Exploratory Evaluations of a Computer Game Supporting Cognitive Behavioural Therapy for Adolescents

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ABSTRACT

The need to provide effective mental health treatments for adolescents has been described as a *'global public health challenge'* [27]. In this paper we discuss the exploratory evaluations of the first adolescent intervention to fully integrate a computer game implementing Cognitive Behavioural Therapy. Three distinct studies are presented: a detailed evaluation in which therapists independent of the design team used the game with 6 adolescents experiencing clinical anxiety disorders; a study in which a member of the design team used the game with 15 adolescents; and finally a study assessing the acceptability of the game and intervention with 216 practicing therapists. Findings are presented within the context of a framework for the design and evaluation of complex health interventions. The paper provides an in-depth insight into the use of therapeutic games to support adolescent interventions and provides stronger evidence than previously available for both their effectiveness and acceptability to stakeholders.

Author Keywords

Computer games, adolescent mental health, complex health interventions, cognitive behavioural therapy, evaluations

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms

Human Factors, Design.

INTRODUCTION

Mental disorders are health conditions defined by the experiencing of severe and distressing psychological symptoms, to the extent that normal functioning is seriously impaired. The Global Burden of Disease Study has found that mental health difficulties are currently the leading cause of disability in developed countries [34]. Large scale international studies also conclude that many people experiencing difficulties do not receive appropriate specialist treatment [35]. The human and economic costs of this situation are substantial and calls have been made for innovative new approaches to help in addressing this challenge [30]. Young people have been identified as particularly vulnerable [5, 27]. Patel et al. [27] state:

> *"Most mental disorders begin during youth... Poor mental health is strongly related to other health and development concerns in young people, notably lower educational achievements, substance abuse, violence, and poor reproductive and sexual health. The effectiveness of some interventions for some mental disorders in this age-group have been established, although more research is urgently needed to improve the range of affordable and feasible interventions, since most mental-health needs in young people are unmet, even in high-income countries."*

Cognitive Behavioural Therapy (CBT) is the recommended form of psychological intervention for a wide range of mental health problems in adults [8]. Writing in 1997 and reflecting on 25 years of the successful development of CBT, Aaron Beck the chief originator of this approach, indicated that one of the greatest challenges for CBT in its second 25 years was its translation into therapeutic programmes suitable for children and adolescents [3]. The meta-cognitive tasks in CBT, requiring people to think about their thinking, are often challenging for adults and do not come naturally to younger people. Research suggests that effective CBT programmes for younger people should be tailored to their developmental needs, use content which is young person focused, emphasise elements of fun and make the process experiential [2, 5, 8].

Recent years have witnessed a significant increase in research on the use of technology to support psychological or talk-based interventions [12, 24]. Much of this work has focused on computerised CBT (cCBT) interventions targeting mild disorders in adults. Systems targeting younger groups, and groups experiencing more severe difficulties, have received significantly less attention, and our understanding of the requirements of such systems remains limited. Coyle and Doherty [11] recommend that systems targeting adolescents seek to provide an engaging, client-centred experience. In the context of face-to-face interventions, which many adolescents find difficult, it is suggested that technologies such as computer games can be used as a *'third party in the room'*, helping to make the

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therapeutic process less difficult for adolescents by taking some of the emphasis off direct face-to-face conversations.

The primary contribution of this paper is to present the exploratory evaluations of gNats Island, a computer game developed to support face-to-face CBT interventions for adolescents experiencing medium to severe mental health difficulties. The game is designed to fully integrate with a six-week clinical intervention. As such, it constitutes a significant alteration to the conduct of a treatment. Our research is reported within the overall context of a framework for the design and evaluation of complex health interventions [7]. No similar evaluation has been reported to date. A secondary contribution is to demonstrate the use of mixed methods to evaluate a new computer supported mental health intervention. Three distinct studies of gNats Island are presented. Taken together they provide strong initial evidence of the potential of therapeutic games to support adolescent interventions. They also provide an in-depth insight into the use of technology to support face-to-face treatments with young people experiencing moderate to severe mental health difficulties. Alongside those interested in mental health technologies, this work will be of interest to researchers investigating health technologies more generally. It is also relevant to the broader community interested in serious games, behaviour change technologies and design for younger users. We begin by providing a brief introduction to the central theories of CBT.

COGNITIVE BEHAVIOURAL THERAPY

The central theories in CBT focus on the relationship between the ways we think, feel and behave [3]. We have constant thoughts and ideas running through our minds which we usually do not notice (automatic thoughts). When we experience emotional difficulties, e.g. clinical anxiety or depression, our automatic thoughts have a highly negative flavour (referred to as negative automatic thoughts). These negative thoughts affect our mood which may become depressed or anxious. This in turn can affect our behaviour and we can become slowed down, withdrawn, avoidant and locked in a self-perpetuating cycle that precipitates and maintains a mental health problem. CBT provides a structured set of techniques aimed at breaking this negative cycle. Many interventions begin by teaching people about the relationship between thoughts, feelings and behaviours. People are then taught to identify and challenge negative automatic thoughts. By identifying patterns in their automatic thoughts, people can then learn to challenge the underlying beliefs (Core Beliefs) theorised to drive negative thinking. In essence CBT requires people undertake a meta-cognitive task in which they think about their thinking in a personalised but abstract manner, observing their thoughts, realising the impact on their mood and behaviour, gradually learning and applying new ways of thinking and behaving.

TECHNOLOGY IN TALK-BASED MENTAL HEALTHCARE

Early research on mental health technologies was largely led by mental health researchers and focused on electronic contact as an extension of face-to-face communication and the computerisation of self help materials [12]. More recently this area has become a focus for HCI research, with investigations of the therapeutic potential of a range of interactive systems, including virtual reality [20], relational agents [4], mobile systems [25] and computer games[9]. Given the nature of the system described in this paper, we focus here on two areas: cCBT and computer games in adolescent interventions.

Systems implementing CBT have dominated early research on mental health technologies [24]. In part this is due to the strong evidence supporting the effectiveness of CBT. However the theoretical background of CBT has also played an important role. CBT is based on an information-processing paradigm. It is more highly structured and sequentially implemented then other major theoretical approaches to psychotherapy, thus lending itself more easily to computer-based implementation [12]. cCBT systems typically involve a combination of psycho-educational elements delivered through text and videos, psychological questionnaires, and text based exercises. Research on cCBT for adults has achieved several notable successes [24], particularly in regard to reducing contact time between clients and therapists while still maintaining clinical effectiveness, and the UK National Institute for Clinical Excellence has recommended specific programmes as low intensity treatments of choice for adults experiencing mild depression and anxiety [26]. Challenges remain however. Adherence rates for many systems in real world settings is poor and research on systems supporting more intensive interventions for people experiencing more severe difficulties has been limited [11]. Whilst development is beginning, research on cCBT for young people is also very much in its infancy [14, 22]. Abeles et al., for example, have provided preliminary evidence of the effectiveness of an 8 week CD-ROM-based intervention for adolescents [1].

Much of the literature on computer games and adolescent emotional health focuses on persistent concerns regarding possible negative effects [18]. However interest in the use of therapeutic games is growing rapidly [9, 21]. Several games, including Reach Out Central (ROC) [6] and Treasure Hunt (TH) [29], apply CBT. ROC is an online game targeted at people aged 16-25. It aims to improve mental health awareness and reduce the stigma associated with seeking help, but is not intended for direct use in clinical settings. Aimed at 8-12 year olds, TH focuses largely on behavioural aspects of CBT. It is designed to support therapeutic activities between clinical sessions. Other theoretical approaches have also been applied. For example Personal Investigator (PI) implements Solution Focused Therapy [13]. Like ROC and TH, the game described in this paper implements CBT. However its context of use (face-to-face clinical settings) and interaction style more closely resemble those described in PI.

COMPLEX HEALTH INTERVENTIONS

Mental health interventions such as CBT are typically defined as complex health interventions - interventions

involving many components and interconnected parts [7]. The introduction of technology, an untested component in most mental health settings, has the potential to increase the complexity associated with evaluating such interventions. Campbell et al. describe a framework for the design and evaluation of complex health interventions. They highlight the use of both qualitative and quantitative evidence [7] and the use of a phased approaches that mitigates against the risks and costs of failure in large-scale clinical trials. Their framework can provide an effective overall structure for research on technologies designed to support mental health interventions. Alongside theoretical and modelling stages, it highlights three distinct clinical evaluation stages: exploratory, definitive and long-term implementation.

This paper focuses on the exploratory evaluation of gNats Island. Trials at this stage focus on testing design ideas and gathering the information necessary to design large-scale clinical trials. The provision of strong clinical evidence is not a primary concern, though initial questions may be addressed through pilot clinical studies, e.g. case studies. It is also important to assess the acceptability to stakeholders of new interventions - an issue which has been emphasised in the case of new technology based interventions [9, 32]. Definitive clinical trials - e.g. randomised controlled trials (RCTs) involving large subject numbers - are designed to provide strong evidence regarding clinical effectiveness. They typically require substantial time and resource commitments (e.g. several years and million dollar budgets). They also require strict protocols and thus offer limited flexibility. The final evaluation stage - long-term implementation - examines the transition of interventions into day-to-day clinical practice.

Campbell et al. emphasise the need for an iterative process of evaluation and refinement, in which early exploratory studies feed into further theory and modelling stages, eventually progressing to definitive trials. While the framework does not explicitly consider interventions that make use of interactive systems, the overall approach fits well with HCI practice and lends itself to the use of complementary HCI methods. For example, an iterative cycle of theory, modelling and exploratory evaluations bears a strong resemblance to design and evaluation processes within HCI research. In their paper on the design of PI, Coyle and Doherty describe the use of balanced decision making criteria, drawing on theory and user input from both the HCI and mental health domain [11]. Doherty et al. [15] have also provided formative guidelines for the design and evaluation of mental health technologies. In our work it has also been beneficial to draw on research in health technology more generally [28] and from broader areas of HCI research. For example, given the aim of designing a game appropriate to the developmental needs to adolescents, research in designing for younger users has a high degree of relevance to the work described in this paper [16, 23]. There is also a body of relevant work on the use of computer games in educational and other health care areas [21, 33]. Many studies in recent years have reported success in the use of persuasive technologies and systems to support behaviour change [10, 17]. The system described in this paper also aims to support personal change, however based on the theoretical model in CBT, change is predicted to occur through a focus on the interrelated nature of thoughts, feelings and behaviours. Finally we drew on Learner Centred Design, which highlights the need to focus on learning outcomes while also addressing interaction issues [19, 31]. This advice has direct relevance to research in mental health areas, where the cost of design failures can be severe, and systems offering poor interaction are less likely to deliver positive therapeutic outcomes.

Ultimately definitive trials and long term implementation studies are required to provide strong evidence regarding the effectiveness of computer-supported interventions. However, given the complex nature of mental health interventions, and the preliminary nature of research in this area, exploratory evaluations represent a substantial and necessary undertaking. They allow for greater flexibility and offer a cost and resources-effective means to gain an in-depth insight into both therapeutic and HCI issues.

GNATS ISLAND

gNats Island is a computer game that implements key aspects of CBT. It is designed to support face-to-face clinical interventions with adolescents aged 10-15. The core design team responsible for gNats Island included two HCI and two clinical psychology researchers. Early design and modelling phases built on the game and interaction styles described in the design of PI [11, 13]. Like PI, gNats Island is designed to run on inexpensive computers, generally available in clinical settings. Further basic requirements included the need to complement current clinical practice and not require significant new training for therapists. Questions regarding the types and amount of gameplay and how they would best complement therapeutic aims arose frequently during the design of gNats Island. A balance was required, whereby the game would be sufficiently engaging, but would not distract from therapeutic processes. Given concerns raised by clinicians in previous studies - that excessive action-oriented gameplay could be distracting [12] - a conservative approach was adopted and gNats Island is largely character based. Players navigate through a 3D world in which they meet a series of characters. These characters introduce mental health concepts using spoken conversation, embedded animations, videos and questions regarding the player's own situation (Figure 1). Throughout the game players carry an in-game notebook, in which they answer characters' questions and record new ideas.

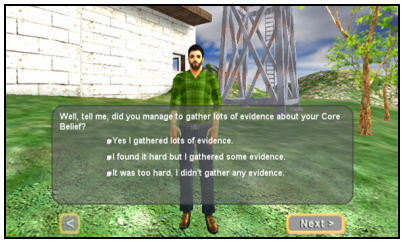

Figure 1: a conversation with a character in gNats Island.

gNats Island was initially adapted from a paper-based CBT manual for adolescents, previously developed by a psychologist on the design team. Subsequent to the creation of an initial prototype, an extended design process was undertaken in which conversations with individual game characters, the overall structure of the game world and means of interacting with characters underwent multiple rounds of refinement. This process drew on lessons regarding interaction difficulties reported in evaluations of previous therapeutic games in adolescent interventions. For example many young people experiencing mental health difficulties also experience learning difficulties. In PI open questions on therapeutic issues were presented using text in an in-game notebook. Players responded with keyboard input. An over reliance on keyboard and literacy skills was found to cause difficulties for some adolescents [13]. In gNats Island pre-recorded readouts are provided for all text and multiple choice and visual scaled questions are included alongside open questions. Image slideshows are also included in such a way that game characters can talk players through new concepts using images and diagrams.

gNats Island provides an overall narrative in which players visit a tropical island and meet a team of wild life explorers. Negative automatic thoughts are presented as little creatures called gNats that can sting people, causing negative thinking. Each type of gNat - of which there are nine in all - is introduced with a cartoon, voiceover and story describing its effects, Figure 2. For example being stung by a Black and White gNat can cause people to think in extremes. gNats provide a concrete representation and means of externalising an important CBT concept. Through a series of conversations with game characters players are introduced to strategies for identifying and challenging negative thoughts. Concrete metaphors such as catching, trapping and swatting gNats are used to describe this process. Similar approaches are used with other important CBT concepts, such as Core Beliefs.

Clinical use

gNats Island implements CBT in a generalised manner and is intended for use with adolescents experiencing a range of difficulties, including depression and anxiety. It is designed to fully integrate with a six session, manualised, face-to-face intervention, Table 1. Sessions typically last one hour, with the game used for 45 minutes. Alongside the game, gNats Island includes a manual for clinicians, outlining the structure of the intervention, and a paper-based workbook for clients. This workbook contains summaries of ideas introduced in the game and exercises which clients are asked to complete between sessions. Exercises are introduced by game characters during sessions.

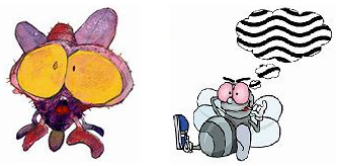

Figure 2: the Complete Disaster and Black and White gNats

S1	Introduction to the concept of negative automatic thoughts and the relationship between thoughts, feelings, behaviours.
S2	How to identify and capture negative automatic thoughts.
S3	How to challenge and restructure negative thinking.
S4	Core beliefs, what are they and how to capture yours.
S5	How to challenge your core beliefs.
S6	Overview and summary.

Table 1: structure of the manualised treatment, sessions 1-6

In sessions a clinician and adolescent sit together at a computer, but the adolescent has full control of the mouse and keyboard. Rather than talking face-to-face with the adolescent, the clinician acts as a partner in their exploration of the game world. Many of the questions and issues that a therapist might normally raise are instead introduced by game characters. As such gNats Island represents a substantial reshaping of the traditional therapeutic interaction. It aims to do so in a way which is supportive of the client-therapist relationship. It is intended that conversations with game characters will provide a context for more detailed conversations between the adolescent and clinician. Further, it is predicted that gNats Island will help to reduce the difficulties many adolescents experience with face-to-face interventions and assist in creating a client-centred, fun and experiential process.

Further details of the design, game world and user interactions in gNats Island are available in the ACM Digital Library video figure which accompanies this paper.

EXPLORATORY EVALUATIONS OF GNATS ISLAND

Our initial exploratory evaluation of gNats Island has involved three distinct studies. Taken together they have provided a means of investigating both clinical and HCI issues. The first study sought to provide initial evidence regarding the clinical effectiveness of the gNats Island intervention. Clinicians independent of the design team used the game in a manualised manner with six adolescents experiencing moderate to severe clinical anxiety disorders. In the second study a member of the design team (a clinical psychologist) used the game in a flexible manner with 15 adolescents as part of his clinical practice. This study allowed us to gain a more in-depth insight into the use of gNats Island, focusing more closely on HCI, alongside clinical questions. The final study investigated the acceptability of the game to 216 professionals who work regularly with adolescents. Ethical approval for studies was obtained from the relevant institutional ethics boards.

CLINICAL STUDY 1

Clinical study 1 (CS1) was a detailed evaluation in which five clinicians independent of the design team used the game with six adolescents experiencing anxiety difficulties (aged 11-16, 4 male). Each adolescent in this study was referred to the psychology team at the participating hospital having previously received treatment for physical difficulties at the Gastroenterology Unit. In each case the intervention was delivered in a manualised manner - based on a formal treatment protocol set out in the therapist's manual and delivered over six one-hour sessions spaced one

week apart. This study had several aims: to investigate the impact of gNats Island on interventions; to gather initial evidence regarding clinical effectiveness; and to assess the acceptability of gNats Island to clinicians and adolescents.

Both qualitative and quantitative data were collected. Upon completion of treatment, each adolescent filled in a questionnaire about the game. Semi-structured interviews were conducted with the five clinicians. A team member and an independent researcher identified themes in transcriptions of these interviews and a coding frame was agreed and then applied to each. Two randomly selected transcripts were subjected to an inter-rater reliability test by a second independent coder. Adjusting for chance using Cohen's Kappa, the reliability score was a strong 0.857. Quantitative data was gathered via a series of standardised clinical questionnaires, completed over a 20-week period by clinicians, adolescents, and adolescents parents. Baseline measures of mental health symptoms were collected at points eight and four weeks prior to treatment and prior to the first treatment session. Post-treatment symptom measures were collected upon completion of the final session and at a six-week follow up. At each of these points a parent completed the Child Behaviour Checklist (CBCL) and the adolescent completed the Youth Self Report (YSR). Both are widely used clinical measures, which provide standardised scores indicating symptom levels for a wide range of mental health difficulties. Session-by-session quantitative data was also collected. At the end of each session adolescents completed the Child Session Rating Scale (CSRS) and clinicians completed the Working Alliance Inventory (WAI). The CSRS and WAI measure clients' level of treatment satisfaction and the strength of the therapeutic relationship between clinicians and clients.

Clinicians feedback

All five clinicians reported positive overall impressions of gNats Island. They commented positively both on the impact of the overall intervention and on specific issues:

"Yes he loved it. I think he wrote down that it changed his life actually. I've seen him for follow-up since then and he has continued to do really well."

"I think certainly they began to recognise their automatic thoughts and the relationship between feelings and thoughts, so I think that was one of the big benefits of it"

Positive factors

Four clinicians commented positively on the way in which ***the game changed the dynamics of the therapeutic interaction***, noting both specific factors (e.g. eye contact) and the general role of the game as a mediating factor:

"I thought it was really good from an eye contact point of view, he doesn't like making a lot of eye contact, so having the screen to focus in on was perfect."

"It was almost like a transitional object or an external kind of mediating factor, so that I suppose the sessions were less directed, less challenging … so the child found it easier to engage through the medium of the game."

Three clinicians felt ***the game had a beneficial impact on the client-therapist relationship***:

"The most valid point about the game is that it enhanced engagement and thus the therapeutic relationship."

This is an important finding as concerns regarding damage to this relationship have been identified in previous studies addressing the acceptability of technology in mental health interventions [12]. Clinicians valued the way that gNats Island supported and even enhanced two-way conversations between therapists and clients. One clinician stated: *"I like the way it's not taking the therapist out of the equation"*.

Enjoyment and client engagement were discussed frequently and three clinicians commented on specific parts of the game that adolescents found funny and which helped to lighten the mood of sessions. Importantly from a therapeutic perspective clinicians felt that humour and ***concrete representations helped adolescents to understand and engage with CBT concepts***:

"It's something they greatly enjoy, so if a child enjoys coming to therapy sessions then you're on to a winner."

"I think that for younger clients CBT can be appropriate depending on the presentation, but having this was a really nice way for the kid to put their head in that space."

Three clinicians spoke about the importance of the ***supplementary materials*** provided with the game. The therapist's manual and paper-based client workbook were described as excellent, and the in-game notebook, which can also be printed, served several purposes:

"The logbook was excellent. When he finished the game it was great for him to go away with that. It was a great reference for him and he was proud as punch to get it."

Limitations and difficulties:

In the case above the printed logbook served as a tangible reward and a reference for the client. In one case however a clinician felt that ***transitions between the computer and paper-based workbook caused difficulties***:

"I found that the charts, as clear and as colourful as they are, were the poor cousin to the computer screen, so that jumping between the two different formats jarred a little."

Two further clinicians reported difficulties with paper-based ***between-session exercises***. In one case the adolescent did not complete any exercises. A second was initially enthusiastic, but became less so as sessions progressed.

Four of the participants identified parts of the game where ***the pacing of information*** could be improved. Specific comments were also made on ***aspects of CBT practice***, either present or not present in the game. While clinicians were generally positive regarding the impact of the game on the client therapist dynamic, two did express concern about ***the potential for therapists to be sidelined*** if clients become overly involved in the game:

"I did find times that they were pressing on ahead… If they had difficulties or questions, certainly I was there to clarify. I was playing a bit more of an observer role"

Clients' reports on how enjoyable they found gNats Island				
Not at all enjoyable	Not really enjoyable	Kind of enjoyable	Very enjoyable	Extremely enjoyable
1	0	0	4	1
Clients' reports on the helpfulness of gNats Island				
Not at all helpful	Not really helpful	Kind of helpful	Very helpful	Extremely helpful
0	0	3	1	2
Would you recommend the game to a friend?				
No – 1			Yes – 5	
Have you changed in any way since completing gNats Island?				
No – 0			Yes – 6	
Less worry	"I don't worry about as many things" "About finding out my core belief and now I don't worry as much"			
More positive	"I can think more positive" "I am more positive and better armed to deal with my depression"			
More confident	"I am more confident in swatting gNats"			
Feeling better	"I am getting better"			

Table 2: client's responses to questions on gNats Island, n=6.

Finally individual clinicians suggested a number of areas for improvement. For example, one felt the game needed *"greater variation and more options"*, including the ability to ***personalise it to individual clients***. Another felt the game could be expanded to include a ***parental role***.

Future use

Four of the five clinicians reported that they would recommend the game to colleagues[1]. All five indicated they would like to continue using the game - *"Most definitely continue to use the game"*. However asked to elaborate, three highlighted ***a preference for using the game in a flexible manner***:

"Probably with some clients contract to do 6 sessions and complete the full program. With others utilise various modules out of it, depending on the child's needs."

Client feedback

Table 2 shows the responses of the six adolescents to questions on gNats Island. The majority found the game very enjoyable. Asked what they liked most, some referred to specific parts of the game, e.g. *'dancing in the disco'*. Others commented on the game in general:

"It was a game and it was more fun than just talking."

"That it was on a computer - not paper. It was fun."

One client did not enjoy the game at all, stating:

"I would prefer talking about problems and setting goals rather than what I did in the game"

Each adolescent felt the game had been helpful to some degree. When asked if they felt they had changed in anyway since completing the game, all chose yes and provided specific examples, Table 2. Five said they would recommend gNats Island to a friend. Asked for a final opinion regarding the game just two adolescents responded:

"Please make a Part 2." *"It's brilliant! (It) changed my life!"*

Case Studies

By combining feedback from adolescents and clinicians with quantitative data from each intervention, this study produced a series of detailed case studies that provide preliminary evidence on the clinical effectiveness of gNats Island. What follows is a representative sample.

Amy's case highlights the complex nature of the difficulties that young people can face. Aged 11, Amy was diagnosed with dyslexia at age 7. She had experienced post-traumatic stress and attended therapy two years previously following a break-in at the family home. She also had a history of being bullied at school. Amy's mother reported reduced physical activity, mood swings, a withdrawal from friends and a refusal to sleep in her own bed. Upon referral to the psychology team she was diagnosed with generalised anxiety disorder. Amy was shy and anxious when she first met the clinician, but reacted positively to gNats Island. The clinician felt the game helped to structure sessions and that Amy was motivated to attend as she enjoyed the game. However concern was expressed that Amy may have engaged only superficially with issues raised in the later stages of the intervention. This observation is supported by quantitative data collected for Amy's treatment. Amy's CSRS scores, indicating client satisfaction and engagement, rose from sessions 1-3 before dropping in session 4. WAI scores also indicate the therapeutic alliance between clinician and client improved over sessions 1-3 but declined over the remaining sessions. At the post-treatment follow up however the clinician noted a marked improvement in anxiety symptoms. For example Amy was now sleeping in her own bed. Quantitative parental CBCL scores also indicate a marked improvement, with Amy moving from the clinical to normal population range for affective and anxiety problems, at both post-treatment and follow up.

Derek (15) was the adolescent who did not enjoy gNats Island. Upon referral he was diagnosed with anxiety and depressive symptoms including a low mood, social withdrawal and a negative outlook, all of which were negatively impacting his daily functioning. The clinician reported that the game helped in structuring sessions and that Derek initially engaged well. However he became less interested in later sessions, as he felt the game did not have a clear purpose or goal and preferred to talk directly with the clinician. Derek's CBCL symptom scores remained stable over the course of the intervention, indicating a neutral effect. Following this intervention he received further treatment including a course of anti-depressants.

The quantitative measures of Carla (13) are representative of the remaining adolescents. Carla was referred to the psychology team with moderate anxiety that impacted her daily functioning. When she first met clinicians she appeared articulate and self-confident, but tearful. She was very reluctant to attend the first session. However, WAI and CSRS scores support the clinician's observation that Carla

[1] Each clinician in CS1 received a 75-90 minute introduction to gNats Island. The clinician who would not recommend the game clarified that he was extremely busy and would not have the time to explain the game to colleagues.

engaged enthusiastically with the game-based treatment, indicating a strong and gradually improving therapeutic alliance and high session rating scores. CBCL scores indicate significant improvements in anxiety levels post-treatment, with maintenance at follow up.

Discussion

This study has provided initial evidence that gNats Island is acceptable to mental health professionals, with each clinician indicating they would like to continue using the game - albeit with the option to use it flexibly. The majority of adolescents also reported enjoying the game and would recommend it to a friend. With the exception of Derek (neutral clinical impact) case studies suggest that the intervention had a positive impact on adolescents. Unlike previous studies of games in face-to-face interventions, this study has provided quantitative evidence supporting clinicians' observations regarding the impact of the game. It is important however at this point to note that, while the CBCL scores indicated improvements in anxiety symptoms for many of the adolescents, clients self reported YSR symptom scores were less conclusive. In most cases YSR measures varied widely across baseline collection points, thus preventing firm conclusions on this measure.

One of the most important factors observed in this study was the change in dynamics supported by the game. Adolescents attending mental health services - particularly those who are reluctant to attend, e.g. Carla - can often react confrontationally or not at all to direct dialogue with a clinician. With younger children clinicians will often use play materials (e.g. puppets or building blocks) to ease the difficulties associated with clinical settings. This study provides evidence that technologies such as computer games can act as an age-appropriate mediating factor in adolescent interventions. Unlike the situation in which play is used with younger children - where games provide the clinician with a means of observing the child's behaviour - the game in this case helps to actively engage adolescents in a cognitive bahavioural intervention process. It is important that, while the game altered the dynamics of the client-therapist relationship, it did so in a manner that clinicians felt supported and even enhanced this critical relationship. Support for the client-therapist relationship was a critical factor in clinicians acceptance this new technology.

Alongside providing outcome measures, quantitative data collected in this study has served a second purpose. Session rating scores highlighted points in the intervention at which some adolescents experienced difficulties. For example, the scores of some adolescents (e.g. Amy) were found to dip in session 4. Our second clinical study provides a more in-depth insight into this and other important issues identified in the first study - e.g. the flexible use of gNats Island.

CLINICAL STUDY 2

In our second clinical study a member of the design team (an experienced clinical psychologist) used gNats Island with 15 adolescents (8 male), experiencing difficulties including anxiety, depression, anger management and interpersonal issues related to autism spectrum disorders. In some cases the game was used in a manualised manner, in six one-hour sessions spread over six weeks. However, in most cases the game was used flexibly, with the overall intervention extending over longer or shorter periods. When used over longer periods, sessions within the six week manualised treatment were sometimes repeated or supplemented with additional therapeutic activities not included in the game. Over shorter periods parts of the manualised treatment were omitted. In each case the clinician made decisions based on his ongoing assessment of the adolescent's needs. Given this flexibility of use we did not seek to collect quantitative outcome measures. Through the direct involvement of a design team member, the aim in this study was to gain a deeper insight into the real world use of gNats Island. During the study the clinician kept a case notebook and debriefing sessions were then held with an HCI researcher. We believe many of the lessons learned in this study can be generalised to a wide range of mental health technologies. Consequently, in reporting this study, we focus largely on these issues.

Results and discussion

As in CS1, gNats Island was found to have a positive impact on young people, with many reacting very enthusiastically to the opportunity to play the game. Clients as young as nine were found to respond positively to and understand the representations of CBT concepts used in the game. Many adopted the language of the game, frequently referring by name to gNats that had stung them. Some also came up with new types of gNats and in several cases drew pictures of these gNats in their workbooks. As this suggests, the paper-based supplementary materials were again popular with many adolescents. However, as in CS1, it was found that transitions between a computer and paper were *'jarring'* with some adolescents. Clinicians in CS1 also reported that two (of six) adolescents did not complete paper-based between-session exercises. A similar trend was observed in this study. While this is not at all unusual in adolescent interventions, previous research on cCBT suggests that mobile and online systems may prove more effective than paper in supporting between-session activities [25]. In future we believe the most effective approaches will involve an integrated use of multiple technologies, alongside paper-based options – e.g. by integrating the use of computer games in sessions, with the use of mobile and online activities between sessions. We did however note one simple way in which the current use of technology in gNats Island should be extended. At 3-month follow up sessions with each adolescent, many were disappointed at the absence of a gaming option. Future versions of the intervention will therefore include gaming options at follow up sessions. This recommendation - that follow up sessions offer options similar to treatment - can be generalised to many mental health technologies.

As noted in the section 'gNats Island', questions about how gameplay could best complement therapeutic aims arose frequently during the design of gNats Island. Ultimately a

conservative approach was taken and gNats Island has limited amounts of action-oriented gameplay. The question of how additional gameplay might be integrated into future games was an important consideration in this study. The clinician observed that at the end of sessions, after conversations with game characters, young people liked to continue exploring the 3D world. Based on this observation we believe it will be beneficial to add short gaming action-oriented episodes at the end of sessions. Instead of focusing on therapeutic issues, these episodes will provide a wind down space. Winding down time is particularly important after sessions in which difficult issues have arisen. Short gameplay episodes could also serve as an unconditional reward for clients' achievements in each session.

In developing gNats Island we sought to maintain high production values and provide a high quality 3D environment. However, given the research focus and relatively low budget of this project (as compared with many commercial games), we did have some concerns as to whether or not the game would meet the expectations of young people. In practice the clinician found that a simple step in expectation management was sufficient to offset any difficulties. When the clinician first met clients he would ask if they played computer games, and if so what games they liked. He then invited them to play gNats Island, but played down the graphics in the game, saying they might not be like their favourite games. He also suggested that like many games gNats Island might be a bit difficult, but that this was ok. Future versions of the therapist manual that accompanies gNats Island will include an example protocol for introducing the game.

As we have previously noted, quantitative tracking data in CS1 showed that session rating scores for some clients dipped in session 4. In this study it was observed that some clients - particularly younger ones - found modules four and five more difficult than earlier modules. This is the point at which Core Beliefs, one of the more difficult, but most important concepts in CBT is introduced. This indicated that the pacing of the therapeutic content in these modules should be revised and possibly simplified. As the current version of gNats Island is quite cognitively focused, the inclusions of additional behavioural exercises may prove useful. Given that many behavioural exercises lend themselves well to implementation as simple puzzles and games, these exercises would provide a way of introducing novel interaction elements to the later stages of gNats Island. They would also provide checkpoints that allow clinicians to assess if clients have understood concepts introduced in the game. However, unlike the overall structure of CBT which is relatively constant across many interventions, different types of behavioural exercises are typically required based for example on the age, developmental levels and the difficulties faced by clients. Greater flexibility will therefore be required.

Finally, while gNats Island does not include an explicit role for parents, many parents did make use of the paper-based client workbook to follow and better understand their children's treatment. Unfortunately, in some cases ad hoc parental roles arose that caused difficulties. For example some parents actively monitored if adolescents were completing between-session exercises in their workbooks, treating it similar to school homework. In interventions it is helpful if clients complete these exercises, but clinicians, unlike parents in these cases, will not pressurise adolescents to do so, as this has the potential to increase adolescent resistance to a therapeutic process. While future mental health technologies for adolescents may benefit from incorporating an explicit parental role, it is clear that this role should be carefully designed and should provide clear guidance for parents. They should, for example, provide separate supplementary materials for all parties.

PROFESSIONAL SURVEY

CS1 provided initial evidence that gNats Island is acceptable to both clinicians and adolescents. As previously noted, the provision of such evidence is an important objective in exploratory evaluations. Our final study was designed to further assess the acceptability of gNats Island to a wider range of mental health professionals. Thirteen workshops were held, each of which included a brief introduction to research on cCBT, followed by a 75-90 minute practical session in which gNats Island was demonstrated and the client and therapist manuals were distributed for participants to review. In total 216 professionals participated in these workshops, including clinical psychologists (26.8%), childcare and protection workers (14.1%), social workers (10.1%), educational psychologists (10.1%), child and adolescent psychiatrists (9.1%), trainee clinical psychologists (6.1%) and psychotherapists (4.0%). Professional experience varied greatly, ranging from 6 months to 35 years, with a mean of 8.94 years (SD = 7.73). 54.7% of the participants reported regularly using CBT techniques in their work. 28.5% reported they did not. 16.8% did not answer this question. At the end of each workshop, participants completed an anonymous questionnaire. When completing this questionnaire, they were reminded of the importance of giving honest feedback, whether negative or positive, as this would inform further development of the intervention.

Do you think this game would be useful in your clinical work?				
Not at all	Somewhat	Quite	Very	Extremely
0%	3.1%	15.3%	39.8%	41.8%

Table 3: Participants' ratings of gNats Island, n=216

Results

Table 3 shows participants' responses to a Likert question about the potential usefulness of gNats Island in their work. Participants also answered open questions regarding the usefulness of the game, likes and dislikes and potential concerns. As reflected in Table 3, participants' perceptions of gNats Island were largely positive. Some identified particular client groups with whom the game could be useful (e.g. "*boys 9 years and up"*). Others referred to particular ways in which the game could be helpful. As was

the case in CS1, support for the client-therapist relationship was identified as particularly important. Of those who rated the game as 'quite' or 'somewhat' useful, the main pattern of response referred to the unsuitability of the game for their client population:

"Most of the children I see come with many systemic and interpersonal difficulties not targeted in this package. It will be useful to address anxiety symptoms etc though."

93.5% of participants identified specific aspects of the game that they liked. 18.5% referred to the game being engaging and appealing to young people. 15.7% commented on it being interactive. 13.9% thought the game was user-friendly and easy to follow. 46.3% of participants also identified aspects of the game that they did not like. Overall 16.2% of participants commented on issues related to the game's graphics. Whilst most felt the graphics were of a high standard, some expressed concern that they might not meet the expectations of adolescents. 12.5% made comments relating to language used in the game, suggesting that there was too much text in places or that some language was too complex and would require explaining for younger clients. A similar pattern arose in response to an open question regarding concerns about using the game in clinical settings. 11.1% thought the game was not suitable for some clients, based on age or cognitive ability. 67.1% of participants reported no significant concerns.

Finally participants were asked an open question about the structured use of the game over six sessions with their client group. 44.4% thought six sessions were sufficient. A further 27.3% also responded yes, but commented on using the game in a flexible manner. In a similar vein, 10.2% of participants stated that it would depend on the client:

"It would very much depend on the client issues that are being dealt with and how deep rooted core beliefs are."

10.6% of participants felt six sessions was too short or that there should not be a set number.

Discussion

This final study provides further evidence that gNats Island is perceived as both acceptable and useful by a broad range of mental health professionals. As in CS1, flexibility in use emerged as an important consideration. In many ways this reflects current clinical practice. 61.6% of participants in this study reported currently using manualised (non-computer based) treatments. However many reported doing so in a flexible manner.

DISCUSSION AND CONCLUSIONS

Research on the use of technology to support adolescent mental health interventions is clearly in its early stages. In this paper we have reported on the first fully integrated use of a computer game to support a CBT intervention. We conclude this paper by considering several important lessons which can be drawn from the studies reported. Taken together the studies provide an in-depth insight into the use of technology to support a face-to-face intervention for adolescents experiencing moderate to severe difficulties. Definitive evidence on the clinical effectiveness of the gNats Island intervention will require larger scale clinical trials. However building on previous research, this paper provides good initial evidence of the potential of therapeutic games to assist in adolescent treatments. Unlike previous studies of games in face-to-face settings it provides quantitative evidence to support the observations of clinicians. We have also presented strong evidence that a game-based approach can be acceptable to both young people and mental health professionals.

Technology in this case has served several purposes. By reshaping the dynamics of the therapeutic interaction in an age appropriate manner, it helped to create a context in which adolescents could engage more easily with the therapeutic process and with the clinician. The game provides an overall structure and active process. By using elements of fun and concrete representations of difficult concepts, it seeks to make the CBT process more suited to the developmental needs of adolescents. While potential improvements have been identified, particularly in the case of younger adolescents, client engagement was good in both clinical studies and feedback from clinicians and adolescents suggests that the game did help in creating the fun and experiential process recommended in adolescent interventions.

Many of the lessons from this paper can be generalised to other mental health technologies. While gNats Island does change the dynamics of the therapeutic interaction, it does so in a manner supportive of the client-therapist relationship. This was critical to clinicians' acceptance of the game and we recommend that this relationship be carefully considered when designing any new system in this area. Designers should also consider the protocols surrounding use of technologies (e.g. how to manage expectations when introducing new technology), consider developing supplementary materials for both clients and their parents, provide paper-based options and options at follow up sessions similar to those used in the intervention.

Based on the experience of the clinician in our second clinical study, we believe that gNats Island and other mental health technologies will be most effective when clinicians have the option to use it flexibly. Used flexibly, technology can help to provide a structure around which clinicians can tailor interventions to best suit the needs of their clients, including the option of a manualised approach. To support flexibility, systems should be modular, be easy to pick up and put down and easy to integrate with other therapeutic activities.

From the perspective of large-scale definitive evaluations, which require strict protocol, flexibility of use creates challenges. The exploratory nature of the evaluation in this paper allowed us to undertake three complementary studies, each providing a different view on the use and usefulness of gNats Island. They provided a valuable and flexible context in which to address both HCI and clinical issues. Future work on gNats Island will therefore involve both formal

and exploratory studies. In our formal study the game will be used in a manualised manner. Exploratory studies will be used to further examine the flexible use of the game, and to investigate new design ideas. Many of the professionals who participated in the professional survey have volunteered to participate in these studies. As this field progresses there will also be a need for long-term implementation studies, examining the use of systems such as gNats Island in day-to-day clinical practice.

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