlier and with less specific boundaries (e.g. asking them to create a comic that describes a conflict), produced more irrelevant, generic or vague ideas. In contrast, the "barebones" game system provided participants with pre-defined elements that they could connect to, e.g. characters, a basic setting and the general functionality of the game. Once accustomed, they were then asked to come up with ways in which characters might interact, design physical spaces with crafts materials and define which activities or challenges characters might encounter, how game metrics like a character relationship status would be affected by certain events etc. Although participants were younger, male and not autistic, this study is especially relevant as a reference for this thesis in terms of game concept and content, as "Village Voices" aims to teach conflict resolution in social, narrative-based scenarios [63].

There are also several other techniques that have been used to actively involve children in contributing to design decisions and game content. Popular techniques used in design workshops also include drawing, story-boarding, low-tech prototyping and Wizard of Oz experiments[30][44].

6.2.3 Insights on co-design with young autistic people

Resulting from the co-design of the "ECHOES" application with autistic children [18], Frauenberger et al. (2014) highlight a number of observations,

[30]Wizard of Oz refers to a rapid prototyping/product-testing strategy where developers use role playing to test how end users will interact with the product: Hereby, the participants typically interacts with an interface whose responses are not generated by a computer, but by a human behind the scenes.

challenges and recommendations [44, 43], see table 5.

Table 5: Observations, challenges and recommendations for co-designing with young autistic people [44, 43].

Observations and Challenges
Practical difficulties arise from organising group sessions with a small number of participants of varying "user profiles", infrequent access to these participants and time restrictions
Parents, caregivers and/or teachers play a role in building relationships and trust between participants and researchers, which is necessary for co-design
A mismatch in communication strategies between children and researchers may lead to outputs that can be subject to misinterpretation (e.g. illegible handwriting, unexpected use of templates for storyboards).
Unforeseen aspects of the task may derail participants from the actual goal, as they become more engaged in something else (e.g. objects with very engaging sensory properties).
Recommendations
The exact involvement of participants, its importance and potential outcomes should be communicated to them clearly; expectations on the effectiveness of the end product need to be managed (avoid disappointment and loss of trust in case of failure)
The means for self-expression and communication of participants should be chosen carefully to support them and ensure that the output is also usable by researchers.
Participants' creativity should be scaffolded, but not constrained: use of open-ended questions, no implication of "correct" outcomes or test situations
Due to the variability among participants, researchers need to make an effort to understand each participant and tailor activities to their needs, avoiding frustration.
Ethical implications of involving participants should be considered, making sure that they actually desire the outcome that they are working towards (and are aware of it). No risk or demand placed on participants should outweigh the benefit of their inclusion, so researchers should carefully consider the demands and responsibilities placed on participants that may be very susceptible to anxiety.

While Frauenberger et al. worked with younger children, Bossavit et al. report on involving a "designer team" of four autistic boys between 11-15

years in the design of an educational serious game [21]. While they conclude that this co-design process provided considerable benefits, they unfortunately do not explain the co-design methods in more depth.

6.3 Co-design in this study

6.3.1 When and why were autistic girls involved?

This study followed Khaled and Vasalou's recommendation to involve younger co-design participants at a mid-way stage of game design, when a relatively defined boundary object (in the form of a "bare-bones game system" was created [63, 62]. Specifically, we reflected on how the girls could significantly contribute by taking advantage of skills and knowledge that they already have and decided to involve them in defining game content that relates to their own lived experience and difficulties they face. As the game had a large storytelling component, the idea was essentially to focus the co-design on creating narratives and game characters, as well as gaining insights on how to scaffold this content appropriately regarding difficulty. We also did not exclude the possibility of co-designing other game features, which depended on the amount of ideas and experience participants had with other video games.

6.3.2 Workshop design

Given that the building of game narrative was the goal, the workshop was inspired by practices in interactive storytelling (IS) [126] or interactive fiction (IF) [105]. IS is practiced by different communities on- and off-line, from completely text-based interactions to those enriched by a different medium (e.g. a board game, cards...), as well as RPGs played on dedicated forums through text posts [126] or even on other platforms like forums, chat rooms, blogs or social media sites [52]. A game will be based on a plot or story-line that describes the game world and players get role definitions, e.g. with the character's backstory and characteristics, to learn about the role they are playing. They interact with the game world by taking on the role they were assigned and participating in developing the story from their point of view "in character". There is often a playing order, so no one gets left out in contributing to the story [126, p.5-8]. Zalka also points out that, different to other games, there are generally no winners or losers, set end points or ultimate narrative goals: The players are motivated by the enjoyment of creating stories together [126].

With the idea to use role-play for a co-design activity, a few test story-

Figure 19: Prototypes of game mechanics: E.g. the cards were used in test workshop sessions to experiment with how a point system could work, and how suitable the selected concepts were for representing social skills.

telling sessions (not with the target group) were conducted by adapting common practices of the RPG "Dungeons and Dragons" (D&D)[31] for the purpose of playing social scenarios. This also required the adjustment of the typical D&D character descriptions and game rules to be less focused on physical and magical abilities (e.g. stealth, agility, strength and magic spells) and more focused on social skills (e.g. persuasion and empathy), see fig. 19. An interview with an experienced D&D "dungeon master" (facilitator of the session, playing narrator and the game world, including several NPCs) further shaped the workshop to include a **"session 0"** (before the actual role-playing session), which is when players are introduced to the general scenario they will play, are allowed to define their roles and allow the facilitator to learn about the participants to customize the challenges to fit with player interests and requests.

The workshop idea was also discussed with experts, some of which pointed out that the imaginative capabilities of autistic children performing a free story-telling activity may not be up to the task, as also suggested by studies like that of Craig et al. (2000) [31]. In contrary, **there is some evidence of an affinity between autism and certain aspects of collaborative story-telling and roleplaying games**[32].

[31]https://dnd.wizards.com/dungeons-and-dragons

[32]Fein, in an ethnographic field study conducted in an autism youth camp, notes that

6.3.3 Ethical Approval

Ethical approval for the activities involving participants was granted, see Appendix A.1

6.3.4 Recruitment of Participants

Figure 20: Recruiting participants for the survey and the workshop via FANN's Twitter

Participants were recruited via social media channels (Instagram, Twitter) of FANN, the Female Autism Network Netherlands, as well as through the personal LinkedIn accounts of a team member for this project (and head of FANN), see fig. 20. Contact was made by interested parents/ participants (etc.) either through social media or e-mail. After checking that participant requirements were met, the information leaflet, as well as a detailed schedule for all sessions was shared with them and an information session via video call was scheduled. The information leaflet and consent form can be found in Appendix A.2.

6.3.5 Information Session

The information session was scheduled with each participant individually and, in case of younger participants, through and with their parent(s)/ caregiver(s). The session was conducted via video call. A detailed protocol for the session can be found in Appendix A.3.

there were three ways in which these activities met the needs of autistic youth: (1) "The structured social practices of roleplaying [...] provided the support and organization participants needed for successful social coordination"[39, 2], (2) The central game narratives (with a psychological theme) provided a way to accept and re-interpret behavioural and emotional characteristics of autism positively and (3) the social environment of the camp created a sense of belonging for autistic people, as their characteristics were shared and valued [39].

6.3.6 Homework

Participants were asked to write down social situations that they found difficult, confusing, upsetting etc. and would want help and advice for dealing with. The purpose is to make participants feel prepared to contribute to the brainstorm in session 0 (see Fig. 21) and also reduce the time it will take. For every activity, participants were reminded that they are under no obligation to share anything with the group if they are not comfortable doing so.

Figure 21: Screenshot of collaborative whiteboard during a session 0, where participants shared conflicts and situations that they find difficult to handle - or "enemies", as one girl called them (an appropriate description in the context of game design!)

6.3.7 Session 0

This session is meant as a hybrid between a focus group, a brainstorm session, card-sorting tasks (see Fig. 22) and the "session 0" (previously introduced). Inherently, this session was already a part of the co-design as the focus group / brainstorm questions were explicitly related to game content and game mechanics. They were also based on the presentation of the bare-bones game prototype to provide a frame of reference and spark conversation about its features (following Khaled and Vasalou's transformational approach [63, 62]. This session was conducted via video call with a group of participants (some with parent/caregiver as support) and the facilitator. With all participants' consent, the session was video-recorded to allow for note-taking afterwards. A detailed protocol can be found in Appendix A.3.

6.3.8 Storytelling/Role-Play Session

The purpose of this session was to co-create a story that contains challenging social situations and somewhat realistic (or at least reasonable and relatable)

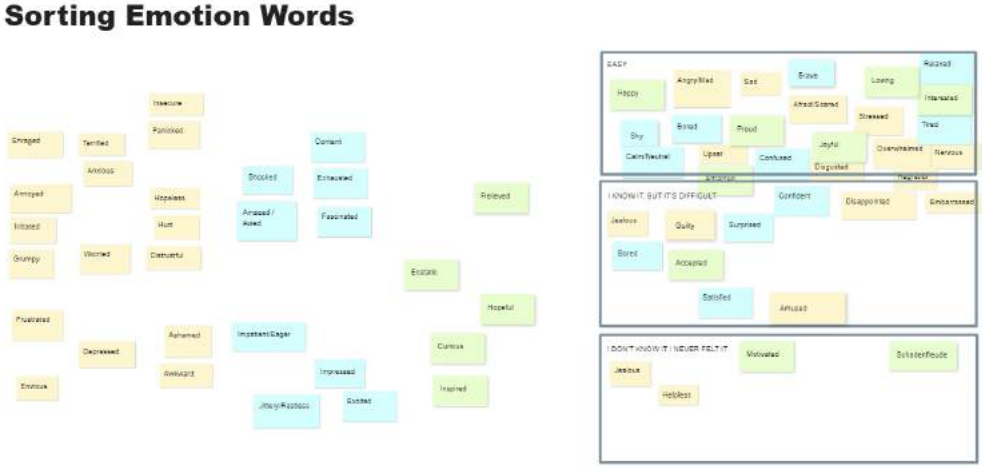
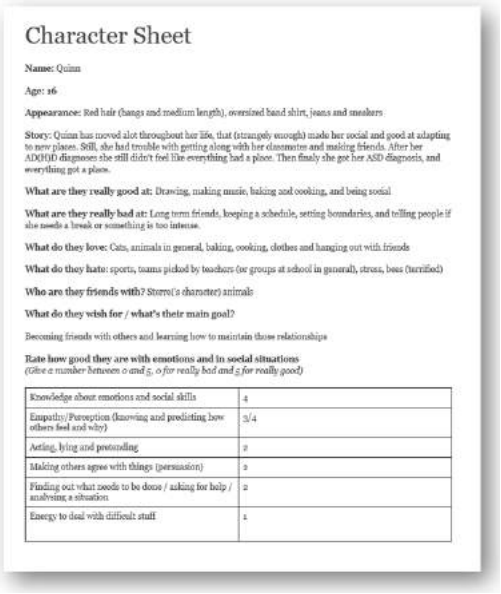


Figure 22: Mid-progress during the card-sorting activity in session 0. Participants discussed how each of them would position an emotion, what it means to them and agreed on its place.

reactions and coping methods, advice etc. for autistic girls. Participants played the role of characters they themselves created previously (e.g. see Fig. 23) and the facilitator took the role of "dungeon master", playing the adapted "social" version of D&D with a setting inspired by input from participants during session 0. This workshop was set to last a maximum of two hours and participants could ask for breaks or leave at any time, but session duration was adjusted to participants needs at the time and participants were once again informed that they may leave or request breaks at any time. Again, the bare-bones game prototype was used to "set the scene" for the role-play and acted as boundary object. A power-point presentation with images of story locations was used as visual aid throughout the session. A detailed protocol can be found in Appendix A.3.

6.3.9 Co-design outcome

In total, six autistic girls between 10-16 years participated in the co-design for this study to some extent: An individual information session was scheduled with everyone, the younger ones (10-13y.o.) attending with their parent/caregiver. One participant dropped out after not being able to make it to the first group session due to personal reasons, although she shared a considerable amount of ideas and suggestions already in the first meeting. The youngest participant did not feel comfortable participating in group activities or many video calls in general, so the workshop content was adjusted for her



Character Sheet

Name: Quinn

Age: 16

Appearance: Red hair (bangs and medium length), oversized band shirt, jeans and sneakers

Story: Quinn has moved alot throughout her life, that (strangely enough) made her social and good at adapting to new places. Still, she had trouble with getting along with her classmates and making friends. After her AD(H)D diagnoses she still didn't feel like everything had a place. Then finaly she got her ASD diagnosis, and everything got a place.

What are they really good at: Drawing, making music, baking and cooking, and being social

What are they really bad at: Long term friends, keeping a schedule, setting boundaries, and telling people if she needs a break or something is too intense.

What do they love: Cats, animals in general, baking, cooking, clothes and hanging out with friends

What do they hate: sports, teams picked by teachers (or groups at school in general), stress, bees (terrified)

Who are they friends with? Storm(a character) animals

What do they wish for / what's their main goal?

Becoming friends with others and learning how to maintain those relationships

Rate how good they are with emotions and in social situations
(Give a number between 0 and 5, 0 for really bad and 5 for really good)

Knowledge about emotions and social skills	4
Empathy/Perception (knowing and predicting how others feel and why)	3/4
Acting, lying and pretending	2
Making others agree with things (persuasion)	2
Finding out what needs to be done / asking for help / analysing a situation	2
Energy to deal with difficult stuff	1

Figure 23: Character sheet of a participant to be used in the storytelling session.

to do as a written/drawn homework. One "session 0" was conducted with three participants (12, 13 and 16 y.o.) - the fourth one only signed up after this session had taken place. One storytelling session was conducted with three participants (11, 13 and 16 y.o.) - one of the girls dropping out due to a conflicting schedule in the last moment; the youngest participant attended with her mother.

Results of the co-design activities are integrated in chapters 5.2 and 5.3, as they contributed to setting game requirements both concerning content and goals, as well as game features. A few excerpts from (transcripts of) the collaborative storytelling session are presented here:

> (Excerpt from storytelling session about predicting other's actions and tricking them.)
> *P1: "Exploring the castle is something we .. could do, but actually going inside? That's different.. it seems so dangerous."*
> *P2: "I think we could trick the boys to think we're going in the castle, but we're really just going right behind the first door and wait there. Then we come out with a fake treasure!"*
> *P1: "That's smart! We just get some random things from there and spray them with gold or something.."*

P3: "Oooh! You know, I'd say let's get the treasure and get out of the castle as fast as we can." (She continues to explain her concerns that the other team might steal the treasure and pretend they found it first.)

(Excerpt from storytelling session about communicating needs and negotiating group action.) Narrator: "Everyone's been getting a bit tired, especially (character of P1)."
P1: "Maybe we could go back to camp?"
P2: "Well I'm gonna stay inside the castle and find the treasure!"
P1: "Then I'll stay, too!"
(...)
P1: "Let's not split up. It's better to stay together. But look, I'm tired. When it's getting dark, we have to go back."
P3: "If she's tired, we should put the bottles back and go to the camp and get a nap."

(Excerpt from storytelling session about being aware of rules and the concept of hiding when you are not following them)
Q1: "Hey, do you want to race with me? The first who's at the tent, gets to say that they found it."
Q2: "And if someone tries to steal it, I'll call the cops! I have a phone."
Q1: "I don't think anyone should call the cops, we are doing something we're not supposed to..."

As these excerpts show, participants had different levels of understanding of social situations and ToM concepts. While it turned out to be fairly difficult to include exact dialogues from this session in the game prototype (the storytelling session was set in a summer camp for a castle, but the prototype had to first introduce the player to the new location without immediately sending them to summer camp...), the workshop produced examples of different answering styles and insights on how problems were solved among participants, which were then used to create dialogue segments in the game prototype.

7 General Feedback on the Game and Preliminary Play-Test Results

7.1 General feedback on game concept and features

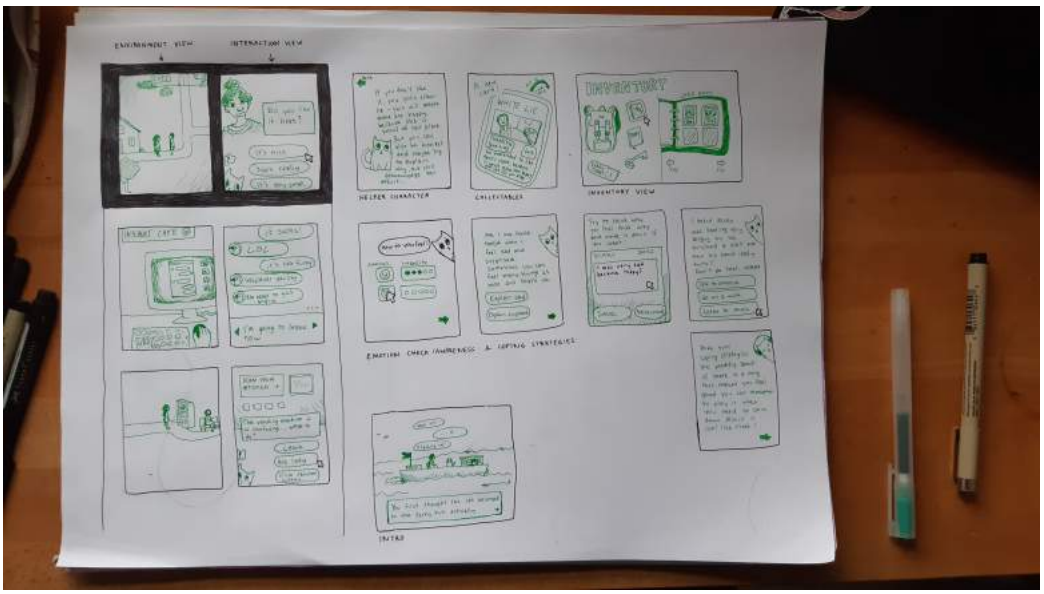


Figure 24: Wireframe sketches (for last pre-technical prototype feedback session).

Following the presentation of a set of wireframes/sketches portraying different game features (see fig. 24) to a group of autism experts (researchers and practitioners), a feedback and group-discussion session produced the following comments:

- It might be difficult for some players to know "how they feel" - so if the game prompts players to be aware of their emotions, it should also include feeling "nothing" and slowly encourage players to examine that further to recognize nuances.
- Using emojis to pick emotions may not be the best idea, since then there is ambiguity in what emotion they stand for. Suggestion to talk to expert on teaching emotions through applied games for more advice.
- Diary feature may provide a great source of data for autism researchers - discussed ethical implications of making such private (diary has connotation of being secret) data with researchers. However, good idea

would be if players can use what they wrote in the diary to bring to a therapy session and discuss it there.

- Use of experience cards, especially those related to theory of mind concepts, was met with approval - more resources were given to provide list of different theory of mind concepts to include as game content

- Positive reaction to the way in which the game is similar to an interactive story book, but with added rewards. Reminds of a type of strategy (playing through situational stories together) used in autism therapy.

During co-design sessions, participants also commented on an earlier version of the prototype and besides having many suggestions for features and expansions (incorporated in ch. 5.3), all participants - even across age groups and interests - liked the RPG-type / pixel art style of the game. Especially the older participants thought that it was "cute", but without being childish, as well as "easy on the eyes". The younger participants, on the other hand, could relate it to other games that they love to play.

7.2 Play-test methodology

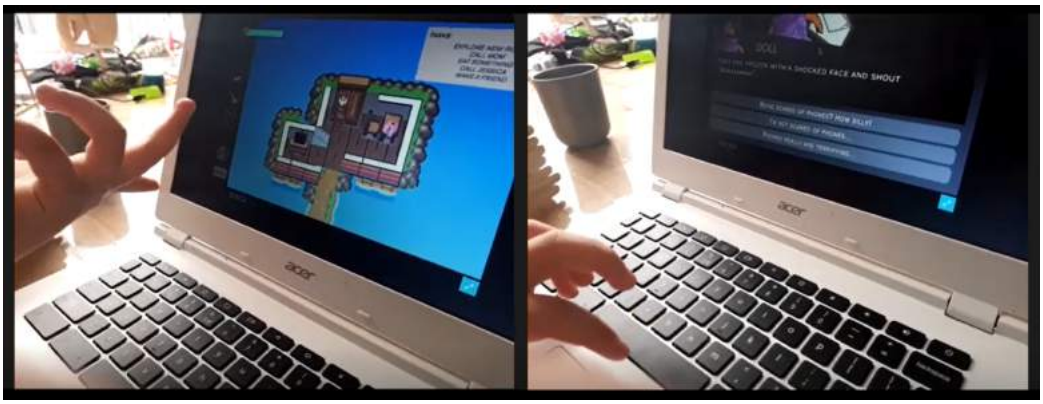


Figure 25: Play-testing the prototype with a participant via video-call.

A WebGL[33] Unity build of the playable game prototype was released to itch.io with restricted access[34], which is a website that hosts games for free,

[33]WebGL is a JavaScript API (Application Programming Interface) for displaying interactive graphics (therefore, games) within a web browser.

[34]Since a number of game assets in the prototype were under copyright, the application was not shared publicly, but via a private link with a password

and access was shared with play-test participants. The play-test was conducted as a 1:1 session[35] via video-call (see Fig. 25, took ca. one hour per participant and was video-recorded (with permission from participants and their parent(s)/caregiver(s)). Ethical approval was obtained (see Appendix A.2).

The purpose of this preliminary play-test was to observe a member of the target user-group interact with the prototype and gather information on its usability, whether participants liked the style and concept of the game, found it enjoyable, whether game features that were meant to increase motivation had the desired effect, to understand whether in-game interactions were engaging, gain insight on whether any emotions were triggered during game-play, whether participants learned anything new through it and to hear their thoughts and opinions on some of the not yet fully implemented features.

The central methods were 1) observing the player's behaviour without any guidance during game-play, as well as with prompts from the researcher to find certain features or fulfill a task (e.g. noticing hesitance, confusion, mistakes and genuine reactions), 2) using a think-aloud protocol with the player by asking them to verbalize their thought processes and opinions and 3) ending the session with a semi-structured interview to cover any un-answered questions regarding the session's information goal. As think-aloud protocols have a downside of taking some of the player's attention and cognitive capacity from the task at hand, the idea was to suggest it at the start, but not necessarily reinforce it if the participant has trouble multi-tasking during game-play (however, this turned out not to be an issue).

7.3 Play-test results

In the present study, the play-test session was conducted with two autistic girls (11y.o. and 16y.o.), both of which had previously taken part in the co-design workshops (they will be referred to as P1 and P2). The findings and observations are grouped by topic and participant.

[35] 1:1 in the sense that one participant would play-test in the presence of the researcher and not in a group setting. One participant's parent(s) joined to help her with the video-call (e.g. holding the phone camera) and to watch the session.

7.3.1 Usability / ease of use

Both participants required no help understanding how to use the game and navigated it very confidently (P1 only needed a small hint to find the inventory and P2 to interact with an object for the first time). A source of slight frustration (for P1) was that "sometimes I press something accidentally where I didn't want to go" or when she accidentally restarted a dialogue without meaning to.

Regarding the helper character, both participants were made aware of its existence, but almost never clicked to ask for help. P2 pointed out that it might be good to include a "pop-up" at the start to first introduce it, but also said that they just did not feel that they needed any help throughout the session.

7.3.2 Game style (visual/concept)

P1: While her mother commented that she was, at the start, worried that there would be too much text and information, the participant was very fast and thorough when reading (this was also clear when she read some parts out loud) and mentioned that she really liked the text and it was not a problem for her. It is also worth noting that she seemed to think through every possible answer option carefully, before choosing one. While her opinion on adding voice-over and/or animation could not be obtained, she asked her mother to "narrate" the mom-character's parts of the game dialogue, which might indicate that she would have enjoyed hearing the text spoken out-loud. She was very attracted to the 2d top-down map that she could explore ("I'm going to explore!"), which seemed to be one of her favourite features (wishing she could explore even further, e.g. go into the cafe or train) and sparked a lot of curiosity. She also mentioned that the cards look "so cool" and frequently pointed out that she liked different visual elements, indicating that overall the visual style of the game resonated with her.

P2: Aside from liking the style of the game, she felt positive about the use of magic in the game concept: "I think it helps to understand things, because in real life you can't undo things or repeat things and I think it makes it more logical and more helpful to actually learn things."

7.3.3 Effectiveness of motivational features

P1: Both the collectable cards and the ability to make a to-do list and work off the tasks seemed to be motivating to the participant. For example she

was thinking out loud: "Ok, I have to make a friend, so I'll do that. But I don't know how to.. so I'm going to go around and choose one.. I wish I could be friends with the cat! ... I'll choose this girl, she seems cool!". Encountering cards in the dialogue was met with a happy reaction ("a new card!!") and she could demonstrate an understanding of how the card helped her progress towards game goals.

P2: The central feature that motivated her was the to-do list: "I want to accomplish the list, I think that's the main thing." This may also be due to already being very used to relying on notes, as she explains: "With notes (...) I had the comfort of knowing that I wrote everything down, so that made me (feel) at ease so I wouldn't forget anything (...) and also like little things, that don't even have any meaning, but I would know, ok when I'm stressed out I'll just get this out of my pocket or something, that'll help." However, she also pointed out that the game asked her to make a lot of decisions regarding the creation of this task-list at the start, which was "a lot" (too many consecutive choices).

Regarding the collectable cards, she "was not (...) working towards them, but when they popped up it was a nice thing."

7.3.4 Interest and engagement in dialogues/character interactions

P1: She mentioned that it was her favourite part "when I met a lot of people in the game", although throughout the game she seemed most excited when the interaction was with or about an animal. It was clear that she enjoyed interacting with a character that shared some of her interests and, when asked, she pointed out that after exchanging phone numbers (in the game) she would now consider her a friend. Other character interactions were not as engaging, especially when it was not her own choice to do so (e.g. task prompt from facilitator).

P2: While interacting with characters, she was able to provide a lot of suggestions on how to improve the dialogue and options both in terms of clarity and to make her relate better to the player character: One point of improvement was to include options that are more and less outgoing to suit different players' personalities, "because *why* is more outgoing, like asking about it (...) at least I would then not intentionally ask why". Interestingly, she always picked options according to what she would do in real life, despite being very self-aware and knowing that it may not be the best option: "I'll probably go for the sorry, because I always say sorry too much."

Another recommendation was to be very explicit about how the answer

options link to the previous text. This was prompted by some confusion e.g. when the character did not explicitly offer food ("I have some food to share, if you want") and the answer options were agreeing or disagreeing, despite not actually being asked "Do you want it?"[36] Aside from illogical answering options, the participant was able to follow all character interactions well and, when prompted, showed that she was actively reflecting on them while playing: "She's getting annoyed, she's, like, being mean, without a real reason... at least I don't feel she has a real reason to..."

Furthermore, the participant indicated that she would appreciate if the game provided more characters to form relationships with, some of which could become deeper than others: "If you have a few (relationships) you have more conversations (...) it would be a bit like real life, so you don't have, with every person you know, the same relationship and the same depth". The relationship status of still unknown characters could be a question mark (to inform the player that not all NPCs have been met), "like a pòkemon card where you just see the shadow".

7.3.5 Triggering emotions

Both P1 and P2 seemed (and said they felt) relaxed throughout the game.

P1: There were some moments of light, temporary frustration or impatience as a result of involuntarily clicking on something or if the game made her wait: For example, during a sequence where the player character goes to bed, the game waits for several seconds with only minimal feedback, while no interaction is possible. When asked to reflect on when other games would make her feel frustrated, she mentioned a time when her character accidentally fell into a cave with a creeper in "Minecraft" (essentially, a trap that might kill your character).

7.3.6 Testing skills in the game

Testing ones skills by requesting riddles from the "guardians" was not yet developed in the prototype, so the feature was explained by the facilitator when the player tried to access it in the game.

[36]Rather than avoiding this type of situation, it may actually be a feature of "neurotypical" conversations that the game could explain to the player. However, in some cases the game might want to avoid any confusion, so the necessity for very clear and logical links should be kept in mind (e.g. if the game enquires about the player's emotion, there should be a clear prompt so the player knows exactly what they are supposed to do at that time.)

P1: She pointed out that she would probably like receiving a riddle/test, as long as she could repeat it (if failed) and it wasn't "too hard".
P2: She felt that a situation that would be a good test for her, specifically, would be to watch a realistic group conversation and have to decide when it would be appropriate to answer/reply/join (i.e. the task would be to determine when someone is addressing you).[37]

7.3.7 Learning something new in the game

There were several times at which P1 was confronted with a concept that she did not yet seem familiar with (e.g. questions on gender identity related to clothing, something that came up as a topic of interest and confusion during one of the workshops). However, especially with cards, it was not clear if the card by itself was enough to prompt a continuation of the thought or it would be forgotten as soon as the card was collected, so the "skill testing" feature where the cards are revisited in the form of a quiz/riddle are likely a helpful addition. Interestingly, the participant was also not familiar with stimming, which was a topic in a part of the game and suggests that adding more parts about exploring autism can be a very beneficial aspect.

In contrast, P2 was familiar with stimming and agreed that the ability to explore different tools and safe ways to do so might be helpful for girls that are not aware of it and suggested that the shop in the game should provide many examples. She also demonstrated her own stimming toy, see Fig. 26.

7.3.8 Overall player engagement and enjoyment

P1: She seemed to enjoy the game ("I love gaming, so... this game is very nice!" and "It was very fun"[38]) and did not get bored of walking her character around, looking for all possible interactions until the session was over. The game seemed to also induce a lot of curiosity in questioning what was going on with certain characters or situations - especially when it seemed to contradict her own thoughts on the matter (how did the ghost cat go into the bag without falling through it? Are humans animals or monkeys?) - and sometimes prompted her to try predicting what would happen next.

P2: While she also seemed fairly engaged throughout the session, her comments suggest that the level of difficulty in this prototype was too low

[37]This was also an example for a complex social situation that could not be simulated by using text-based interactions as they are currently implemented in the game and should be taken into account.

[38]While some of these comments may have been out of politeness, there were several spontaneous positive reactions that reinforced the statements.

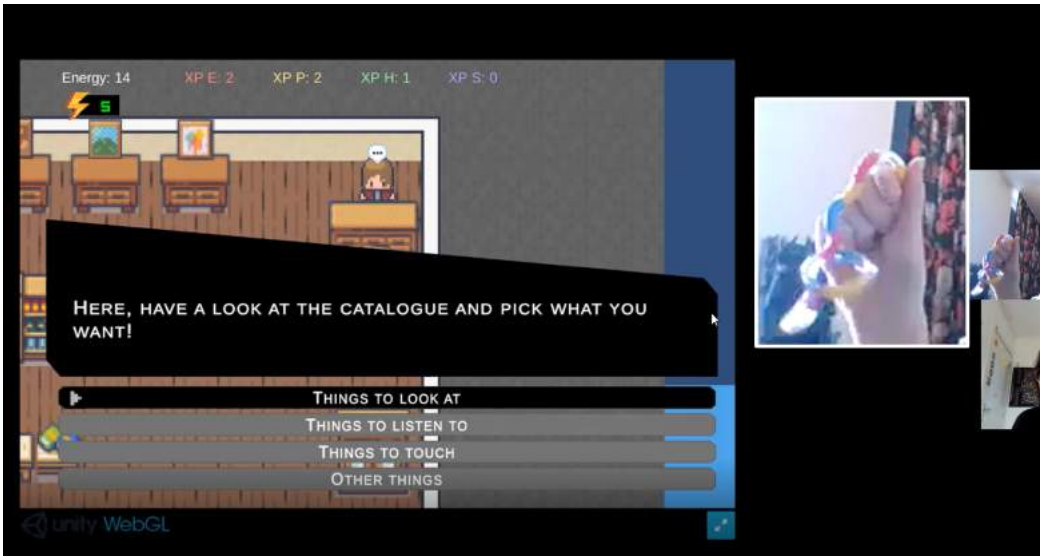


Figure 26: Participant demonstrating their stim toy (a tunnel/"tangle" with different textures) as they encounter the game's stimming exploration feature during the play-test.

for her and she did not necessarily learn anything new (she mentioned that other autistic girls would probably find a lot of the concepts introduced by the cards helpful, but she already knew them). However, she was still highly motivated to fulfill all the tasks she set herself, she was interested in the potential to develop relationships with NPCs and was not bored.

7.3.9 Summary: conclusions from preliminary play-tests

The game seems to have succeeded at being motivating and for the most part engaging, although the currently only written, text-based dialogues are likely not a good solution to keep players interested for a long time. Given the preference for visual aspects of the game, it could be helpful to add more movement (e.g. changing facial expressions on characters) and voice-over to alleviate the amount of reading that is necessary and potentially make the situation feel more immersive.

The most successful features of the game, as currently implemented in the prototype, seem to be the task-list and collectable cards, as well as the autonomously explorable environment. Players also seemed interested in interacting with the characters and building relationships, especially if they previously had the opportunity to set this as a goal for themselves.

While participants understood the point and reward system of the game, the current implementation did not yet balance difficulty vs. skill in a way that would provide insights on how motivated players are to actually build their skills to be able to expand their dialogue options (i.e. currently it is too easy to always succeed, which obviously does not drive the desire to put effort into gaining more experience points. On the other hand, being able to drive the story forward and cross off tasks was motivating enough by itself.)

(It is also worth mentioning that one of the play-testers recognized a game character that was based on her input in the co-design session and seemed amused, but satisfied that her contributions were included: "I have a whole character based on me, I feel honoured.")

8 Discussion

8.1 Discussion: Design of the applied game and final prototype

The goal of this study was to create a safe, computer-game environment for adolescent autistic girls to autonomously explore and learn to better understand (neurotypical) social interactions and emotions. A review of related work and common criticisms and recommendations in the field suggested that to succeed, the game would need to 1) use game design principles known to enhance motivation and enjoyment in players and 2) properly integrate learning goals with those principles. Furthermore, it was advised to determine these goals by collaborating with subject matter experts and gaining insights from the target audience, as well as generally taking an inclusive design approach to actively involve autistic girls not just as users, but as co-designers.

The present work followed all of these recommendations and succeeded in integrating collaboratively determined game objectives with game design principles and many of the feature recommendations proposed by Tang et al. (2019) [112]. The current concept integrates a motivating storyline with real-life scenarios, as well as fun aspects, meaningful opportunities for rewards, feedback and both short-and long term goals, while also giving the player autonomy on several levels. One key principle that is currently not addressed sufficiently is the implementation of progressive levels of difficulty and individualisation. Indeed, the game currently does not provide many ways in which the player can customise their environment or themselves (e.g. changing their appearance). Perhaps more importantly, there is no way to set a starting difficulty or have the game react to the player's level of existing abilities to adjust the amount of challenge they are faced with. Therefore, **further exploring how an appropriate level of difficulty/challenge can be provided to players of different levels is an avenue for future research** that is likely worth pursuing, especially as the amount of pre-existing knowledge and skill varies largely across the target audience. Addressing this challenge may prove to be particularly difficult, as players can differ on each of the four skills (e.g. very knowledgeable about emotions, but not good at perspective taking).

As, to the best of our knowledge, there are no comparable applied games for autistic girls, this work created a starting point to provide accessible support for this target group in the form of a computer game. The prelim-

inary play-test with the given prototype is not yet sufficient to make general statements on whether the game is sufficiently engaging, the right level of challenging and ultimately effective in transmitting some knowledge and skill to players (and whether this is the case for all or only certain members of the target audience). However, initial results are promising: Both participants felt safe and relaxed in the game environment and showed an interest in continuing to explore it and meet new characters to interact with. Except for some issues caused by mistakes in the prototype, the interaction design was suitable for both play-testers. A very successful feature turned out to be the short-term goal setting feature, which was highly motivating. The style and type of the game was also found to be appealing to members of the target audience across ages and also considering sensory preferences, which indicates that the overall concept is promising. **An important aspect that requires further development is to create more realistic and immersive social interactions that can elicit emotions and also train more dynamic skills, such as participation in a group.** Suggestions here would be to work towards animating NPCs to some extent and adding voice-over. **More research is also necessary into how different emotions can really be elicited by game situations.**

In general, **for the game to be properly tested regarding its long-term goals, it needs to become more complete**, which is not a small task with the chosen concept: While the prototype was built in such a way that would be easily extendable (considering the 2D tilemap environment and the low-effort addition of more characters and dialogues), a quite complex aspect of implementation turned out to be the writing of dialogues based results from co-design workshops (see discussion on co-design aspect). A major hurdle here was a lack of time and a more experienced narrative designer and/or someone with more direct insights in every-day situations of autistic girls. **Future developments of this game need to consider new strategies to expand game content collaboratively, perhaps by also involving parents and educators.** The current game prototype could also not yet deliver implementations of some features that were found to be especially interesting by experts during the feedback session, such as having the game prompt players to self-evaluate their emotions and potentially write diary entries, that could be an interesting starting point for conversations with therapists. It is likely **worth exploring such features that facilitate the use of the game outside of gameplay**, also e.g. regarding the use of xp-cards to encourage real-life interaction among players to build non-fictional relationships (see also ch. 8.3).

8.2 Discussion: Co-designing with autistic girls

Overall, the process of involving autistic girls through co-design workshops had a high positive impact on the project and was a rewarding experience. Several participants and their parents expressed their excitement about the project and there seemed to be no moments where participants felt uncomfortable or anxious. While many things went differently than planned and expected, the collaboration still produced a large amount of relevant and helpful content that could be used in the game directly, or to meaningfully inform its design. While not all aspects of the workshop were engaging for every participant (partly due to their very different profiles), everyone was still able to contribute at one point or another and no one was excluded during group sessions. Furthermore, conducting group meetings - while questionable in terms of productive time management - seemed to be an exciting or enjoyable moment for everyone. Also notable was the generally cheerful and relaxed atmosphere during group meetings, even when participants were meeting each other for the first time. However, there were also challenges in the process of recruitment, organisation and during the workshop itself, many of which corresponded to those mentioned by Frauenberger et al. (2014) [44, 43] (see Chapter 6). These difficulties were largely due to practical challenges like working with a limited time period, a limited number of participants that were living in different locations, differing schedules and limited availability. Most of these challenges are inevitable, however there are some aspects that are worth reflecting on in more detail:

Providing information. The decision to invite all participants (with or without parent) to an individual information session after receiving the information brochure showed to be very helpful for both sides, successfully establishing a better sense of trust and comfort that reduced anxiety about further interactions. This study does not provide a comparison to a case where no information session was conducted, but it was clear that all participants felt more comfortable and relaxed when meeting again. In a few cases, the information session itself already produced interesting insights and design suggestions that could be used in the game. The information brochure, which had an extension with a complete session schedule, also received positive feedback from a pleasantly surprised parent, who pointed out that it was very helpful and in its level of detail. Another advantage of the information meeting was that it made it possible to negotiate a different way of participation for a participant with high social anxiety, who did not feel comfortable in group sessions. Through a quick initial conversation, we were able to determine a way that would enable her to contribute through her interest

in writing. While this produced some additional efforts in converting the workshop format, it proved to be effective in including and representing an important subset of the game's target group. **Therefore, future studies using co-design with a similar target audience should take the time to schedule individual 1:1 sessions before inviting participants to group sessions, as it had many benefits.**

Meeting online. Online sessions had the advantage to reduce location and time constraints of participants during recruitment and scheduling of the workshop. Due to the extremely limited pool of participants and concerns related to the pandemic, meeting online was probably - in this case - the only viable option. However, **online meetings brought several disadvantages that future workshops may be able to avoid, if in-person meetings are possible**: The technology itself was distracting to some participants, e.g. the green frame around the speaker became a topic of discussion several times. One participant also had technical problems, which caused significant time delays. While it is possible that several participants found it easier and safer to sit in front of a screen in a comfortable environment rather than meeting strangers in an unfamiliar environment, communicating through a video call likely reduced their focus and commitment to participating productively. It also reduced opportunities to use physical materials in activities, although the virtual whiteboard successfully acted as interesting visual support and helped return the focus to the topic at hand. One larger consequence of meeting online was that it made longer workshop sessions impossible and each session was set to a maximum of two hours.

Workshop format: Session 0. The differences in communication style and attention across participants made the progress during the session fairly slow and at times chaotic. Everyone got along and almost no ice-breaking was necessary. However, some participants dominated the discussion and, when distracted, derailed or interrupted the discussion of the whole group. While this required patience, flexible time planning and constant efforts to stay on-topic, it was also an interesting opportunity to understand participants interest and their dynamics in a free conversation. The differences in age an (autistic) profiles of participants also resulted in a dilemma for planning the session content and methodology: Some needed a lot more structure than others and got very engaged in an activity with a clear definition, e.g. picking an emotion card and putting it in a category. Others worked better with open-ended exercises, e.g. brainstorms. The use of the game prototype created a high interest and motivation, as well as a clear point of reference for everyone. However, the way the activities were set up, the connection to

the game was not always clear, which in turn reduced motivation. Especially talking about "real life" seemed to be more boring for a younger participant, so it would be worth investigating how acquiring this kind of information can be "disguised" better, to make it more exciting. Here, too, it is likely that an in-person meeting would provide more opportunities to create more engaging activities, e.g. with physical materials. Finally, it is worth pointing out that participants expressed a high interest in contributing to the game by writing, making art or animations outside of the workshops. This made it possible to additionally involve participants meaningfully in game design by directly addressing their interests and talents.

Workshop format: Storytelling session. Overall, this session was very engaging to participants, who after the first few minutes of habituation were actively contributing to the story. Something that the workshop failed to do was to provide an easy-to-use dialogue or narrative that could be integrated in the game, which was in large parts due to the choice in setting for the session, which did not match the computer-game setting. Furthermore, the session was (and had to be) too short to reach a part of the story where more in-depth character interactions and dialogues could take place, since a large part of the session was spent getting used to the game rules and the group setting, as well as "getting into the story". **Future work should consider whether this workshop concept could be more suitable, if a longer time period (e.g. several sessions with the same group) was available for role-playing. Furthermore, it is likely helpful for the facilitator to already have experience conducting a role-play session in order to best engage participants, reduce awkwardness and produce a utilizable story.**

Further recommendations and opportunities Regardless of whether the co-design workshop was suitable to produce narrative content for the applied video-game, the interaction between autistic girls in the session was overall positive and suggests that this type of activity and session format may be helpful in a completely different setting: For example, **a similar storytelling workshop may be organised to enhance community building in a school setting, allowing autistic girls to more easily engage in initial "ice-breaking" interactions with their peers.** Alternatively, **a therapeutic setting may also profit from the use of role-play games with either a group of autistic girls, a mixed autistic and non-autistic group or in a 1:1 setting. Role-playing and co-creating a fictional narrative turned out to, indeed, also produce scenarios that gave insights on the real-life difficulties and thoughts**

of autistic girls - but in a playful and non-pressuring manner.

8.3 Closing thoughts: a solution or a bridge?

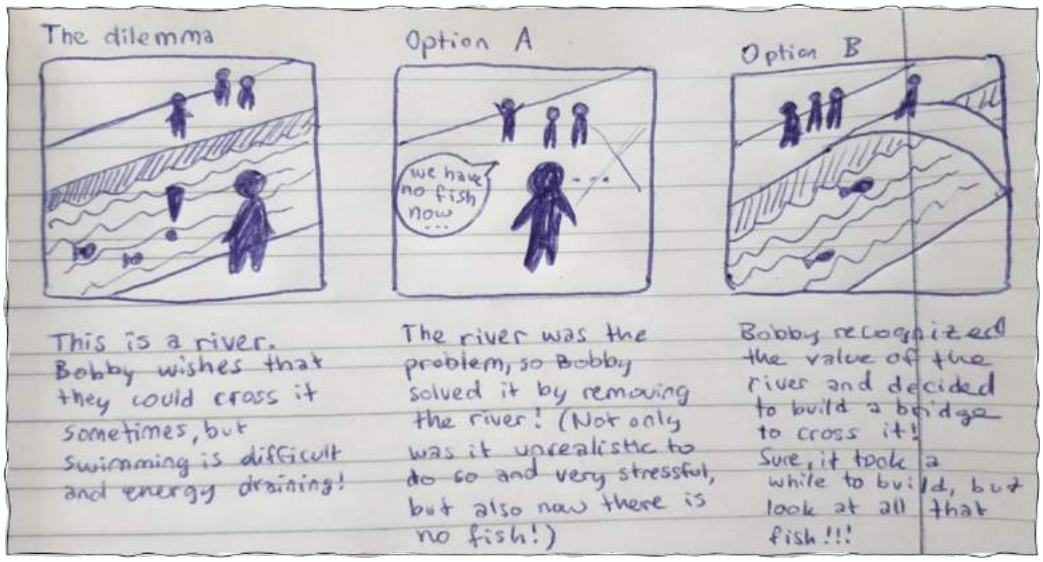


Figure 27: (Img: Claudia Libbi, 2021)

> *"For every complex problem there is an answer that is clear, simple, and wrong."* (H. L. Mencken, 1880-1956)

A few years ago, Evgeny Morozov wrote a book in which he questions "the folly of technological solutionism", the philosophy that seems to permeate modern life by prescribing technology to solve every problem and thereby obfuscating the underlying, systemic problems [82]. In a critical paper on digital technology for education, Sancho-Gil remarks that *"Solutionism, results from disregarding the characteristics of "wicked" problems, by 'inventing' a problem, misrepresenting this fiction as a genuine and urgent dilemma and advocating the use of digital technology to fix it"* [94].

To some extent, this work has already acknowledged "wickedness" and moved away from trying to oversimplify autism and inventing problems that need to be solved. And Morozov's critique does not vilify all technology, but rather questions its place in the world. So perhaps we should ask: What can the game (proposed in this thesis) realistically provide support with, and what can it not - or should it not promise to do?

Regardless of whether the proposed game will, indeed, help players participate more comfortably in social life - it is hard to imagine that a single-player computer game can truly enable a player to suddenly make (real-life) friends - especially considering that simulating the complexity of real social interaction without involving other real people is arguably one of the bigger challenges even for state of the art, high-tech game productions. Being a game played alone on a computer conceptually meets the goal of being practical, accessible and creating a safe environment to fail in without running the risk of impacting one's real life. However, playing "alone" inherently does not afford making real-life friendships.

While out of scope for the current project, there may be a promising direction for future work in exploring how the proposed game can be adapted or extended to facilitate the creation of a community[39] - therefore becoming an intermediate step, a bridge, to real social interaction. If autistic friendships tend to be based on activities [86, 88], then perhaps the shared (but individual) experience of game-play can be an ice-breaker in conversation. And aiming to facilitate the formation of friendships between autistic girls may be very valuable and beneficial: Crompton found that spending time with autistic friends or family positively relates to having a happy social life as an autistic person and helps feeling a sense of "belonging"[33]. In an interview, an autistic woman refers to it as "having a tribe" [58] and Milton (an autistic researcher) explains that, from personal experience, it seems that he learned the most important things from other autistic people, as they could relate to his experiences and explain how they navigated similar problems [85].

[39]While it may not be a realistic standard to aspire to, the Minecraft community is a good example for a game community that has proven to be a great source of support specifically for autistic people [92].

Of course, we hope that the proposed game can be a valuable tool for autistic girls, but it is important to not mistake it for a one-time-use magical potion aiming to fix problems[40]. Like all technology, it would be better to regard it within its context and consider how it can supplement what is already part of an autistic girl's life: Can it help start conversations with parents and therapists? Can it help to break the ice with a potential friend? Can it empower the player to find their own support strategy? I hope that this work can inspire future studies to think in a similar direction and contribute to the change in paradigm from "we can fix you" to "you're great how you are and we can help you grow".

[40]Not only is that inevitably going to lead to disappointment, but it also implies that there is something wrong with the player, that needs to be fixed. I liked what Matt Haig wrote in "Notes on a Nervous Planet": *"Much of what is sold to us is the idea that we could be better than who we are if we tried to become something else. [...] We need to build a kind of immune system of the mind, where we can absorb but not get infected by the world around us."* This is quite a radical statement, although probably quite in tune with the autism rights movement, and should probably not be generalized to mean that we shouldn't want and try to change as we grow and be supported in doing so - the result shouldn't be stagnation. But it is also important for researchers and designers to make sure their "solutions" never imply that the things that a person cannot change, aren't inherently harmful and make them them, are bad or undesirable.

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A Additional Materials Regarding Methodology and the Design Journey

A.1 Ethical Approval

EC-CIS ADVICE FORM

RP 2021-169	**Designing a Serious Game for Autistic Girls**
Name of reviewer	Dina Babushkina
Date	
Conflict of interest - Description of closeness, severity, and consequences that reviewer decided upon (see CoI document)	
Not that I am aware of.	
Review	
☒ No adjustments needed. Secretary can send advice.	
☐ Needs minor adjustments, please, send to ethicscommittee-cis@utwente.nl. Secretary can send advice after receiving adjustments.	
☐ Needs major adjustments, please send to me for review, with cc to ethicscommittee@utwente.nl.	

A.2 Workshop Info Leaflet and Informed Consent Form

Information Leaflet: Co-Design (Storytelling Workshop) for Autism "Serious" Game

CONTACT

University of Leiden, Faculty of Social Sciences (Developmental Psychology) &
University of Twente, EEMCS (Human Media Interaction)

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For queries, complaints or comments about the research, please contact the Ethics Committee Computer & Information Science (ethicscommittee-cis@utwente.nl)

DETAILS OF THE RESEARCH

What is the goal? We are making a serious game* for autistic girls between 10-16 years to become more comfortable with social interactions and dealing with emotions. The game is about social encounters and gameplay will focus on interaction with game characters. To make these as relatable as possible for the players, we want to invite the biggest experts – autistic girls - to create the stories and interactions together!

**Serious games are games that are not purely made to be fun, but try to teach something or encourage some behaviour/thoughts – but that doesn't mean they shouldn't be fun!*

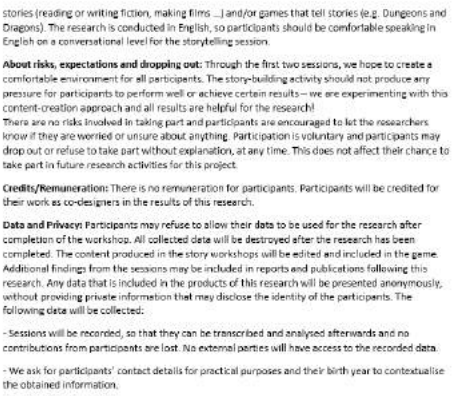
How does it work? To participate, girls are invited to take part in a story-telling/role-play game workshop that will happen online, through a video-calls! There are three parts:

1. **Getting to know each other:** To make sure that the participants have a good time and the workshop produces nice results, we first went to meet participants individually (online). Here you can learn more about the project and workshop and we will talk about whether you are happy to do the workshop with other autistic girls or would like to do it with e.g. your parent or friend.
2. **Preparation session:** If you are familiar with the role-play game "Dungeons and Dragons", you might be familiar with "session zero"! Before we meet to create a story together, all workshop participants meet to create their characters, get to know each other and decide on topics, themes or social scenarios that the story should include. Based on this, we will prepare the story workshop!
3. **Story workshop**: **Finally,** this is where we meet to build a story together. You have your characters, and we prepared the world, situations and fictional people to interact with. Let's play! Participants will be able to learn more about the exact procedure in the preparation session.

Duration: There is no definitive duration or number of times we have to meet, as this also depends on participants' preferences and availability. We propose the following: (1) Getting to know each other for 0.5-1h (2) Preparation session for 1h (3) Story workshop for ca. 2-3h. If you have fun and one workshop wasn't enough, we may do additional workshops (this is of course optional). Workshop(s) will take place throughout June and July.

Participant requirements: This form is to recruit autistic girls between 10-16 years. The workshop does not require any experience or skills, but it is helpful if participants enjoy activities related to

Figure 28: Infoleaflet co-design part 1



stories (reading or writing fiction, making films ...) and/or games that tell stories (e.g. Dungeons and Dragons). The research is conducted in English, so participants should be comfortable speaking in English on a conversational level for the storytelling session.

About risks, expectations and dropping out: Through the first two sessions, we hope to create a comfortable environment for all participants. The story-building activity should not produce any pressure for participants to perform well or achieve certain results – we are experimenting with this content-creation approach and all results are helpful for the research!
There are no risks involved in taking part and participants are encouraged to let the researchers know if they are worried or unsure about anything. Participation is voluntary and participants may drop out or refuse to take part without explanation, at any time. This does not affect their chance to take part in future research activities for this project.

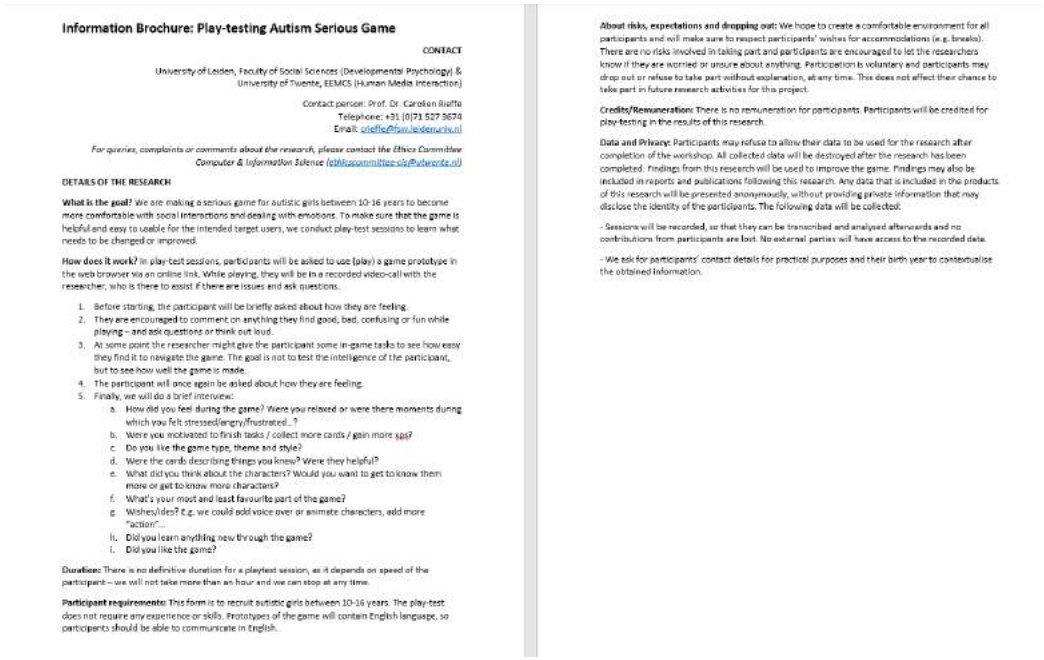
Credits/Remuneration: There is no remuneration for participants. Participants will be credited for their work as co-designers in the results of this research.

Data and Privacy: Participants may refuse to allow their data to be used for the research after completion of the workshop. All collected data will be destroyed after the research has been completed. The content produced in the story workshops will be edited and included in the game. Additional findings from the sessions may be included in reports and publications following this research. Any data that is included in the products of this research will be presented anonymously, without providing private information that may disclose the identity of the participants. The following data will be collected:

- Sessions will be recorded, so that they can be transcribed and analysed afterwards and no contributions from participants are lost. No external parties will have access to the recorded data.

- We ask for participants' contact details for practical purposes and their birth year to contextualise the obtained information.

Figure 29: Infoleaflet co-design part 2



Information Brochure: Play-testing Autism Serious Game

CONTACT

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For queries, complaints or comments about the research, please contact the Ethics Committee Computer & Information Science (ethicscommittee-cis@utwente.nl)

DETAILS OF THE RESEARCH

What is the goal? We are making a serious game for autistic girls between 10-16 years to become more comfortable with social interactions and dealing with emotions. To make sure that the game is helpful and easy to usable for the intended target users, we conduct play-test sessions to learn what needs to be changed or improved.

How does it work? In play-test sessions, participants will be asked to use (play) a game prototype in the web browser via an online link. While playing, they will be in a recorded video-call with the researcher, who is there to assist if there are issues and ask questions.

1. Before starting, the participant will be briefly asked about how they are feeling.
2. They are encouraged to comment on anything they find good, bad, confusing or fun while playing – and ask questions or think out loud.
3. At some point the researcher might give the participant some in-game tasks to see how easy they find it to navigate the game. The goal is not to test the intelligence of the participant, but to see how well the game is made.
4. The participant will once again be asked about how they are feeling.
5. Finally, we will do a brief interview:
    a. How did you feel during the game? Were you relaxed or were there moments during which you felt stressed/angry/frustrated...?
    b. Were you motivated to finish tasks / collect more cards / gain more xps?
    c. Do you like the game type, theme and style?
    d. Were the cards describing things you knew? Were they helpful?
    e. What did you think about the characters? Would you want to get to know them more or get to know more characters?
    f. What's your most and least favourite part of the game?
    g. Wishes/ides? E.g. we could add voice over or animate characters, add more "action"...
    h. Did you learn anything new through the game?
    i. Did you like the game?

Duration: There is no definitive duration for a playtest session, as it depends on speed of the participant – we will not take more than an hour and we can stop at any time.

Participant requirements: This form is to recruit autistic girls between 10-16 years. The play-test does not require any experience or skills. Prototypes of the game will contain English language, so participants should be able to communicate in English.

About risks, expectations and dropping out: We hope to create a comfortable environment for all participants and will make sure to respect participants' wishes for accommodations (e.g. breaks). There are no risks involved in taking part and participants are encouraged to let the researchers know if they are worried or unsure about anything. Participation is voluntary and participants may drop out or refuse to take part without explanation, at any time. This does not affect their chance to take part in future research activities for this project.

Credits/Remuneration: There is no remuneration for participants. Participants will be credited for play-testing in the results of this research.

Data and Privacy: Participants may refuse to allow their data to be used for the research after completion of the workshop. All collected data will be destroyed after the research has been completed. Findings from this research will be used to improve the game. Findings may also be included in reports and publications following this research. Any data that is included in the products of this research will be presented anonymously, without providing private information that may disclose the identity of the participants. The following data will be collected:

- Sessions will be recorded, so that they can be transcribed and analysed afterwards and no contributions from participants are lost. No external parties will have access to the recorded data.

- We ask for participants' contact details for practical purposes and their birth year to contextualise the obtained information.

Figure 30: Infoleaflet play-test

Co-Design for Autism Serious Game: Informed Consent Form (for parents and children)

CONTACT

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University of Twente, EEMCS (Human Media Interaction)

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For queries, complaints or comments about the research, please contact the Ethics Committee Computer & Information Science (ethicscommittee-cis@utwente.nl)

Brief summary: This study aims to create a computer game for autistic girls between 10-16 years to become more comfortable with social interactions and dealing with emotions. Participants are involved to co-create relevant and appropriate game content and test the usability and effectiveness of game prototypes.

- ✓ I have read the information letter. I could ask additional questions. My questions have been answered correctly. I had enough time to decide to participate.
- ✓ I know that participation is completely voluntary. I know that at any time I can decide not to join to do or to stop. I don't have to give a reason for that.
- ✓ My data (including video images) is encrypted and stored for the duration of this study. Unauthorized persons cannot access the data.
- ✓ The school does not receive information about individual pupils. There are no statements about individual people done.
- ✓ My research data will be used to design a game as product of this research and findings will be included in reports and publications following from it.

For parent/caregiver/guardian:

I consent to my child's participation in this study as described in the attached letter.

- ☐ Yes
- ☐ No

Optional: Here you can also indicate whether you consent to the use of the video recordings for scientific conferences and / or educational purposes: I give permission to show the video recordings made at scientific conferences to others researchers. Your child is not blurred in the video recordings, so it may be recognizable.

- ☐ Yes
- ☐ No

For child:

I consent to my participation in this study as described in the attached letter.

- ☐ Yes

Figure 31: Consent form part 1

☐ No

Optional: Here you can also indicate whether you consent to the use of the video recordings for scientific conferences and / or educational purposes: I give permission to show the video recordings made at scientific conferences to others researchers. I am not blurred in the video recordings, so it may be recognizable.

☐ Yes
☐ No

Name of child: _____

Year of birth: _____

Name of primary
parent/caregiver/guardian: _____

(If applicable) Name of secondary
parent/caregiver/guardian: _____

Date: _____

Contact details (how would you like us to stay in contact with you?): _____

_____

Signature of primary
parent/caregiver/guardian: _____

(If applicable) Signature of secondary
parent/caregiver/guardian: _____

Signature of child: _____

Signature of researcher: _____

Figure 32: Consent form part 2

A.3 Workshop Protocol

A.4 Schedule and questions for expert interview and brainstorm

Schedule

10-10:15 – Info about the project & help me understand what kind of experience you have with autistic kids! Also so you can ask questions about what I'm doing.

10:15-10:30 – Given the info given in the intro (learning goals, certain elements like "building blocks"), I'll ask you to imagine a game for an autistic girl and tell me about it. I'll ask you to completely ignore what is or isn't possible technologically – let's imagine we can magically build anything. No pressure, I'll have some guiding questions later, but I just want to hear any thoughts you might have without being biased!

10:30-10:55 – Guiding/brainstorm questions (we don't have to get through all of them, we'll see).

10:55-11:00 – Wrap up!

Brainstorm questions (will be explained better in session):

- What kind of virtual agent would be appropriate? (how autonomous, with/without a face? Animated expressive? Realistic or not?
- Scaffolding for different levels of difficulty: What aspects are difficult and should be increased gradually as child progresses? (e.g. number/intensity of distracting stimuli, complexity of social interaction, difficulty of conflict resolution)
    - Do we want some kind of calibration? And how would we do that?
    - Consider using something like FaTiMa: What character should the friend character have?
    - Might we consider multi-player scenarios
- What are strategies used by therapists to practice social interaction?
    - Role-play different situations? What situations could be relevant for girls at different ages?
    - How to facilitate skill transfer?
- How to create a safe environment to experience stress in? We want to induce anger so they can learn to recognize and deal with it, but there is no direct supervision – what are ways to make this "ethical" (safe)?
- The in-game story: How should it be and which elements have to be realistic, which don't? We can think on a spectrum:
    - If we simulate a completely realistic/normal situation in real life it may be easily transferable, but also boring and confront us with questions like whether all children in the target group share the same "normal".
    - On the other hand, introducing fictional/unrealistic elements like magical powers can help embedding things like "going back in time to repeat an interaction" more embedded in the game's storyline and universe, make things more interesting and fun, but also make it harder to transfer skills to real life interactions.

A.5 Survey questions: Survey about Preferred Activities and Media of Target Group

See Fig. 33

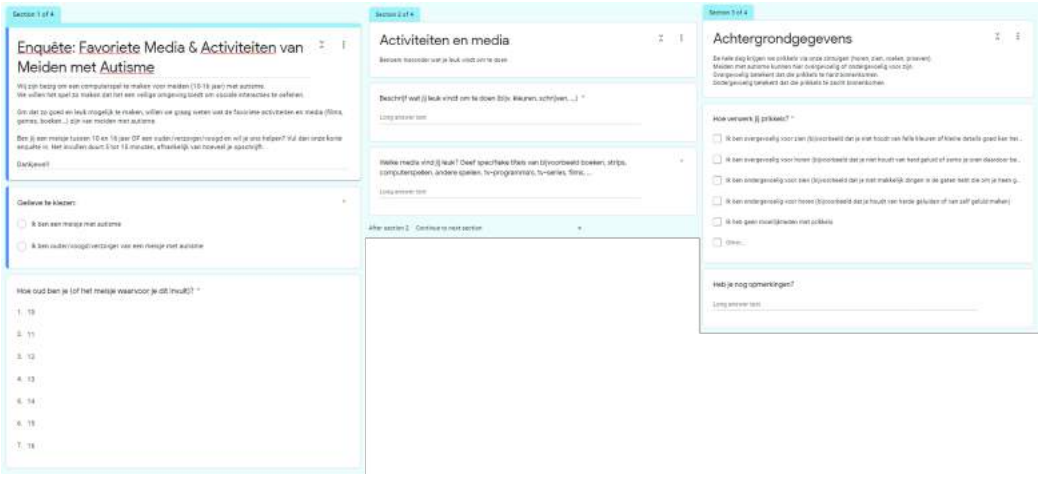

Figure 33: Survey questions in Dutch.

A.6 Findings from the Survey about Preferred Activities and Media of Autistic Girls between 10-16 Years

There were thirty-three responses to the survey. Girls either responded autonomously or parents/caregivers filled it in for them. Table 6 lists activities and media grouped by age and Figures 34 visualizes media by age as "moodboards".

(a) Age 10

(b) Age 11

(c) Age 12-13

(d) Age 14

(e) Age 15

(f) Age 16

Figure 34: Moodboards of media by age

Table 6: Activities and Media grouped by Age

Age	Activities	Media
10	Putting cars, dolls and other toys in patterns	Slime videos (on Youtube), Pokemon go
	Singing, korfball, making tiktoks	Camp Kiekiewaka (series), Julie and the Phantoms (series), Leven van een loser (books), Donald Duck, leeuw met de strepen (book)
	Colouring, watching YouTube videos (also specifically Enzo Knol), Makeup, Horses/Unicorns	Spangas, Sims, Roller coaster tycoon
	Games on the tablet, reading, playing outdoors, cuddling with animals	Basically all books with letters and pictures, Super Mario, slitherio, Titans go (series), glitter force/ Pretty Cure (series), How to train your dragon (films), Wings (series/film), Justice League (film)
11	Horse riding and drawing	Star stable online (game), Heartland (series), Gouden paarden (books), Droompaarden (books), Vrije teugels (series), Mystic (tv series?)
	Colouring, crafts	Donald Duck, Garfield, jeugd journaal, The hunger games (book/film?), moe mijn keurige ouders in de bak belanden (series)
	Horse riding, nature, crafts	Horse Vloggers on YouTube
12	Writing, reading, dealing with horses	Tiktok, Harry Potter
13	Drawing, making jewelry and clothes, crafting	Harry Potter (films), Stranger Things (series), Friends (series), Family guy (series)
	Makeup, buying clothes, drawing, taking care of animals, watching Netflix and Videoland (etc.)	Instagram, Tiktok
14	Paddle boarding and drawing	Frozen (films), the Sims (game)
	Being creative, social media (on phone), making music/singing	Social media (Instagram, Snapchat, Tiktok)
	Drawing, cooking, horse riding	Fiction and fantasy genere, (used to read Donald Duck), roblox (game), Vampire Diaries (series), Riverdale (series)
15	Drawing, painting, gaming, listening to music, chatting	Minecraft (game), series/films on Neflix (unspecified)
	Making things (with hands) like crafting	De efteling (themepark? On youtube?)
	Football	Temptation island (series), first dates, girlz, fortnite
	Making tiktoks, makeup, going shopping	Wie is de mol, de mol Belgium, Harry Potter, fantasy books, the traitors
	Reading, drawing	Chatting (activity?), zondagskind, Minecraft
	Sewing, painting (cards? Handletteren?), football, (mtb?)	Harry Potter, wie is de mol, expeditie robinson
	Reading, boxing, gymnastics, making fake wounds (make-up special effects)	Dutch series (unspecified TV?), books on psychiatry
	Reading	Books by Mel Wallis de Vries, the Sims, horror movies, books about dragons (etc.)
	Drawing, listening to music, chatting online with friends all over the world	Harry potter, wie is de mol, 3 op reis, expeditie robinson, tiktok videos, amangas (among us?), fornite, minecraft, donald duck, jungle book (live action), cabaret (genere?)
	Singing, acting, sudoku, making tiktok movies	Youtube and Netflix (unspecified), Instagram, luisterboeken (fantasie), Zombies vs. plants (game), Zelda (game on switch)
	Handicrafts/crafts, drawing, buying/styling clothes, restyling rooms, caring for/ observing animals, listening to music	
16	De efteling (probably refers to fantasy-themed amusement park), gaming	Raveleijn books, Efteling (youtube), the Millers (movie), full house (series)
	Animals, drawing, walking	Stripd (Stripped?), TV shows and computer games (unspecified)
	Reading, everything to do with animals	Warrior cats
	Writing, reading, drawing	Dutch literature, Harry potter (books)
	Making and listening to music, learning about language and foreign languages	Springvloed, the bridge
	Cycling	Scorpion (series)
	Jewelry making, walking	Spangas, brugklas, de regels van Floor
	Drawing, puzzles, gaming, reading, coloring	Wie is de mol, expeditie robinson, harry potter, mangas (unspecified), anime (unspecified), Minecraft, tiktok, werewolves (game? Or as genere?), Exploding kittens (game), Settlers (game), speed cups, dice games, amangas (among us?), fortnite
	Reading, complaining, sometimes gaming, walking, making music, playing disaster tourist, travelling	

A.6.1 General Themes

- Fantasy/magic/heroes/world discovery: de efteling, Harry Potter, Zelda, Justice League + fantasy books mentioned very often (e.g. with dragons, warrior cats, the genre as a whole)
- Social life: Reality TV, social media, sims, TV shows/films about families and young people
  - Dating and romance reality tv
  - Fortnite, Roblox and Minecraft have social aspects
- Animation and cartoons / manga (heroes and magical girl theme at age 10, Donald duck comes up across ages)
- Mystery/crime/detective/spies: Among us, de Mol, Crime TV shows, Werewolves, Stranger Things
- Worldbuilding / active story creation with other people: Minecraft, Roblox, Werewolves, Sims, Among us, Tiktok, Rollercoaster Tycoon.

One girl commented: *"ik vind roblox leuk om te spelen want daar heb je voor ieder wat en ook als je eens klaar bent met bijv een parkour dan ga je over naar een roleplay ofzo... het is maar net waar je zin in hebt."*

A.6.2 Some differences by age

10-13:

- Heroes (cartoon or real actors) and magic: teen titans, justice league, winx, glitter force, how to tame your dragon, frozen, harry potter, pokemon go
- Social life more friendship/school related (Dutch TV with young actors)

14-16:

- Romance and dating becomes a topic (e.g. in Riverdale and vampire diaries subplot, dating reality tv, more "adult" TV and anime/manga often contains romance etc.)
- Darker themes: crime/mystery/fantasy related (also dark humor like in exploding kittens, plants vs. zombies and one girl liked horror movies)