FOCUS

DESIGNING GAMES & SIMULATIONS FOR LEARNING PROJECT

Chris Hovey, David Lockard, Heena Gulati, and Mi Sophia Lu |

Introduction

Focus is a single-player puzzle-adventure game meant to assist children diagnosed with ADD/ADHD in overcoming everyday difficulties commonly encountered due to these disorders.

The game has been designed as a supporting activity to the methods set forth in the book *Organizational Skills Training for Children with ADHD*, by Richard Gallagher, Howard B. Abikoff and Elana G. Spira (Guilford Press, 2014). In this book the authors detail a set of behavioral tools designed to assist parents and therapists in guiding children towards the construction and maintenance of healthy daily routines.

The authors frame their method as one of intervention; a cardinal objective being to help children develop and maintain healthy routines relating to material organization and time management. Our game proposes to support this method by providing children treated according to it with an engaging platform to practice the skills it advances.

The game mechanic is based on a persistent-world 'virtual pet' scheme, in which the player is tasked with maintaining their avatar's well-being via methodically overcoming level-based challenges.

While the practice of upholding a routine is of value in itself, in *Focus* the game tasks will reflect the 'real' ones set forth in the book; and just as the child starts to implement the method on their own daily life, they will be asked to do so on their avatar's daily life. As the therapy progresses, the therapist and/or parents will 'unlock' new tasks, skillsets and objectives based on the child's real-life progress.

Focus is a game meant to be used as a supplementary tool in therapy sessions for children diagnosed with ADD/ADHD. Its conceptual design is based on the activities and tasks described in the book – Organizational Skills Training for Children with ADHD : An Empirically Supported Treatment - by Richard Gallagher, Howard B. Abikoff and Elana G. Spira. Since the book serves as a treatment manual for Organizational Skills Training (OST), the game *Focus* is also aimed to teach and reinforce those skills for ADD/ADHD children undergoing therapy.

According to the evidence-based literature in the book, therapists working with ADD/ADHD children have to address a significant problem of OTMP (difficulties with organization, time management and planning). The organizational skills are important for children so that they can meet the demands and needs of the tasks that have to be completed at school and home. The intervention plan described in the book focuses on teaching these skills to children which will not only help in reducing the symptoms of disorder but also ensures that these children can have optimum level of functioning in their daily lives.

Through this game, therapists and parents will be able to teach the skills for dealing with OTMP in a fun and playful manner vis-à-vis solving different kinds of puzzles simulating real-life situations encountered by the child.

Studies have shown that games and simulations in conjunction with traditional therapies can be beneficial for treating children with ADD/ADHD since the players are required to focus on tasks for long periods of time in order to achieve goals. As a child plays through the game, he/she learns to develop strategies, recognize patterns and focus intently on the task at hand (Kazdin, 2011). Hence, our game *Focus* can be a platform for the children diagnosed with these disorders to learn and practice those skills that are being taught to him/her in the formal therapy sessions.

Background

➢ *Target Audience*

The primary target audience for this game are children aged 8-12 who are are currently working with a therapist using the methods outlined in this book. While the common symptoms of ADD/ ADHD affect children in various ways, this game aligns itself with the ones focused on by this book; namely, difficulties with organization, time management, and planning (referred to as OTMP), which often have an adverse effect on school and home functioning.

While this document details a version of the game meant to be integrated into an ongoing therapist-child dynamic, a future version could be modified so as to serve children less severely

affected by these disorders (who as such are not undergoing therapy), or as an aid to parents whose children lack access to behavioral therapy. In addition, this game could be modified to serve as a tool to be used after therapy is concluded in order to reinforce the skills developed during sessions.

In outlining the research supporting their method, the authors of *Organizational Skills* note that a recurring problem in addressing the negative repercussions of ADD/ADHD on children's daily lives is children's tendency to fall back into ineffective routines during intervals between clinical sessions. The authors suggest that a schedule of once-weekly meetings is insufficient to battle this tendency, and they conclude that in regards to establishing healthy organizational routines, a two-session per week schedule is needed to fend off relapses. This is true even during the school year, when organizational skills are called upon frequently. The authors stress the importance of 1) practicing the organizational skills at close intervals, and 2) providing the children with frequent encouragement and feedback for their efforts.

We aim to support implementation of this clinical intervention by providing clinicians and students with a game to be used during the period of therapy, which is designed to aid in both these aspects.

ADD/ADHD are disorders with characteristic symptoms of impulsivity, hyperactivity, inattentiveness, disorganization, difficulty in time-management and attention-shifting (DSM-5, APA). As mentioned earlier, our game *Focus* has been designed to supplement the therapeutic resource material defined by the authors, its main idea is to teach skills for organization, time-management and planning (OTMP).

The session plans in the book have been designed for elementary school children in grades 3-5 (8-12 year old) who have been diagnosed with ADD/ADHD and are undergoing therapy sessions with a counselor. Through this game, children will be able to learn and practice the OST skills in a fun and playful manner. The game mimics the real-life scenarios encountered by the child which will give them an opportunity to understand how the skills learnt in therapy can be transferred in their daily lives. It will help them make connection with the in-therapy learning to the behaviors related to organization and planning needed in everyday life.

Since the aim of clinical behavior therapy is to empower the client (in this case, children) with relevant skills to be able to deal with everyday life situations effectively without the need of a therapist, this game can be used to support the long-term outcome intervention plan for ADD/ADHD children.

➢ *Learning Objectives*

The Educational Objectives include:

1. Recognize examples of common "glitches[1]" in their own attention.
2. Implement and uphold the strategies being provided by the therapist for dealing with these "glitches", including
    a. Goal planning
    b. Complete a task without getting distracted
    c. Avoid distracting locations and scenarios
3. Increase players self-efficacy regarding their ability to overcome "glitches" in their own life.

According to the book, OST uses behavioral skills training procedures to improve children's organizational skills and enhance their OTMP functioning. Certain evidence-based claims made by the authors regarding the skill-deficits in ADD/ADHD children are:

- Children with ADHD often do not systematically keep track of short-term and long-term assignments.
- Children with ADHD also have difficulty managing the materials that are necessary for completion of school assignments.
- Children with ADHD also have difficulty managing time effectively, and this negatively affects their ability to complete schoolwork and other important tasks.

As described in the book, in the first phase of treatment, children, their parents, and teachers were asked to work together to beat the 'Glitches'. The modules delineated by the authors to be used with the ADD/ADHD children are:

[1] "Glitches" being the terminology employed by the authors to describe to students different behavioral aspects that warrant corrective measures

Module 1: Tracking Assignments

Module 2: Materials Management

Module 3: Time Management

Module 4: Task Planning

The skill-deficits and the modules outlined by the authors form the framework for defining the learning objectives of our game which are as follows:

1. Recognize examples of common "glitches[2]" in their own attention.
2. Implement and uphold the strategies being provided by the therapist for dealing with these "glitches", including
    a. Goal planning
    b. Complete a task without getting distracted
    c. Avoid distracting locations and scenarios
3. Increase players self-efficacy regarding their ability to overcome "glitches" in their own life.

The above-mentioned learning objectives corresponds to the following dimensions of Bloom's Taxonomy (Bloom et al., 1956):

- Evaluating (Objective 1)
- Analyzing (Objective 1)
- Applying (Objective 2)
- Understanding (Objective 2 & 3)
- Remembering (Objective 3)

➢ *Existing Market Solutions*

Existing Market Solutions which claim to train skills for dealing with ADD/ADHD are frequently designed to train cognitive skills such as memory and attention. *Fit Brains Trainer*

[2] "Glitches" being the terminology employed by the authors to describe to students different behavioral aspects that warrant corrective measures

from Rosetta Stone, for example, uses gamified cognitive tests with a daily set of five challenges to train, track, and improve user's memory, focus, executive function, and logic skills. *Peak - Brain Training*, from Peaklabs, also claims to improve attention and focus for people with ADD/ADHD using a suite of games very similar to *Fit Brains Trainer*. *Peak*, however, lacks the social comparative feature that *Fit Brains* offers as the end of each challenge. Both game suites attempt to improve cognitive skills based on claims that doing so improves ADD/ADHD related behavioral problems.

Focus differs greatly from these existing market solutions in a number of ways. Rather than training cognitive skills, our design aims to reinforce the practical integration of a specific clinical intervention. It does this by providing players with an avenue to playfully practice the methods in a game environment which is encouraging and relaxed. While separate from their lives, the scenarios they will encounter through their avatar will (for the most part) very clearly mirror the ones they face in real life. Successfully enacting the organizational skills the children are learning on a digital avatar, we propose, will encourage them to enforce these skills on themselves, and aid in successfully following the methods set forth in the book. For example, players who successfully identify the potential distractions in a virtual bedroom will be more able to identify and control for them in their real-life bedrooms.

Focus also differs from the existing market solutions by emphasising a playful narrative with sociocultural elements. Our purpose in using a parallel-timeline narrative is to make a meaningful connection between player actions in-game and child actions in real-life. However, *Focus* still incorporates cognitive training by offering "bonus mini-games" for achieving "bonus objectives" in various stages. The mini-games that are unlocked for achieving the maximum organizational sequence are established cognitive training games.

Some popular games are also used to encourage the ADHD child to connect the game-based skills to real-world skills. For instance, *Bad Piggies,* a puzzle game, requires the child to think flexibly and use different strategies. The game has clear elements of win/lose state and teaches the cognitive skills required for planning, organizational skills, problem-solving and decision-making. Since the executive functioning is disrupted in children with ADD/ADHD, the game can be used to train for these deficits. Our game *Focus* differs from this game as the former provides a platform to rehearse the required skills in the gaming environment which makes it

easier for the child to transfer them to the real life situations which is not the case in the latter game. It will also help the child make direct connections with therapeutic skills taught by the counselor and understand the applicability of those skills.

Design

➢ *Overall Game Idea*

Focus is a level-based puzzle-quest game set in the third person, designed to be played on any tablet device or personal computer. It shares similarities to a tamagotchi-type game, evoking a persistent-world parallel timeline in the gameworld. It follows as story-driven plot based around an avatar who is navigating situations similar to the child's and is faced with similar problems.

Like in a tamagotchi-style game, the player's goal is to maintain a level of wellbeing for a cartoon character, who we shall call their avatar. This wellbeing is measured using three parameters called health bars, which will be explained later on. The game itself is played as a series of sessions; When the app is opened, a new game session starts. Each session contains a number of levels. Each level presents the player with a challenge that mirrors situations the player is likely to encounter in their real everyday life. The player overcomes these levels by implementing solutions and strategies that they are being asked to use on their own daily life by the therapist.

A therapist who chooses to utilize this game in conjunction with the method set forth in *Organizational Skills* will remotely control certain game parameters, based on an evaluation of the individual child's needs and progress. For example, they will set a minimum number of sessions the child must play every week. They will also 'unlock' new types of tasks in accordance with the therapy's progress and focus.

And perhaps most fundamentally, the therapist will be charged with setting the game's win state. One win state may be keeping a certain one of the avatar's health bars at over 75% for

two consecutive weeks. Another may be making sure the avatar is succeeding all bag-packing scenarios until a certain pre-established time.

By utilizing engaging, affective design considerations, we aim to make *focus* intrinsically motivating to an extent that the player will seek to succeed without needing the therapist/a parent to 'look over their shoulder.' We envision a situation where the therapist may offhandedly ask the child how they are faring in the game and compliment them for their success. The therapist may then, later, point to the child's success at the game as encouragement when/if the child is in need of some in their real life. (Exploring the potentialities of this dynamic would be a central topic of research for evaluating this game, which will be detailed below.)

A note about the parallel time scheme: Each day in the real world will have its equivalent in the game world. For example, if the child does not play the game for a whole week, despite knowing that in order to maintain a 'healthy' avatar they must play it at least three times per week on three different days, they will encounter an avatar with a very messy room, who may or may not have done their homework. In order to allow the player to practice scenarios from different times in the day without having to make the child open the app in the morning/late at night, the timeline mirroring will be partial: Each day the child opens the app, a session will commence that corresponds to this day. Yet the specific time of day in the game world will not necessarily correspond to the specific time the level has been opened in real time. For example, when opened in the evening, the player may encounter an afternoon scenario.

➢ *Mechanics + Walkthrough*

The game mechanic is introduced in its most pared-down form in the first level of the first session. In this level, the player is tasked with guiding their cartoon character avatar out of bed rather than oversleeping (see fig. 1). In this level, as in throughout the game, players are confronted with a scenario and an objective, and must choose between two "powers" - "focus" and "avoid" - by tapping the one they wish to apply and then dragging it to the object/area in the scene to which they wish to apply it. Via experimentation, the player would understand which areas in each scene are applicable for dragging powers onto. A reactive highlighting tool (fig. 2) would help them in establishing the borders and content of these areas before a decision is made

and a power is “dropped” onto the scene. When satisfied with their solution, the players hit the “Go!” button, and two things result from this choice: 1) a short animation is played, which displays to the player the result of their choices and moves the narrative to the next level, and 2) the number on the success bars change in accordance.

Figure 1

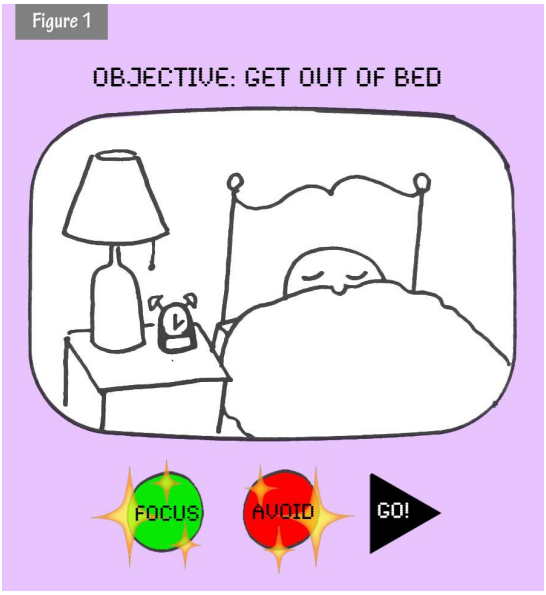


Figure 2

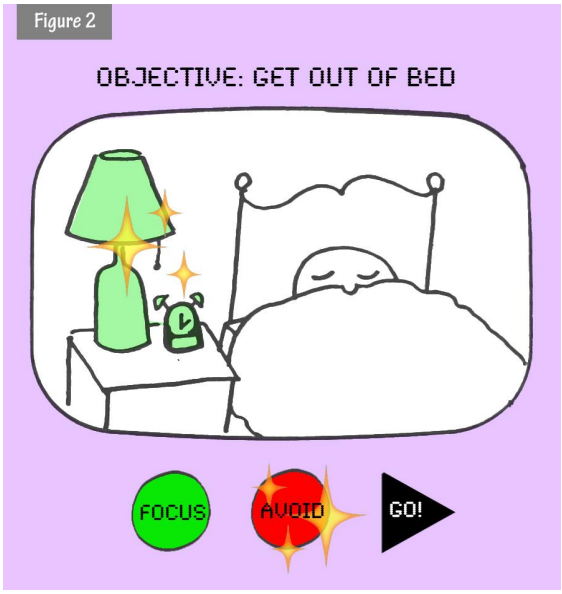
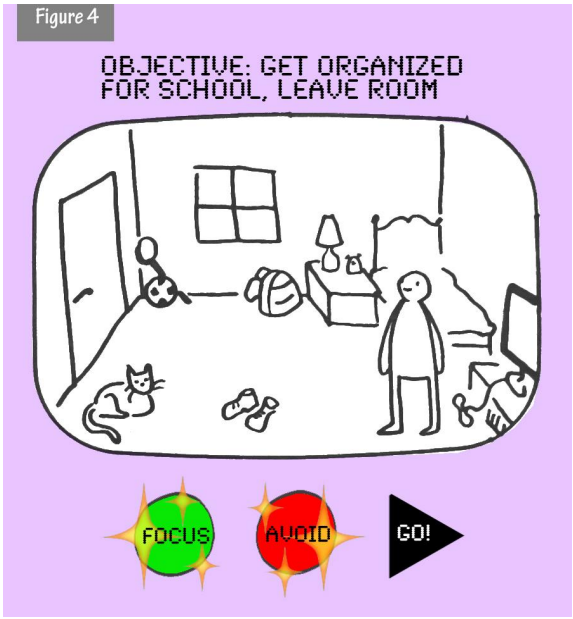


Figure 3

Figure 4



There are three success bars: 1) Time Success 2) Space Success 3) Mini-Games meter.

The first is connected to tasks involving time management, such as the getting-out-of-bed scene. The second relates to tasks that involve keeping track of materials for school, etc. While the Mini-Games bar acts as a measurement of success playing the intermittent mini-games, a feature that will be explained later.

In the level just described, the correct application of powers would be to place a "focus" on the alarm clock/lamp area and an "avoid" on the bed in which the avatar is sleeping (fig. 3). Once "Go" is pressed, an animation would show the character turning off the clock, turning on the lamp, and getting out of bed, and the narrative would move on to the next phase in the avatar's day (fig. 4) after a "success" sign is flashed and the Time Success meter is raised a notch. If, on the other hand, the player would choose to focus on the bed, the resulting animation would show the avatar nestling deeper into its covers and missing the school bus. The 'Time success' bar would go down a notch and a replay option would appear, prompting them to try again.

The animated 'outcome' sequences will vary based on based on the player's individual choices, and will act as an immediate feedback feature. A NPC in the form of a cat who follows the character everywhere will act as a helper, providing verbal hints on the mistakes the player has made via thought bubbles. These animations are meant to manipulate player emotions by helping them connect how their 'preparation' and 'outcomes' in the game relate to their personal experiences. For example, a player who neglects to find more than two distractions in a scene may find that their character ends up playing with toys instead of finishing their homework in time, and subsequently only turns in only half an assignment in class the next day. An animation of this type is meant to remind players of their real-life mistakes, but then offers them a chance to do it better through a replay.

The *Mini-Games* bar become available when players successfully achieve the maximum speed bonus on certain levels and unlock cognitive training games for short durations of time. For example, in the case given above, if the player gets the speed bonus that allows their character to earn 'game time' after completing their homework, it actually unlocks a cognitive

training game for a brief period of time. Rather than build these games out separately, we intend to solicit the use of empirically established games for cognitive training to include in these bonus stages.

Once the players display an understanding of the basic game mechanic, additional features will be layered onto it, allowing for a greater integration with the methods described in *Organizational Skills*.

For example, in later stages, players will be confronted with situations asking them to allocate powers according to an optimal sequential order. If the player chooses to focus on the door before focusing on the shoes - the resulting animation will show the character leaving the room barefoot, only to return perplexed with dirty feet, etc. In such levels, the numbers will appear on "focussed" objects in the order which they were chosen for "focus". Choosing an "optimal" sequence (in accordance with the methods set forth by the authors) will impact success at the stage, which will be reflected in the resulting animations[3] and in the numerical benefit signified via the meters.

In addition, later stages will see the introduction of limits on the 'supply' of powers available for using; in such stages, the players will be asked, for example, to identify the three most crucial things to focus on, based on their understanding of the situation at hand.

Lastly, as mentioned in the intro, *focus* has a series of cognitive mini-games embedded within it. Overcoming Time Success levels (Which are often contingent upon maintaining high Space Success) cause the third Mini-Games bar to go up. For example, if the player fails to sequence the planner and binder properly, the outcome would be a scene in the classroom, where the avatar is digging into his messy backpack, pulling out random paper including commercial flyers, but failing to find the right homework sheet. If the player successfully complete this stage, the outcome will be a close-up shot on a well-organized backpack, and the avatar will use the extra time 'earned' to turn on his/her iPad to play a game, which then becomes the newly unlocked bonus game the player is invited to play.

[3] A star system might be implemented in order to clarify relative success in these stages

➢ *Aesthetic + Narrative Design*

Aesthetic design factors form a central part of the game's intrinsic interest. They are used in conjunction in several ways, all as part of the game's overarching embedded narrative (Jenkins, 2003).

1. Humor

The animated sequences will be rendered in an exaggerated cartoon fashion to facilitate player engagement and enjoyment. They will be short and snappy in order to maintain engagement and not adversely impact the player's interaction with the game. When a player makes a mistake, the result will be humorous rather than punitive; for example, in a stage where the player is asked to prepare for the next day, if the player fails to identify and "avoid" the distractions, the outcome would show the avatar's parent enter the bedroom, take away the avatar's ipad away and give it to the cat, who would proceed to happily jump up to a high place and play a game on it.

2. Variation in outcome animations

In order to allow for the player to be engaged despite being asked to do the same tasks again and again, the animations will often vary even when the scenario is the same. For example, when the player is confronted with the waking-up scenario for a second time, the resulting animation will feature a surprise: Rather than just getting up and turning of the clock like in the first session, the animation will show the avatar jumping on the bed three times and falling off the bed, before proceeding to the next level.

3. Deviation from naturalistic narrative

On the whole, the representation of the routine tasks faced by the avatar will be rendered in a relatively naturalistic cartoon fashion, in order to avoid obfuscating the relation between the strategies used by the player in real-life and in the game-world. Yet later in the game, the player will be surprised to see that the narrative takes his avatar to places far removed from the regular house-school scenarios. These surreal episodes will last between a few days and a week, and at their end the avatar will always be deposited back in their 'regular' home. During these

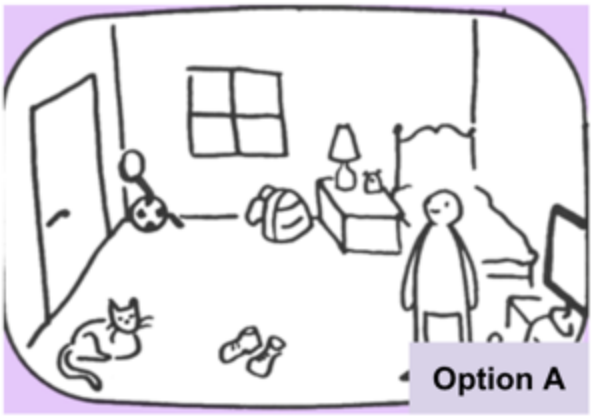
deviations, the character's tasks will be very similar to the daily ones, yet will be changed to fit the scenario. Such deviations may include:

Narrative change	Old task	Revised task
The avatar gets invited to live on bird island by a huge toucan who lands on his windowsill one morning	Put pencil into pencil case, not directly into bag	Put pencil into pencil case, not directly into friendly pelican's beak
The avatar chases a rabbit into its burrow, becomes the mad hatter's helper	Put pencil into pencil case, not directly into bag	Put magic wand into magic wand case, not directly into bag

➢ *Imagery Design*

The general visual language will be based upon research into the attention pattern of children who suffer from ADD/ADHD. While the preliminary proposal uses clean lines and sharp colors, characters, item customerization, scene designs, and color palettes would need to be tested early during development stages to identify appropriate arousal activating designs to keep players engaged and focussed on play.

Focus leverages both 2D cartoon and 3D graphics for same scene but different difficulty levels. For younger players or children with more severe ADHD symptoms, 2D version would be shown first, while other players would have the option to skip to the 3D graphics directly upon their choice.



Research into the effects of using different types of imagery is especially important for *Focus* considering that the attention span of the target audience is likely much lower than the general population. Whether or not customizable character designs are more engaging for the target population should also be explored and possibly incorporated into our early stages. Similarly, whether to have the players customize their distraction options or even upload pictures of their real life environment as background instead of using our pre-generated background, would be research questions during our needs assessment and ideation phase. One interesting research question could involve the exploration of using adaptive color palettes, for the whole playthrough, based on character design choices in the beginning of the game. Such as using complementary, contrasting, or neutral palettes to increase engagement and attention.

It has also been found that color combinations is a powerful design element that produces profound psychological and physiological reaction (Karp & Karp, 2001). This relationship is particularly enhanced for children with ADD/ADHD as they may be more sensitive to these color combinations due to heightened sensory responses and strong visual processing abilities (Freed & Parsons, 1997). Hence, it is our endeavor to use the color combinations and other design elements in a way that it makes positive contributions to the child's progress and not hinder it. In order to ensure that our game's imagery design is not compromising with the child's mental health, it is important to create and test different versions of the game with variable design elements so that the data can help us make informed choices about it. The available research literature and expert opinions such as trained mental health professionals can also inform our decisions about the design.

Theoretical Foundations

➢ *Theory of Change*

The theory of change for *Focus* is that it will model and practice behaviors for proactively eliminating distractions and planning activities before starting them, in order to reinforce the same planning behaviors in players' daily lives. Grounded in Self-Determination Theory (Deci & Ryan, 1985), the tasks and outcomes of *Focus* are designed to motivate players by relating to their senses of Competence and Autonomy in managing their own disorder. Through managing the lives of a virtual agent, whose life mirrors their own, the players will gain a sense that they have control over their own behavior, and then exercise behaviors that enable them to do so. Part of this is clearly 'drill-and-practice', especially if players are already becoming skilled at controlling personal 'glitches' in their everyday life. However, for patient-players that are only beginning to recognize their 'glitches', the game offers the opportunity to experiment with and apply what they are being taught by their counselors and parents. Meanwhile, the extended levels of the game provide same-but-different novel situations facilitating players to generalize and abstract the needed knowledge, which can enhance the knowledge transfer for learners in their daily life (Perkins and Salomon, 1989).

Intermediate outcomes of using *Focus* are expected to occur during counseling sessions and conversations with parents. Through guided reflection, players can talk about how their positive and negative outcomes in the game relate to their own, real-life experiences. It is hoped that these reflections will also enable intrinsic-motivational-orientation shifts regarding player autonomy and competence for managing their own lives. Long-term outcomes of playing *Focus* include the application of appropriate organizational and preparation strategies for goals in players' real-lives *without* prompts by parents, teachers, and counselors.

Learner Models	Evidence Models	Task Models	Presentation Models
What should be learned?	What behaviors teach these constructs?	What tasks and activities elicit these behaviors?	How should these tasks be presented? (mechanics)
● Goal planning ● Complete a task without getting distracted (Overcome task-hopping) ● Avoid distracting locations and scenarios	● Using a planner ● Choosing the right tools by selective attention and clearing an area of distractions ● Choosing appropriate settings	● Teacher & parent reminders ● Point systems, reminders from parents, and reflection with counselors ● Prompts and reminders from parents and teachers	● On screen "Objective" ● Choosing which objects to focus on & avoid before starting a task (drag & drop rule to object) ● Selecting the best setting for a goal before starting it (tap the chosen location)

➢ *Cognitive Foundation*

Focus is designed to encourage various levels of cognition, according to Bloom's taxonomy, through the interactions of a few simple mechanics. While there is one 'perfect arrangement' of powers and sequences in each level, the players are not given more than a goal and are encouraged to explore the environment and test various arrangements in order to find what that 'perfect arrangement' is. From the mechanic of using two drag-and-drop powers -- *ignore* and *focus* -- players can engage in many meaningful interactions, or dynamics, with scenes, objectives, and objects. Using Bloom's Taxonomy we can describe these dynamics as cognitive applications at various levels:

- **Remembering**: identifying objects that impact their behavior.
- **Understanding**: categorizing objects as ‘distracting’ or ‘helping’ to show understanding of how objects impact their behavior.
- **Applying**: judging situations and applying what they have learned in their therapy sessions.
- **Analyzing**: analyzing how objects impact goal states and identifying optimal sequences to complete goals.
- **Evaluating**: experimenting with different sequences and number of available distractions to achieve different outcomes.

In addition, we applied principles from Mayer’s Cognitive Theory of Multimedia Learning (2009) to minimize extraneous cognitive load to foster generative processing, including Multimedia principle, feedback principle, coherence principle etc. We not only visualized organizational tools that are newly introduced by therapists to players, including the Daily Assignment Recorder, Accordion binder and color-coded backpack tags etc. in relevant settings (Guilford Press, 2014), but also the consequences of their actions as the different cut-scenes. These cut-scenes provide timely formative feedback to players based on their individual decisions. Moreover, learners start with simple real life scene to activate prior knowledge to prepare to integrate the new information from novel fantasy scenes (Ausubel, 1978).

For our game *Focus*, several cognitive design considerations have been made based on different theoretical models.

According to the *Cognitive Information Processing Model* (Schunk, 1996), information is transferred from working memory to short-term memory and then long-term memory. Research has shown that the attentional deficits, hyperactivity and impulsivity seen in ADD/ADHD children stems from the working memory impairments (Barkley, 1997). These attentional deficits and working memory impairments hinder the child’s ability to keep track of the short-term and long-term assignments in school and at home. The therapeutic sessions and the game plot seeks to teach these skills so that children with ADD/ADHD learn to focus on their attention and complete the required tasks in a timely manner.

Research has demonstrated that the drag and drop game mechanics are considered to be effective for people with working memory deficits (Shneiderman & Plaisant, 2005). Hence, it

lends support to our decision of using drag and drop mechanics in the design so that the game-play itself does not increase the working memory load for those children. As it has also been suggested by the *Cognitive Theory of Multimedia Learning* (Mayer, 2001), the aim of a designer should be to reduce extraneous processing, manage essential processing and foster generative processing. Specifically, for children with ADD/ADHD children, it is important that we design the game in a way that the gaming environment does not pose a cognitive load on the child. Rather, the game mechanics should facilitate the learning in therapy sessions by encouraging the child to engage in reflection and metacognition so that he/she can transfer those skills to long-term memory and apply it to different contexts.

From the Mayer's Cognitive Learning Principles, *Feedback* and *Guided Discovery* are the most relevant ones applicable to the design of our game. Since this game is used as a supplementary tool with the traditional therapy sessions with a counselor, every scene has been designed to have a clear-cut objective so that the child knows what behavior is expected for that particular stage. The game will be in sync with the therapist's sessions which will make it easier for the child to practice and rehearse the skills learnt. The authors suggested that therapist gives timely feedback about the child's progress and guides the parents and the child about the next steps. Similarly, our game will give feedback to the child about the mistakes made through animated verbal hints. It will help reinforce the positive behaviors and eliminate the negative ones based on the Behaviorist theory of learning.

➢ *Motivation and Affective Foundation*

We designed a multi-layer incentive system to further engage the players. On the intrinsic reward side, we use humour and novel narrative to encourage players to try out different actions, and bring variety to repeated play experiences, as discussed in the previous section. By leveraging the Tamagotchi digital pet type of narrative, we connect the player with its personalized avatar to ensure a recurring play experience. We also incorporated the classic fighting game narrative to extend the pleasure by same-but-different gameplay from the original task settings. As the therapy program is set over 10–12 week, we further leveraged the fantasy element to trigger the player's curiosity to return the gameplay across their entire sessions.

On the extrinsic reward side, we incorporated both in-game and out-game performance of the player. *Organizational Skills* suggests parents use points to acknowledge children's good behavior or progress, with stickers or stamps as prizes. We integrated this out-game reward system into our games. Parents can login to the player's account with passcode to deposit reward points as in-game currency. Players can then use these points to customize their avatar and unlock various fantasy scenes. Meanwhile, the in-game performance is based on mechanics of the Time Success and Mini-Games bars. The Time Success incentive system uses the sequential objects to affect how long it takes the character to complete the task during animations. By having varying degrees of 'failure' and 'success', such as not getting to play a game that night versus not getting the homework done at all, players will be motivated to arrange objects appropriately and replay failed levels. In that example, 'not getting to play a game' would still allow the player to advance to the next stage, while 'not getting the homework done' would force them to replay the stage. The mini-game bars mainly consists of cognitive training games like All you can E.T. or Guakkamole.

The research on ADD/ADHD has shown that children diagnosed with these disorders usually lose their interest and motivation to learn anything new because they are continually blamed, reprimanded and censured for behavior that is beyond their control (de Zeeuw, et al, 2012). Their poor study habits and organizational skills are negatively criticized due to which they start feeling angry, resentful and frustrated. Multiple internal and external distractors causes them to lose focus on tasks which further deteriorates their performance leading to diminished confidence and engagement in school and home activities (Power et al., 2006).

Shiels et al., (2008) has found that incentives can improve the working memory performance and enhance the motivation of children with ADD/ADHD. The element of having 'time success bar' and 'mini cognitive training games' in our design plan are the strategies to motivate the child for continual involvement with the progressive levels of the game.

Further, the third learning objective of our game focuses on increasing the self-efficacy of the children which can be achieved through the incentive system and reinforcement-through rewards strategies in the game. Through this, positive affective outlook can be inculcated which enhances the child's motivational level to learn and practice the organizational skills taught by the therapist in a fun and playful manner.

The cognitive and motivational design factors interact with each other to support the child's learning and transferability of skills which is the ultimate aim of the therapy sessions and this game.

➢ *Social-cultural Foundation*

As a supplementary solution to the existing therapy sessions, *Focus* enhances the social interaction among all the stakeholders. *Focus* encourages players to have proactive discourses with their parents and therapists, to discuss their progresses, confusions, and accomplishments by enabling the points system. Parents and therapists can identify the player's learning status based on the game data, and develop more specific responses to the players. We also intentionally minimized the competition aspect in our game design, as we would like the players to evaluate their competence with a task-involvement mindset rather than an ego-involvement mindset (Martinez, M. E., 2010).

Evaluation

Assessment mechanics include the application of appropriate rules and the use of proper sequences to achieve objectives. As players apply powers to objects, a counter next to the power tracks the number of items to which it has been applied. After players have applied their powers to all the objects they think are appropriate, the counters turn a color indicating the level of success or failure they have achieved. At the end of animations, players receive a short summary screen showing them a two-column chart of items they labelled. Items incorrectly labeled will be highlighted in red, items that were labeled out of sequence will have a clock stamp on them, and unidentified items will appear as blacked out silhouettes. This summary screen is intended to give hints about how to achieve a greater level of success if players must, or want, to replay the level. Summary screens are archived and can be accessed from the main menu, so that parents and counselors can look at progress and give feedback on any common errors. So the two assessment measure questions are:

- What percentage of each type of objects did the player correctly label?
- Did the player arrange the focus objects into the correct sequence?

Some other possible assessments include the use of a focus measure, such as heat tracking maps to determine if players are working toward a task or sitting idle. Biofeedback could also be incorporated to measure focus and worked into the mechanic by controlling the amount of time they are given to "prepare" a scene for a goal. However external measuring tools may be too invasive and not desirable for the playfulness of the game.

Effectiveness evaluation of the game should follow the standard evaluation used by experts in the area of counseling and skill assessment for children with ADD/ADHD. It should also involve additional playtests, interviews, and questionnaires with players, parents, and counselors in order to evaluate what does and doesn't work in the game in order to improve it.

Stage/Level	Rationale	Methods
Reaction/Opinion ● Is the main message/task in the game consistent with the therapy session? ● Is the difficulty level appropriate? ● How relevant and understandable players think about each scenes and distraction items? ● Does the game facilitate the communication between the player, parent and therapist?	This level of assessment is to ensure our target users are interested to play the game in additional to their therapy sessions. We also need the therapists as the experts to validate our design is aligned with the content and progress of the therapy sessions.	● Expert Review with therapists ● Paper prototype and think-aloud protocols with children
Learning ● Do players understand what actions is desired versus suboptimal in real life? ● Can players successfully complete the tasks based on each objectives?	We need to ensure player can get the essential message from the games, rather than simply use it as interactive storytelling and follow the undesired options.	● Paper prototype and think-aloud protocols with children

Behavior ● Do players need less reminders from their parents after using the games during their daily life? ● Do players achieve performance milestones faster than expected based on the therapist assessments?	Less parents reminder is a direct indicator that the players are more aware of and willingly adopt the correct behaviors. Therapist's assessment provide more objectivity to the behavior changes.	● Focus group and questionnaires with parents and therapists
Impact ● Is the game beneficial to skill building for the target users? If so, at what stage of counseling is it most beneficial?	To promote this game as a therapists recommended supplementary solution, we need to understand the optimal playtime and effectiveness for various sub-segments for target users.	● Game data log analysis ● Control/test group comparison

- ***Research Design for Impact Evaluation***

Research Question: Is *Focus* beneficial to skill building for children with ADD/ADHD, who are working with a counselor to overcome symptoms that interfere with micro-goals? If so, at what stage of counseling is it most beneficial?

  - Would also want to identify how much playtime is most beneficial.
  - Microgoals refer to situations where a child has a simple goal, such as 'get ready to leave school', or 'prepare your room and desk to complete your math homework'. These reflect the organizational, time management, and task planning skill sections of the behavioral therapy book associated with *Focus*.

- A simple research design should involve a comparison of two groups using an independent samples t-test. One group would use the app, while the other group would not have access to any game specifically related to therapy (note: they would still be

allowed any game time they normally are allowed in their lives). However, this design would not help to identify ideal amounts of playtime.

- A more ambitious design would explore multiple factors in order to identify the ideal playtime and phase of counseling to introduce the game to the children. The research design should also explore whether this game, compared to another, non-targeted cognitive training game is beneficial to skill building for attention and focus. This would also require a much larger number of participants. The chart below shows a design of this nature that would require 180 participants.

  Research Design with a 2x4 ANOVA on Play Time X Counseling Phase:

Control: 20 (no game)	**Organization**	**Time Management**	**Task Planning**	**Alternative Game Condition**
High Play Time	20	20	20	20
Low Play Time	20	20	20	20

Appendix

Appendix A: Description of Stages

Key:

- **Focus** = items that must be focussed on to successfully complete a scene.
- **Focus SEQUENTIAL** = items that should be selected in the stated order to get the maximum speed bonus and associated animation (and/or mini-game). Represented as object 1 > object 2 > object 3.1 >< object 3.2 > object 4, where 3.1 & 3.2 can be done in either order.
- **Ignore HIGH** = items that must be ignored to successfully complete a scene
- **Ignore LOW** = items that must be ignored to get the maximum speed bonus, associated animation, and bonus mini-game.
- **Ignore TEMP =** ignore can be applied to these objects, but the effects will only be temporary and it will become a distraction again. Used to represent which location choice is better for a particular goal.
- **Objective** = this will be visible at the top of the screen while players are assigning powers to objects.

Stage 1: simple intro to mechanics

- Scene A: framed over bed with sleeping character. On one side there is a lamp, and the other an alarm clock that is going off. Two thought bubbles are coming from the character's head: a schoolbus by the lamp and sheep jumping a fence over the alarm clock.
    - Objective = Get up for school!
    - Tip appears on screen = "Use your powers to ignore and focus on objects in order to complete your goal."
        - Focus = Bedside Lamp
        - Ignore HIGH = snooze button / dream bubble

- Scene B: bedroom, character is standing shoeless in middle of room. Room is fairly clean with only a few distractions visible.
    - Objective: Get to the bus stop in time for school.
        - Bonus objective: Get to the bus stop in time to play your friends new game! (unlocks a mini-game, such as "All you can E.T." for 3 minutes).
    - Tip appears on screen = "Some objects must be selected in a specific order to achieve your goal."
        - Focus SEQUENTIAL = shoes, backpack, door
        - Ignore LOW = cat
        - Ignore HIGH = soccer ball, game system, and toy

Stage 2: getting homework done (at home)

- Pre-homework: location selection
    - Player is given the **objective to complete math homework assignment for tomorrow**, then asked to choose a location in which to do homework. Options are represented as thought bubbles over the character's head.
        - Option 1: Desk in room
            - Scene is framed looking down at the desk over the head of the character, who is seated and ready to do homework.
            - There are lots of potential distractions placed around the workspace.
            - Ignore HIGH = ⅘ of = Bouncy ball, Action figure, Coloring book, iPad, puzzle
            - Ignore LOW = Cat, novelty eraser, ⅕ from HIGH list
            - Focus SEQUENTIAL = Backpack > Planner > Pencil >< Calculator > Worksheet
        - Option 2: Dining Room Table
            - Scene is framed looking at child from across the table, over their shoulder you can see a sibling playing video games in the other room

- Ignore TEMP = video game noise from sibling, infant sibling at table
- Ignore HIGH = Novelty salt & pepper shaker, iPad, Mom making food in the kitchen
- Ignore LOW = novelty eraser, cat
- Focus SEQUENTIAL = Backpack > Planner > Pencil >< Calculator >< Worksheet

Stage 3: Prepare for the next day (at home)

- In the NPC's bedroom; the NPC is facing his desk, which is covered by piles of book and files; several bags on the floor.
- Objective: Pack for the next school day
  - Bonus objective: Finish packing in time to play a game before bedtime (unlocks a mini-game, such as "All you can E.T." for 3 minutes).
- Tip appears on screen = "Some objects must be selected in a specific order to achieve your goal."
  - Focus SEQUENTIAL = Daily Assignment Record (DAR), related homework sheets, Accordion binder, backpack, calendar, gym bag; pencil, pencil sharpener, pencil box.
  - Ignore LOW = cat
  - Ignore HIGH = game system, and toy

Stage 4: end of day at school

- Scene is framed in a wide shot from the back of the classroom, over the shoulder of the character, facing the teacher. The teacher is summarizing all of the assignments for tomorrow and ongoing (long-term) assignments & writing them on the board. As the teacher finishes, the camera zooms back to show more of the room and the objective comes up
  - Objective: "Get home with everything you need tonight."

        - Bonus objective: “Get to the bus line in time to sit next to your friend with the game system.” [everyone wants to sit next to that kid right?! ;)]
    - Focus SEQUENTIAL = homework summary on the board > planner >< pencil > (relevant) book(s) >< worksheets folder > backpack > door
    - Ignore HIGH = kid folding paper airplanes, window, novelty erasers, class pet (gerbil), comic book/novel
    - Ignore LOW = other students (each ‘ignored’ individually), pencil sharpener with a dull pencil

References

Barkley RA. Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. Psychol Bull 1997; 121:65–94

Bloom, B. S.; Engelhart, M. D.; Furst, E. J.; Hill, W. H.; Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals*. Handbook I: Cognitive domain. New York: David McKay Company.

De Zeeuw, P., Weusten, J., van Dijk, S., van Belle, J., & Durston, S. (2012). Deficits in cognitive control, timing and reward sensitivity appear to be dissociable in ADHD. *PloS One*, *7*, e51416.

American Psychiatric Association: Diagnostic and Statistical Manual of Mental Disorders, 5th edition. Arlington, VA., American Psychiatric Association, 2013.

Freed, J & Parsons, L. (1997). Right-Brained Children in a Left-Brained World. New York, New York: Fireside.

Jan L. Plass, Bruce D. Homer & Charles K. Kinzer (2015) Foundations of Game-Based Learning, Educational Psychologist, 50:4, 258-283

Karp, E.M. & Karp, H.B. (2001). Color associations of male and female fourth-grade school children. The Journal of Psychology, 122(4), 383-388.

Kazdin, A. E. (2011). Evidence-based treatment research: Advances, limitations, and next steps. American Psychologist, 66, 685– 698. doi: 10.1037/a0024975

Martinez, M. E. (2010). Learning and cognition: The design of the mind. Boston: Merrill.

Mayer, R. E. (2001). Multimedia learning. Psychology of learning and motivation, 41, 85-139.

Power, T. J., Werba, B. E., Watkins, M. W., Angelucci, J. G., & Eiraldi, R. B. (2006). Patterns of parent-reported homework problems among ADHD-referred and non-referred children. School Psychology Quarterly, 21, 13–33.

Schunk, D. H. (1996). *Learning Theories (2nd ed.)*. Englewood Cliffs, New Jersey: Merrill, an imprint of Prentice Hall.

Shiels, K., Hawk Jr., L. W., Lysczek, C. L., Tannock, R., Pelham Jr., W. E., Spencer, S. V., … Waschbusch, D. A. (2008). The effects of incentives on visual-spatial working memory in children with Attention-deficit/Hyperactivity Disorder. *Journal of Abnormal Child Psychology, 36*, 903-913.