

Ruby's Mission: Towards an Applied Gaming Intervention for reducing Loneliness of Children with Chronic Illness

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ABSTRACT

Children with a chronic disease, such as cystic fibrosis or juvenile arthritis, often face obstacles that can have a negative impact on children's physical, social-emotional and cognitive development, beyond the actual illness itself. Children with chronic conditions are, on average, lonelier than their peers without such conditions. Feelings of loneliness in children and adolescents have been associated with a wide range of negative outcomes, including school drop-out, depressive symptoms, social anxiety, suicide ideation, low self-esteem, eating disorders, and sleep problems. As such, the present investigation sets out to reduce these feelings of loneliness for children with chronic conditions, and aims to do so by the structured design of an applied gaming intervention. Specifically, the present paper contributes (1) a literature-based understanding on training socioemotional skills as a novel means to reduce feelings of loneliness in chronically ill children, (2) intervention objectives that are aligned to this goal, and (3) a structured proposal for design guidelines that implement the intervention objectives into 'Ruby's Mission'; an applied gaming intervention for reducing loneliness of children with chronic illness.

CCS CONCEPTS

• **Applied computing** → Psychology; • **Software and its engineering** → Interactive games; • **Social and professional topics** → Children.

KEYWORDS

Applied gaming intervention, children, chronic illness, reducing loneliness, socioemotional skills, social competence

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1 INTRODUCTION

Children that grow up with a chronic illness face many challenges far beyond the burden of the disease itself. Their diseases may impact many daily aspects of their lives; from not being able to play outside with friends, to missing classes due to medical appointments [48]. In addition to these constraints, up to 40% of all children with a chronic illness suffer from mental and psychosomatic problems (for example symptoms of anxiety, depression and fatigue) [19, 45, 50, 58]. These challenges persist even after the disease is reasonably under control [47]. Moreover, several social factors, such as stigma, isolation, inequality, and bullying, are everyday reality for a greater proportion of children with chronic illnesses compared to their peers [37, 57]. In the long run, their start in life characterized by greater challenges that can lead to mental, social, and academic limitations, loneliness, and ultimately a reduced quality of life [7, 37, 55, 57, 78]. Approximately 1 million (one in four) children, adolescents, and young adults (0-25 years old) are affected with a chronic disease in the Netherlands (a disease which lasts longer than 3 months, recurs more than three times per year, and/or is linked to long-term medication use, treatments, or aid; [82]).

The challenges associated with childhood chronic illness may also lead to *limited opportunities to participate in play*. Play is considered vital for the developmental of children into healthy adults. From a development perspective, play offers ample physical, cognitive, emotional, and social benefits. It allows the opportunity for

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children to practice their (social) behavioral repertoire, and experiment with alternative scenario's. Furthermore, children are able to address both the positive and negative consequences of their behavior within a safe and engaging environment [8, 18, 20, 40, 53, 54]. As such, play is a natural tool to develop by learning with a positive and supportive context. Therefore, on top of childhood chronic illness, limited play may have long-lasting negative effects for the development of these children into healthy adults.

Indeed, chronically ill children express that they experience relatively little care with regard to the psychosocial problems related to their diseases. Especially *loneliness* is often underexposed. Interviews were conducted with children (aged 8 to 18 years old) from the Wilhelmina Kinderziekenhuis (children's hospital) in Utrecht. These interviews revealed that there is a need for interventions aimed at the consequences of their chronic illness on their day-to-day life. In these interviews they highlighted themes such as: going to school or playing (8-12 years old); meeting with friends (12-18 years old); or playing sports; in short, feeling connected and a part of everyday activities with peers. Therefore, there is a need for interventions focused on increasing and strengthening chronically ill children's contact with peers.

Video games may offer a solution to this need for intervention. Modern technology has led to a dramatic increase in the amount of time children spend on playing video games. On average, the 8 to 14 year old spends more than one hour on playing video games per day [63, 83]. Presumably, children with chronic illness spend even more time playing video games than their peers, as they are often restricted in their participation in other activities. This phenomenon provides a significant opportunity to capitalize on the potential video games hold for creating interventions; particularly because video games offer similar benefits as traditional play; players can immerse themselves in engaging worlds that offer a safe environment in which they can practice with various scenario's and their (social) behavioral repertoire. Moreover, because play takes place in the digital environment, it provides the ability to carefully design, guide, and observe play. Playing video games might positively affect social, emotional, and cognitive development [17]. Indeed, several studies showed that video games can be successfully designed as an intervention for mental health issues such as anxiety or depression, or to improve treatment adherence [10, 11, 30, 32, 43, 60, 71–73, 84, 87]. The developmental benefits, wide availability, and the characteristics of video games makes them great tools to be used for interventions.

Consequently, this study investigates how an applied game can be designed as an intervention for increasing and strengthening contact between children with and without chronic illness. The present paper contributes (a) a literature-based understanding on training socioemotional skills as a novel means to reduce feelings of loneliness in chronically ill children (Section 2), (b) intervention objectives that are aligned to this goal (Section 3.1), and (c) a structured proposal for design guidelines that implement the intervention objectives into 'Ruby's Mission'; an applied gaming intervention for reducing loneliness of children with chronic illness (Sections 3.2, 3.3, and 3.4). Finally, we conclude with a brief discussion (Section 4).

2 TRAINING SOCIOEMOTIONAL SKILLS AS A NOVEL MEANS TO REDUCE FEELINGS OF LONELINESS

2.1 Loneliness in children with chronic illness

A recent meta-analysis has found that children with chronic illness are on average somewhat lonelier than their healthy peers [37]. Several studies have shown that loneliness at an early age might lead to adverse developmental outcomes and health problems, such as higher frequency of visits to the doctor, increased risk of cardiovascular illness, social skill deficits, increased levels of depressive symptoms, and lower perceived general health [33, 61, 70, 85]. Children with chronic illness are not only at increased risk of psychosocial and socioemotional problems associated with their illness, but also for the increased health risks associated with feelings of loneliness. Therefore, it is of utmost importance to recognize feelings of loneliness when treating children with chronic illness [37].

Loneliness is the distressing emotional state that people experience when there is a difference between their desired and perceived quantity and/or quality of social relationships [51]. Children with chronic illness indicate to have a higher need for support than their typically developing peers, while their self-perceived support is lower [2, 79]. A report from the Verwey Jonker Institution in the Netherlands [82], showed that there were significantly more chronically ill children with the desire for more friendships compared to their typically developing peers. This discrepancy in need for support and the actual perceived support might induce feelings of loneliness in chronically ill children. Various studies show that children with chronic illnesses value friendships and being accepted as the most important factors in their life [76, 80]. This was also confirmed in qualitative interviews studies from 2017/2018 with chronically ill children at the Wilhelmina Children's Hospital (WKZ) (unpublished data). Even though these children highly value their friendships and social belonging, they often have fewer friends, are more isolated, and have difficulty establishing and maintaining friendships [14, 89]. Despite society's efforts to promote social inclusion, children with chronic illness continue to report more often feelings of loneliness and exclusion and having less contact with the social world outside of home compared to 'healthy' peers [89]. It is important to gain a better understanding of why chronically ill children experience deficits in their social relations.

Two types of loneliness are distinguished; social and emotional loneliness [6]. The experience of emotional loneliness stems from the absence of a close or intimate relationship. Social loneliness stems from the absence of an engaging social network. It is not evident yet if chronically ill children experience one type of loneliness more than the other. Each type of loneliness might be associated with other deficits in interpersonal functioning.

Children with chronic illnesses are often less exposed to (play) activities than their peers. For example, this group has significantly higher levels of school absenteeism, attend special forms of education such as home schooling more often, and participate less in public sport clubs [7, 35, 62, 82]. Furthermore, these children also face other challenges to participating in social activities with peers, such as being stigmatized [7, 41], falling victim to physical violence

[29] or being bullied [56]. Frequent absenteeism from school limits the time spent with peers, reducing the amount of rewarding peer-related activities [75]. Limited time spent with peers might lead to impaired social functioning, which has indeed been found in previous studies [38, 59].

Based on these serious risks for children with chronic illnesses, it is worthwhile to invest in an intervention to reduce loneliness. The literature described above suggests that an intervention targeted at improving social competencies might lead to improved social relations. Many studies found only a small negative effect on the social functioning of children with chronic illnesses [59]. Therefore, it is not directly evident which aspect of social functioning would benefit chronically ill children the most in improving their social relations. We decided in our study to focus on improving 'socioemotional skills' because emotions affect the social situation, they are free of stigma, it offers a heterogeneous approach for reducing loneliness in children with chronic illness, and it might address the underlying social challenges of this population. Our focus on socioemotional skills is further discussed in Section 2.3.

2.2 Socioemotional skills

Socioemotional skills are described in this study as (1) recognizing emotions in one-self and in others, (2) understanding the meanings of emotions to guide thinking and doing, and (3) understanding the subjectivity of emotional experiences. Our description of socioemotional skills has many similarities with several existing constructs such as *mentalizing* [12], *emotional intelligence* [67], *alexithymia* [65], and *theory of mind* [16]. For example, mentalizing is described as the ability to perceive and interpret human behavior in terms of mental states [12], which has similarities with 'understanding the meanings of emotions to guide thinking and doing'. Some of these constructs have already been associated with interpersonal functioning [24, 34, 49]. While detailed discussion of the concept of socioemotional skills is outside the scope of the present paper, we recommend the interested readers to read Fonagy and Allison [12], Goldman et al. [16], Šago and Babić [65], Salovey and Mayer [67]. Next, the three socioemotional skills that are investigated in this study, are described in more detail.

First, the ability to recognize emotions in one-self and in others can be seen as a prerequisite for applying one's socioemotional skills in social situations. Theory and research suggest that misperception and misinterpretation of emotion cues or frequent failure to perceive them at all could seriously impede the development of socioemotional competence [27]. When a person is unable to accurately perceive what emotions another person is feeling, then this person will also not be able to appropriately respond to these emotions. Spithoven et al. [77] conducted a meta-analysis to social-information processing in lonely individuals. In their analysis, they found that lonely individuals do not perform worse on recognizing emotions in others. However, contrary to chronically ill children, lonely individuals are not necessarily more often isolated from their peers. Moreover, they focused on individuals in general and not on children. Childhood is an important phase for developing socioemotional skills. Therefore, it might be that reduced participation may lead to deficits in chronically ill children's emotion recognition skills. Furthermore, the studies included in their meta-analysis

focus on recognizing emotions in facial expressions. The proposed definition does not only focus on facial expressions, but also on extracting emotional feelings in others from the social context.

Second, another aspect of socioemotional skills is understanding the meanings of emotions to facilitate thinking. This includes the interpretation of emotional meanings and considering these in your daily (social) functioning. Emotions convey specific information. For example, happiness usually indicates a desire to be with others while anger might convey a message of feeling treated unfairly [67]. Each emotion is associated with a set of possible actions. Anger for example is associated with attacking, revenge-seeking, withdrawal, or ignite the desire for change. Moreover, emotions coordinate the social interactions and (re)connections between persons [1]. Therefore, understanding the meanings of emotions and using these interpretations to guide your thinking and doing, might help a person to navigate their way through social interactions with others.

Third, is the understanding the subjectivity of emotional experiences; every person experiences emotions differently and possibly different from yourself. Spithoven et al. [77] showed in their meta-analysis that lonely individuals have a negative cognitive bias in all phases of social information processing. They tend to have more attention for threatening stimuli, hold negative and hostile intent attributions, expect rejection, evaluate themselves and others negatively, endorse less approach- and more avoidance-oriented goals, and have low self-efficacy. Understanding that others might have emotions different from yourself might help reduce this negative cognitive bias in social information processing.

2.3 An argument for training socioemotional skills to reduce feelings of loneliness

We hypothesize that training 'socioemotional skills' will improve the social relations of children with chronic illnesses – and therefore reduce feelings of loneliness in the long term – for several reasons. First, emotions affect the social situation. They coordinate the social networks of complex social relationships that connect, reconnect, and reorganize over time [1]. Information is communicated by emotions and their expressions in mutual response to the social environment. Emotions also evoke specific behaviors in perceivers (e.g. approaching a person who is feeling sad or avoiding a person who is angry) and provide information about the relation between people [25].

Second, socioemotional skills are free of stigma; every child/person experiences emotions, regardless of the presence of chronic illness. Stigmatization is an everyday reality for many children with chronic illnesses. Highlighting the differences between children with chronic illnesses and peers may have a disabling effect. So did one study show that children find it hard to maintain a positive self-identity when peers highlight their differences [36]. Another study found that treatments that made these children feel different were considered a burden, and in some cases even led to stopping the treatment [80]. Children with chronic illnesses also indicated that they carefully consider whether they will tell or show others minor or major aspects of their illness [46]. They describe that they are afraid to 'stand out' in a negative way, while striving to be normal, even though not disclosing about their illness may be detrimental

to participating in activities with peers; disclosing might be helpful as it can lead to a better understanding among peers.

Third, an approach that does not focus on illness-specific aspects might be more appropriate for an intervention for reducing loneliness in children with chronic illness. Children with chronic illness are a heterogeneous group who show considerable variations in their daily functioning [42, 68, 69]. As mentioned earlier, children with chronic illness spent on average less time with peers, which might lead to impaired social skills; regardless of type of illness. An intervention focused on improving the social interactions of these children could possibly help a larger audience.

Fourth, chronically ill children might lack a positive language to discuss their illness with their friends and peers. For example, communication and emotional functioning – among others – were highlighted as barriers to maintaining contact between friends after diagnosis of illness or serious injury [26]. The authors argue that it might be important to provide adequate information on how to communicate about their illness with their friends. A meta-analysis showed that interventions focused at improving communication about chronically ill children's health conditions had small effect sizes on decreasing feelings of loneliness and peer problems [13]. They argue that interventions addressing the underlying peer challenges may result in improved social functioning. Improving socioemotional skills might not only help overcome emotional difficulty in communicating about chronically ill children's illness, it could also help address underlying peer challenges.

3 TRANSLATING INTERVENTION OBJECTIVES INTO DESIGN GUIDELINES

3.1 Intervention objectives

A first step towards designing and creating a game for improving socioemotional skills in children with chronic illness, is to define a set of *intervention objectives* which the game should achieve. To remind the reader, a pragmatic working definition of socioemotional skills was found to consist of three aspects: (1) recognizing emotions in one-self and others, (2) understanding the meanings of emotions to facilitate thinking, and (3) understanding the subjectivity of emotional experiences. As such, it is clear that these three aspects may straightforwardly be translated into objectives for the applied game intervention, namely:

- (1) Learn to recognize emotions in one-self and in others.
- (2) Learn about the meanings of emotions to facilitate thinking and doing.
- (3) Learn to understand that emotional experiences are subjective.

Subsequently, in the remainder of this section, we adopt a structured approach for translating these intervention objectives into design guidelines for the actual game interactions (Section 3.2) and guidelines for embedding the game in a certain (social/physical) context (Section 3.3). Finally, after this structured discussion, we conclude the section by presenting the game prototype which follows from the established design guidelines (Section 3.4). We wish to note that while we attempted a structured approach when translating the intervention objectives into design guidelines – building extensively upon academic literature, meetings with clinicians,

child-psychologists, and interviews with members of the so-called 'Childrens' Council' of the WKZ hospital – the resulting list of guidelines is by definition not exhaustive and absolute. Still, we expect that the presented insights are valuable and applicable to researchers investigating related types of interventions, and/or interventions aimed at benefiting children.

3.2 Design guidelines for the game interactions

In this subsection, we adopt a structured approach for translating the previously mentioned intervention objectives into design guidelines for the actual game interactions. Each game interaction is accompanied by an example of a game implementation. Section 3.2.1, 3.2.2, and 3.2.3 discuss these design guidelines for the three intervention objectives respectively. Table 1 provides an overview of the intervention objectives with their respective design guidelines and proposal for implementation in an actual applied game intervention.

3.2.1 Learning to recognize emotions in one-self and in others. In this subsection, we present four game interactions to achieve the first intervention objective. The first concerns including a task or interaction which requires the players to reflect on their own experiences of when they felt a specific emotion. Reflecting on an event when the players felt a specific emotion, they will likely recall many experiences that they coupled to feeling various emotions. It requires the player to distinguish and recognize emotions to find an experience that they strongly associate with this specific emotion. An implementation of such an interaction is to directly ask the players to share a personal experience of a certain emotion with the game world (e.g., an in-game character).

The second game interaction is to require players to deduce the feelings of another game character or entity from the social context. Games can build and present complex narratives and present these to the players. These narratives could be great tools to let players practice with deducing feelings of game characters. An implementation of such a game interaction is to have in-game characters share their story with the players. Based on this story, the players must deduce the character's feelings to choose the optimal interactions for the players to progress in the game. For example, the players could be required to 'read' an in-game character's feelings to persuade him to let them cross a bridge.

Another game interaction to help achieve the first intervention objective, is to teach players about facial expressions and body language associated with specific emotions. This interaction could be implemented in a game by presenting the knowledge via e.g. animations or images. By coupling this information to in-game tasks, the players are required to actually have this knowledge. Therefore, they are likely stimulated to pay more attention to this information.

The final game interaction presented for achieving the first intervention objective, is to stimulate players to make decisions based on their previous, real life, experiences. This interaction is somewhat similar to the first interaction presented. Both interactions require the players to reflect on their past experiences. However, this interaction requires the players to implicitly make a decision based on their past experiences; rather than being explicitly asked to recall a past experience of a specific emotion. An example of



Figure 1: Splashscreen of ‘Ruby’s Mission’: An Applied Game Intervention for reducing Loneliness of Children with Chronic Illness

an implementation of such an interaction is to present the players with a set of events, from which the player must select the event that they associate most with a specific emotion. Asking players to couple given events to emotions, requires them to actively recall their past experiences and the emotions that they felt.

3.2.2 Learn about the meanings of emotions to facilitate thinking and doing. An interaction should be included that presents the players with the emotional meanings of various emotions. Presenting players with the various emotional meanings of an emotion in an (in-game) interaction, could lead to a better understanding of these emotional meanings and their consequence on behavior. The players may then be able to apply this knowledge in their real-life interactions. An example of an implementation of this interaction is that players must interact with a character that is feeling certain emotions. During the interaction with this character, the players must consider the emotional meanings of this character’s emotion to achieve the desired game outcome.

3.2.3 Learn to understand that emotional experiences are subjective. In this subsection, we present two interactions for achieving the third learning objective. The first interaction is to include a task that requires players to share their personal experiences with the same emotions with each other. Key to this interaction is to understand that others might have different experiences than yourself which may lead to other emotions in similar situations. By sharing experiences with each other, players might learn from each other that they have had different experiences with similar emotions or events. An implementation to achieve this game interaction is for players to directly ask if they want to share their experiences as

part of personalizing the city. For example, their experiences can be made visible on large walls in the game world. Sharing these experiences via the game world (implicitly) rather than explicitly, might create a safer environment for the players to share these moments with each other.

Another game interaction that could lead to achieving the third intervention objective, is to include an interaction that requires the players to make a group decision on an emotion-related topic. When the players must make a group decision, it is likely that there will be some initial disagreement. Therefore, the players must discuss the topic/question with each other to find a satisfactory answer. During the discussion, the players will argue, for example, why they think that a specific emotion fits best as an answer to the question. Their arguments might be related to personal experiences, which is an implicit method to share experiences with each other. A possible implementation is to present the players in a game with a set of events that are coupled to certain emotions. For the players to progress in the game, they must make a group decision on which events relates best to the desired emotional outcome.

3.3 Design guidelines for the game embedding

In this section, we present a set of design guidelines for the embedding of the game in a certain (social/physical) context. These guidelines consists of aspects of the game that are not directly integrated in the actual gameplay. Nonetheless, the guidelines for the game embedding are related to – and important for – achieving the intervention objectives. That is, it is important to consider that an applied gaming intervention is embedded in a context in which parents also have a role (Section 3.3.1), in which therapist

Table 1: Overview of the design guidelines proposed for achieving the intervention objectives.

| Intervention objectives | Game interactions | Implementation |
|--|---|---|
| <i>Learn to recognize emotions in one-self and in others (3.2.1)</i> | Requires the players to reflect on their own experiences of when they felt a specific emotion. | Include a task in which the players are directly asked to share their experiences of a specific emotion with an in-game character. |
| | Require the players to deduce the feelings of another game character or entity from the social context. | Based on the story of an in-game character, the players must deduce the character's feelings to persuade him in the players' favor. |
| | Teach players about body language and facial expressions associated with specific emotions. | Information on body language and facial expressions can be shared via animations and images in the game world. Players can be required to use this information in e.g. puzzles. |
| | Stimulate players to make decisions based on their previous, real life, experiences. | Present the players with a set of events from which the players must select the event that they associate most with a specific emotion. |
| <i>Learn about the meanings of emotions to facilitate thinking and doing (3.2.2)</i> | An interaction is required which presents the players with the emotional meanings of various emotions and their consequence on a person's behavior. | Players interact with an in-game character that is feeling certain emotions. To achieve the desired game outcomes, the players must consider the character's emotions during their interaction. |
| <i>Learn to understand that emotional experiences are subjective (3.2.3)</i> | Require the players to share their personal experiences of the same emotion with each other. | Personalize the game world by enriching it with players' personal experiences. For example, by 'painting' large walls in the game environment. Via visualization in the game environment, the players are able to see the experiences of others. |
| | Require the players to make a group decision on an emotion-related topic. | Present the players with a set of events from which they must select, as a group, the event that fits best with a given emotion. Through their own experiences, they will argue which event they think fits best, and share their personal experiences with each other. |

have a role (Section 3.3.2), in which the intervention may benefit from being peer mediated to some extent (Section 3.3.3), that has to be played in an environment that is considered safe for the child (Section 3.3.4), and that poses constraints on the physical setting in which the intervention is played (Section 3.3.5) and on how the game is distributed (Section 3.3.6).

3.3.1 Role of the adult. It is important to carefully consider what the role of the adult should be within the game. It is known that parents actively joining in-game interactions with their children (i.e., co-playing), may have positive effects on the parent-child relationship [4, 39, 74, 86, 88]. However, it is also clear that co-playing with a parent can substantially affect (limit/constrain) the child's in-game interactions and his/her experience. Indeed the presence of parents can influence the child's identity exploration or their social behavior [28]. For example, empirical observations of the initial play tests of 'Ruby's Mission' made it apparent that the presence of parents negatively affected the explorative behavior of the children. In situations where the children were required to solve an in-game task, they would often immediately turn to their parents for answers. On the other hand, during play sessions in which parents were absent, the children would find a solution through discussion and cooperation. As such, the decision was made to instruct parents to only facilitate the preparation of the game sessions but not participate in play with their children.

3.3.2 Role of the therapist. Socioemotional skills, as described in this study, have many commonalities with existing concepts such as

mentalizing and emotional intelligence. Terradas et al. [81] describe how clinicians have an active role in the therapeutic process of mentalization based treatments. From an overview of interventions aimed at improving children's mentalizing capacities, it becomes apparent that the clinician is often responsible for creating opportunities for children to reflect on their own or the clinician's mental states and to create a safe environment in which the intervention takes place [81]. An advantage of including a therapist in the play sessions of the applied gaming intervention, is that the therapist can maintain these responsibilities. On the other hand, through good game design, these tasks could also be achieved by the system. Moreover, including a clinician in the play session could be perceived as intrusive and stigmatizing, possibly leading to the similar negative outcomes as described in Section 2 and Section 3.3.1. Furthermore, a desirable quality of applied gaming interventions, is that they can be applied on a larger scale without the need of scarce and expensive clinicians. This quality makes it possible to reach a larger audience. Therefore, the decision was made to not include a clinician in the play sessions. A possibility that is less intrusive, is for the clinician and the chronically ill child to discuss the results of the intervention after the intervention is finished. The play sessions can be recorded for the clinician.

3.3.3 Peer mediated intervention. Besides parents, clinicians and other adults, it is also important to consider the role of peers. First, the learning objective '*learn to understand that emotional experiences are subjective*' could greatly benefit from sharing experiences

between peers. Games could also achieve this learning objective via narratives and interaction with game characters. However, through peer interactions, children can go more in depth about each others feelings and experiences as they are able to ask questions. Another benefit of designing the gaming intervention to be peer mediated, is that the children are able to practice their socioemotional skills within a (real) social context. An important intention is to increase exposure of chronically ill children in social situations with peers. Therefore, the decision was made to create a multiplayer game such that the intervention becomes peer mediated.

3.3.4 Safe play environment. Creating a safe environment is essential for achieving the desired intervention outcomes. The children should be able to practice their socioemotional skills within a safe and forgiving context. It is important that the game interactions support the creation of such a safe environment. Therefore, the game in this study was designed such that the children are not punished for 'wrong' answers during interactions related with the intervention objectives. However, the system does provide feedback based on the answers and actions that the players take.

Another consideration is the social context in which the game is played. In the previous section, it was mentioned that the game is designed to be a multiplayer game. Emotional experiences are personal and intimate, therefore not easy to talk about and share for everyone. It is important to also create a safe context for the social environment. In this study the decision was made to let the chronically ill children invite friends, classmates, family members, or other peers that they have a relationship of trust with.

Finally the physical setting in which the game is played, can also affect the safety of the play environment. In this study the decision was made to play online from your home environment. Sallay et al. [66] showed that chronically ill children associate different rooms in their home with various feelings and emotions (e.g., security, suffering, belonging). It might be beneficial to instruct the children to play from a room which they perceive as positively valenced.

3.3.5 Physical setting. The physical setting was briefly discussed in the previous section within the context of creating a safe play environment. Another important aspect to consider is the practical implications of various physical settings. Physical distance, lack of time, dependence on parents, inaccessibility of buildings were frequently mentioned as barriers to participation [9, 22, 89]. Especially bringing multiple children together once a week for multiple weeks might prove difficult. Therefore, playing from your home environment alleviates many of these obstacles.

3.3.6 Distribution of the intervention. Another important design aspect to consider, is how to distribute the intervention. Most entertainment games are distributed via large commercial platforms such as the PlayStore, AppStore, or Steam. These platforms seem not suitable for the purpose and type of game in this study. First, even though training socioemotional skills might also be beneficial to healthy children and the game might reach a larger audience via these commercial platforms, it does not guarantee that the intended target audience is reached (children with chronic illness)¹. Another

issue is that the game requires quite some setup. The children can only play the game once a week, they must play in the same group every week, and they must find a moment where all four of them are available. Finally, parents are probably less likely to put in the effort of setting up such an intervention when they or their child discovers the game via a commercial platform.

Another possibility is to distribute the game via schools. Teachers can be asked to recognize children who would benefit from the intervention. However, some drawbacks come with this solution. First, teachers are not trained to recognize which children could possibly benefit from such an intervention. Furthermore, not every classroom has a chronically ill child. Another drawback is that it might feel stigmatizing being asked to participate in this intervention by your teacher.

In this study, the decision was made to distribute the intervention via clinicians and therapists. These professionals are trained for recognizing socioemotional problems in children. We are aware that recommendations from clinicians to play the gaming intervention might be stigmatizing in itself. However, our primary concern is exploring which aspects of the applied gaming intervention (do not) lead to the desired outcomes. To explore these aspects we must expertly identify and select children who will likely benefit from the intervention objectives. Furthermore, the parents also play a significant part in structuring and framing the play-sessions. Adequately instruction the parents on how to structure the play session is therefore of utmost importance.

3.4 Implementation of the design guidelines

In this subsection, we discuss how the previously established design guidelines are implemented in the 'Ruby's Mission' applied gaming intervention (Figure 2). Ruby's Mission is a cooperative online open-world game in which four players must aid a Robot (called Ruby) to complete her mission; to gain understanding of emotions and their meanings. The game is created for both Windows PCs and Macs. The players can communicate through voice communication using their microphones and headphones. We are designing and developing Ruby's Mission according to an iterative processes consisting of the steps 'determine objectives', 'evaluate', 'identify issues', and 'redesign'. Currently, we have had four iterations, in which we have tested the game with four groups of approximately 20 children per group (5 to 6 play sessions per iteration)². The game is developed for children aged 8 to 12 years old³.

experiencing substantial emotional distress (for example, as a consequence of the COVID pandemic). However, to reach such a conclusion, we should start with the basic requirements and find a suitable method to reach our current target audience. Only after laying the foundation, we will be able to scale up to other target audiences as well.

²These play sessions were approved by our faculty's ethical committee. Observations during play sessions and semi-structured interviews were collected during these tests. The results were processed in the game design of the next iteration. For example, an important finding was that when the parents of the players were playing the game with them, the communication between players would drastically decrease. The children would turn to their parents for finding the right answers, rather than engaging in conversation with each other. This impedes the learning objectives. Therefore, we decided to instruct the parents to let their child play the game alone with his/her peers (see Section 3.3.1).

³In several consultations with the Children's Council of the WKZ, they indicated that the transition from primary school to high school is a difficult period in the lives of chronically ill children. During this phase, children transition from a safe school-environment (being in class with the same peers for 8 years) to an entirely new school-environment. They must decide anew which details of their diseases they will

¹We strongly believe that the adopted approach towards training social-emotional skills will not only benefit a cohort of chronically ill children – but that precisely such training of social-emotional skills will also benefit the many other children that presently are



Figure 2: Gameplay capture of ‘Ruby’s Mission’: An Applied Game Intervention for reducing Loneliness of Children with Chronic Illness. A collectable graffiti tag is visible on the wall. In the distance stands an interactable character, which triggers a ‘scenario task’ (see Section 3.4.3).

The entire game consists of 8 levels. We have chosen for an intervention that lasts 8 weeks, the children will play one level per week. As far as we are aware, there is no standard for the length of these interventions. However, a recent systematic review of mentalization-based treatments found that relatively short interventions (under 12 sessions) were related to greater improvements in mentalizing, as compared to more intensive interventions [3]. Each level covers 3 unique emotions. A total of 24 emotions are discussed during the entire intervention. We designed three tasks to achieve the previously proposed intervention objectives. Each task is related to achieving multiple intervention objectives. These tasks are discussed in Section 3.4.2, Section 3, and Section 3.4.3.

3.4.1 Narrative framing. Ruby is a robot who travels to the human world to learn about emotions. Robots know that emotions are important, but they have yet understand what they are. It is Ruby’s mission to understand what emotions are and to convey this knowledge to the other robots. Four experts would help Ruby to complete her mission, but they are not there when Ruby arrives in the human world. It is complete chaos in the human city. The four players must replace the experts and guide Ruby through her mission. The narrative is framed such that the children (players) assume the position of the experts on emotions as they must aid Ruby

share with others and they must build new social relations. Furthermore, we believe that it is beneficial to practice these skill during earlier phases in childhood, because you apply these skills at any phase in your lives.

in her mission. Because the children assume the role of experts on emotions, they will not experience the narrative as stigmatizing.

3.4.2 Task #1: Poster mini-game. The first game task discussed is the poster mini-game (see Figure 3). Three posters can be found in the game world at each level. Once the players reach the poster, Ruby will read some information written on the poster. The text is also visible for the players to re-read. Next to the text, a person is depicted who is feeling this specific emotion. From this image, the players can learn about the body language and facial expressions related to this emotion. This interaction is related to the first intervention objective, because it teaches the children to recognize emotions in others via facial expressions and body language. Furthermore, it is also related to the second learning objective, as it conveys textual information of the emotional meanings of the emotion.

Next, Ruby asks the players to share their personal experiences with her, such that she can gain a better understanding of the emotional meaning. The poster contains text-fields via which the players can privately share their personal experiences with Ruby. This requires the players to reflect on their own experiences of when they felt this specific emotion, which is associated with the first intervention objective.

Finally, the players can choose to share their answer with Ruby only or to share it with the game world. Providing the children the possibility to only share their experiences with Ruby, they can



Figure 3: Screen captures of the poster mini-game. *Left:* the players are presented with textual and visual information on the emotion 'guilt'. Via the input-fields, they can share their personal experiences of this emotion with Ruby. *Right:* if the players choose to share their experiences in the game world, they become visible to the other players via 'post-it' notes next to the poster.

practice with sharing their experiences in a safe environment. When the players choose to share their experiences with the game world, it will make their answers visible to the other players. Their answers are made visible in the game world via notes that are pasted on the wall next to the poster. Sharing their answers with each other supports the third learning objective, as players can now see that they have different experiences with the same emotion.

The interaction is designed such that there is no one correct answer as emotional experiences are subjective. Children learn from each other's experiences when they are shared in the game world. During the preliminary user tests, each child decided to share their experiences with the game world – and therefore each other. Many participants indicated that they enjoyed sharing and learning about each other's experiences.

3.4.3 Task #2: Scenario mini-game. The second game task is the scenario mini-game (see Figure 4). This task was inspired by the Levels of Emotional Awareness Scale (LEAS) which uses vignettes to test emotional awareness [31]. Two scenario's are placed in each level. A scenario starts when the player encounters a specific in-game character. This character tells Ruby a short story about something that happened to him or her. The players must then decide as a group how this character would feel. They can select one or multiple emotions from a set of seven emotions, four primary emotions (anger, sadness, happiness and fear) and the three emotions covered in the current level. After the players made their group decision, they are presented with how this character is actually feeling. This part of the scenario mini-game is associated with the first learning objective; the players must deduce the emotions of another character from the 'social' context.

In the next phase of this mini-game the players must help Ruby to respond in a socially responsible manner to this character. Each player is presented with a *different* answer. They must discuss their answers and select one that they find most fitting as a group. Ruby will respond with this answer. The character will then provide feedback to the players by giving a final response to this answer. The answers were composed in cooperation with child psychologists. Four answers are prepared in total, where each answer mentions

none, one or multiple emotions that the character is feeling. The most fitting answer is the answer that mentions all of the emotions that the character is feeling. This interaction is related to the second learning objective; the players must choose a response to the characters story, while taking into account its emotions. They must carefully consider the emotional meanings of the various answers when they select an answer. The character then provides feedback on the chosen response, by telling Ruby what her response made her feel.

This task also indirectly supports the third learning objective. Because the players must make group decisions on which emotions the character is feeling and which response would be socially the most responsible, they must share their opinions which are based on their thoughts and experiences. Therefore, players might see experiences other than their own.

Preliminary results showed that all groups selected the best-fitting answer. This indicates that the scenarios might prove too easy. Furthermore, the feedback provided by the in-game character has no direct consequences for the game-outcomes. A stronger coupling between the in-game goals and the provided feedback is reasonably to be expected to benefit transfer of the learning objectives.

3.4.4 Task #3: Graffiti mini-game. The last game task is the graffiti mini-game (see Figure 5). Scattered throughout the game world graffiti tags can be found. These tags contain text of situations which are associated to one of the three emotions covered by the current level. Per emotions five tags are to be found. The players can gather these emotions by clicking on them when they see them. After the group collected five tags corresponding to the same emotion, the mini-game is started.

As Ruby's "storage" is not large enough to store all 5 tags, she asks the players to *individually* select three out of five tags which they think correspond best with the corresponding emotion. The children must now call upon their previous real life experiences to make a selection. They are likely to recall and compare previous situations to the ones presented. Therefore, this interaction is associated with the first learning objective.



Figure 4: Screen captures of the poster mini-game. *Left*: The players select as a group which of the 7 emotions the character in the scenario is feeling. *Right*: A player is presented with one of the possible reactions to react with to the character. Below the players can select the answer of a single player (red buttons)

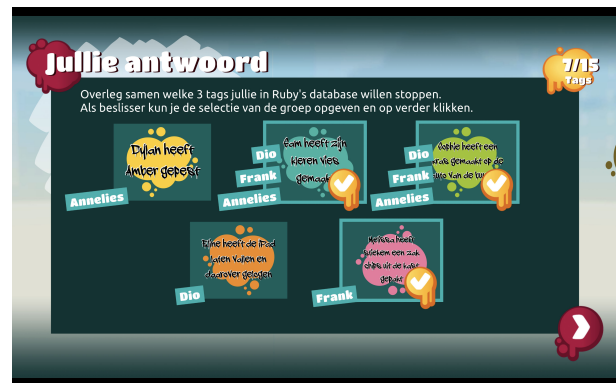


Figure 5: Screen captures of the graffiti mini-game. *Left*: players individually selecting 3 out of 5 tags that fit best with the given emotion. *Right*: players selecting 3 out of 5 tags as a group that fit best with the given emotion. The players can see the selections of the individual players.

In the next phase of this interaction the players will see each other's selections. They must now make a final group decision on which tags to include in Ruby's memory. From the initial play session, it became clear that there are usually two tags that already have the majority of the votes. Therefore, the players must discuss which of the last tags would fit best to the corresponding emotion. Through discussion and sharing their motivation based on their own experiences, the players must make a group decision. Therefore, this interaction is associated with achieving the third learning objective.

3.4.5 Multiplayer. We decided to create a multiplayer game for four players. In Section 3.3.3 we discussed the advantages of a peer-mediated intervention for practicing socioemotional skills. As mentioned earlier, the players are able to communicate through a voice connection. Each game task is designed such that it requires or elicits discussion and conversation between the players. They share their thoughts and experiences to find group answers for a common purpose; guiding Ruby through her mission.

Section 3.3.4 discusses the importance of a safe play environment. Cyberbullying is an inherent risk to online multiplayer games. This could imperil the safe play environment for the children. We hope to limit this risk of cyberbullying by instructing the parents of the participants to find friends, classmates, family members, or other children that already know their child to play Ruby's Mission with. In future experiments, we will investigate if and how often cyberbullying occurs in our game.

3.4.6 Asymmetric gameplay. Some of the game interactions are designed to be asymmetrical to achieve participation of all players. For example, in the scenario mini-game, each of the players are given different answer-possibilities from which they must choose a single option. Another example are the controls. Each player is assigned a specific role. There are three roles in total: (1) driver, (2) collector, and (3) decision maker. The 'driver' is able to navigate Ruby through the city. Collectors are responsible for collecting the graffiti tags by clicking on them. The decision maker is responsible for navigating through group interactions and selecting group decisions. There is one driver, one decision maker, and two collectors. These roles are

designed such that every role is required to complete the game. For example, the driver is the only person able to move Ruby. However, the other players are also able to freely look around. Therefore, they can help the driver by providing directions. Without the collectors, it is not possible to start a graffiti mini-game. Finally, the decision maker must guide the players through the mini-games where there are group decision to be made, otherwise the entire team will be stuck on the same screen.

3.4.7 Persistent game world. The game's persistent world enables investigators to tailor content of game sessions to the individual participant (i.e., create a personalised game intervention). Indeed, such new or adaptive content is leveraged for enhancing player motivation throughout the numerous game sessions. Finally, leveraging a persistent game world directly contributes to the intervention goals, as persistence of player actions is known to enhance moral engagement of players [5, 44].

4 DISCUSSION

The present paper focuses on children with a chronic disease, such as cystic fibrosis or juvenile arthritis, whom often face obstacles that can have a negative impact on physical, social-emotional and cognitive development, beyond the actual illness itself [47]. Children with chronic conditions are, on average, lonelier than their peers without such conditions [37]. Feelings of loneliness in children and adolescents have been associated with a wide range of negative outcomes, including school drop-out, depressive symptoms, social anxiety, suicide ideation, low self-esteem, eating disorders, and sleep problems [21, 23]. As such, the present investigation set out to reduce these feelings of loneliness for children with chronic conditions, by improving their social relationships with peers via training of socioemotional skills. This study aims to do so by the structured design of an applied gaming intervention. Specifically, the present paper contributed (1) a literature-based understanding on training socioemotional skills as a novel means to reduce feelings of loneliness in chronically ill children, (2) intervention objectives that are aligned to this goal, and (3) a structured proposal for design guidelines that implement the intervention objectives into 'Ruby's Mission': an applied gaming intervention for reducing loneliness of children with chronic illness.

Indeed, the design and implementation of the established intervention objectives is a first and necessary step towards creating positive impact for our target audience. While we realize that our goals are ambitious, we are going to *evaluate* the effectiveness of the intervention for achieving the outlined objectives. To this end, we believe the overall assessment on intervention effectiveness is of lesser interest than the deeper understanding of *why* certain effects are (not) generated by the intervention. To this end, we propose the following three (higher-order) facets of evaluation.

Evaluating Quality of the design. We are designing and developing the game in a well-established co-design iterative process consisting of the steps Determine objectives, Evaluate, Identify issues, Re-design, Test. In this development cycle, the evaluation is done through the standard SGDA framework, the Serious Game Design Assessment framework [15], addressing such aspects as "Can the player relate

to the presented narrative and visuals?", "Is the game experience user-friendly for- and accessible to a novice player?", etc.

Evaluating Effect of the Game Experience. This will be evaluated via the validated Game User Experience Satisfaction Scale (GUESS) [52]. It assesses game experience on eight sub-scales: (1) usability/playability, (2) narrative, (3) play engrossment, (4) enjoyment, (5) creative freedom, (6) audio aesthetics, (7) personal gratification, (8) social connectivity, and (9) visual aesthetics.

Assessing Transfer. Transfer of in-game design goals to real world (intervention) goals, is particularly important for applied gaming interventions. We propose to assess transfer via (a) child self-reports on experienced loneliness, emotional problems and social activities, via the Experience Sampling Method (ESM) [64], and (b) parent / teacher reports on perceived affective states of the child and their daily activities with or without peers, via questionnaires.

For future work, we will (a) expand on the precise method for evaluating (and understanding) the effectiveness of the applied gaming intervention, and will (b) explore how the persistent game world can enable investigators to tailor content of game sessions to the individual participant (i.e., create a personalised game intervention). Indeed, to reiterate from Section 3.4, such new or adaptive content may be leveraged for enhancing player motivation throughout the numerous game sessions.

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