GAME DESIGN DOCUMENT

ASTRO ATTENTION

GROUP 9

Davide Console (10672372)
Diana Nigrisoli (10824967)
Laura Pozzi (10868694)
Noemi Manzo (10595959)
Raffaele Berzoini (10607946)

Table of contents

Game overview

Game Analysis

Astro Attention is a game that is thought to help children with ADHD to familiarize and train on a Stroop test in a fun and engaging context.

Mission Statement

In Astro Attention, you'll complete mini games that test your attention and reaction time. These challenges are specifically designed to help improve these skills, making Astro Attention not only a fun way of spending your time, but also an effective tool for training and development. So put on your space suit and get ready to blast off into the unknown in this space-themed adventure that's out of this world!

Genre

Serious game based on Stroop effect.

Platforms

The game is available for pc and android tablet and smartphone.

Target Audience

Astro Attention is thought for people with ADHD as it exploits the Stroop effect to record reaction times related to response inhibition of the player. Given that the Stroop interference effect seems to be immune to age [1], we decided to focus on a target audience with age between 8 – 11 years old, hence the game settings is developed to specifically engage children. The player needs to be older than 8 because certain levels of reading skills are needed to enjoy the storyline. Moreover, the final System Usability Scale questionnaire has been adapted for that age range [2].

Storyline & Characters

The main character is an astronaut that is going back to planet Earth, but he is forced to interrupt his journey due to a spaceship damage. He decides to stop by two close alien planets and ask for help. In each of them he will meet the planet Kings: the Snail King and the Green King. Unfortunately, by the Galaxy law, nobody does anything for free and to get his spaceship fixed he will have to overcome some challenges launched by the two demanding rulers. Therefore, for every planet the astronaut will complete a minigame. The end of the game is left open to allow the user to play each minigame multiple times and improve his performance. This choice has been taken in sight of the purpose of this game: cognitive training for children affected by ADHD.

Game Aesthetics

Astro Attention aesthetic is based on simple and colourful 3D design. The settings and characters present low-polygonal shapes, giving a cartoon-like style to the environment. The background music changes in every scene: in the map is more relaxed, while minigame 1 and minigame 2 present a more fast-paced sound that should help the player feel more involved in the game. The general mood of the game is positive, no negative feeling should be triggered.

User Interface

The UI is kept very simple and clean in order to focus the attention of the player to the game itself. The map is composed by three buttons: two represented by the planets related to the minigames and one for the *Settings* (language and logout), located on the top left corner of the screen (Figure 2). During both minigames, the user can find some information about the minigame rules, the skip-tutorial button and the Menu button shown on the HUD (Figures 6-13).

Control Scheme

The game starts with the userID selection and a *Start* button which, when pressed, checks the validity of the inserted ID (Figure 1). The *Settings* button triggers another interface to change language and logout. When *Start* is pressed the map of the game is displayed. When one of the two planet-buttons is pressed, the spaceship starts flying towards them. Then a Play button triggers a brief dialog of the narrative scheme. In both minigames there is a Menu button to go back to the map. At the end of the minigames there is a simplified SUS [2] and a Submit button to save data. The game is playable both on a mobile using touch inputs and on desktop using mouse and arrow keys. It is possible to skip the tutorial phases by pressing the *SkipTutorial* button or to keep reading the instruction by touching/clicking anywhere on the screen to make the dialogs go on. The instructions are updated at runtime based on the execution platform.

Doctor user interface

Since this game is designed for cognitive training and clinical purposes, there is an extra interface dedicated to the clinician, which can be accessed by logging-in with the ID equal to "Doctor". Then the GUI is updated to another interface to send the collected data for every player in each minigame (mean and standard deviation of reaction times, number of errors, final score) to the inserted email address. This is done via the Send button (Figure 3).

Minigame phases principles

Each minigame is divided into four phases of increasing difficulty. The first two are very intuitive and allow the player to take confidence with the gameplay, they act as control environment with congruent stimuli. The other two are more difficult and are designed following the Stroop effect with incongruent stimuli. The player needs to inhibit one stimulus and focus on the other in order to give the right answer. This division of minigame levels was done following the study of Gray-Mason et al. [3]

FIGURE 1: LOG-IN INTERFACE

FIGURE 2: MAP INTERFACE

FIGURE 3: DOCTOR UI

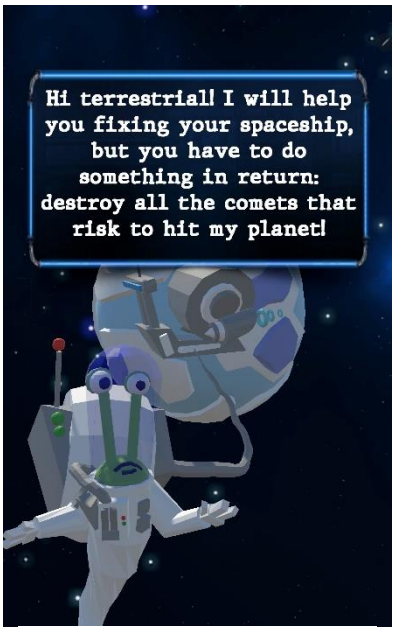

FIGURE 4: SNAIL KING

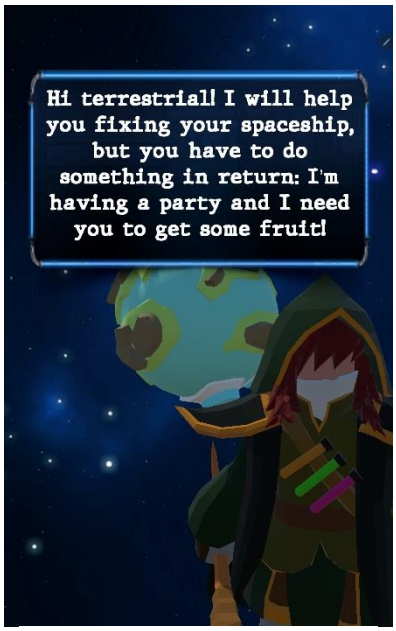

FIGURE 5: GREEN KING

Game Play Minigame1 – Direction Game

Overview and guidelines of Gameplay

This minigame is a first-person shooter game. The game is based on a directional Stroop effect. In the classic test the subject states the direction in which the arrow is pointing suffering interference from the incompatible word. [4] This game is a catchier revisitation of the same concept. Since the game is created for children, it is characterized by non-violent content.

Player Experience

Save the Snail Kingdom from certain doom! A family of destructive comets is heading towards the ice planet, and it's up to you to stop them. As you join forces with the Snail King and take control of your spacecraft, a helpful tutorial robot will introduce you to the buttons that will allow you to blast away the comets. The space in front of you is divided into four sectors, and it's your job to eliminate the comets before they reach the planet. Four phases await, each with its own unique set of instructions. Show off your skills and earn a high score as you complete the questionnaire at the end of the mission. Can you become a hero and protect the Snail Kingdom from the comet threat?

Game Objective

As the pilot of a sleek spaceship, the mission is to select the correct button and blast the incoming comet out of the sky. Every correct choice adds to the player personal score, which will be tallied at the end of the four stages of the minigame.

Gameplay Mechanics

In this minigame, the player controls the gun of a spacecraft that faces incoming comets from all directions. From the second phase onwards, these comets will have a visible direction (i.e., a tail) and it is the player's job to choose the correct button in the cockpit to eliminate them. The cockpit screen displays the rules for each phase, helping the player make the right decisions. As the comets are destroyed, the player will be rewarded with a distinct sound and visual effects, such as an explosion animation and a shaking background. It is crucial for the player to select the right button before moving on to the next challenge in order to emerge victorious.

Button / Touch Input	Performed Action
Touch or mouse left click on cockpit buttons	Shoot a laser in the direction of the comet if the pressed button is the correct one.
Scoring System	
Points	**Score formula for each comet hit**
Phase one and two	$1 + 1 \times \left(5 - min(\text{reaction time[s]}, 5)\right)$
Phase three and four	$1 + 2 \times \left(5 - min(\text{reaction time[s]}, 5)\right)$
Errors	**Penalty for each wrong button selection**
All phases	Score is not affected but number of errors is stored for later analysis by the doctor.

Phase Design.

Phases	
Phase one Congruent position (Figure 6)	It represents the first control environment: the player must consider only the star position. On the screen will appear a star without tail in a specific sector. The player must select the button corresponding to the sector of the comet.
Phase two Congruent direction (Figure 7)	This phase is also quite simple. It represents the second control environment, in which the player must consider only the direction. On the screen will appear a star with a tail in the center of the screen, to avoid bias on the position. The player must select the button corresponding to the direction in which the comet is going.
Phase three Incongruent direction (Figure 8)	This phase is the first incongruent one, the difficulty increases. Each comet is characterized by both a position in the space and a motion direction. The player must select the button corresponding to the position in which the comet is going, not considering the sector in which the comet is.

Phase four Incongruent position (Figure 9)	This phase represents the second incongruent one. Each comet is characterized by both a position in the space and a motion direction. The player must select the button corresponding to the sector in which the comet is, not considering its direction.

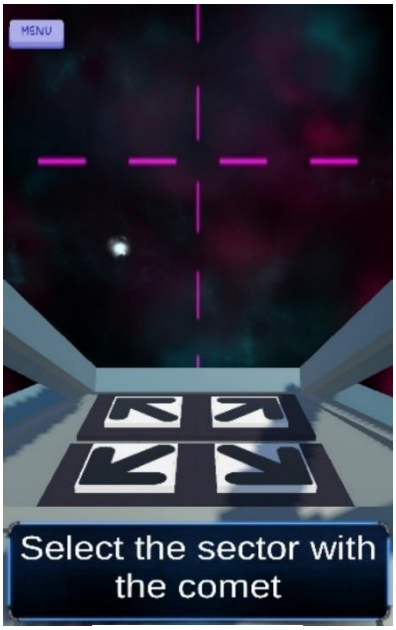

FIGURE 6: PHASE 1

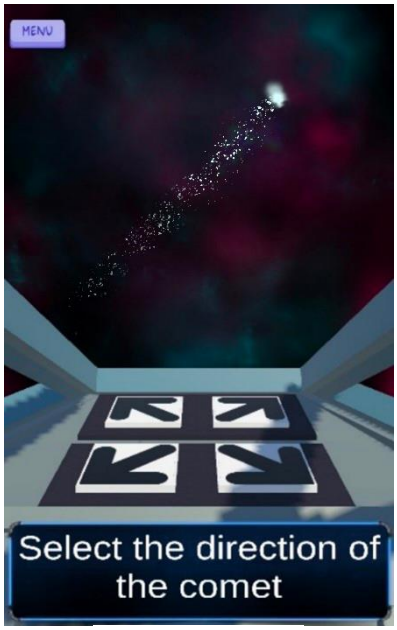

FIGURE 7: PHASE 2

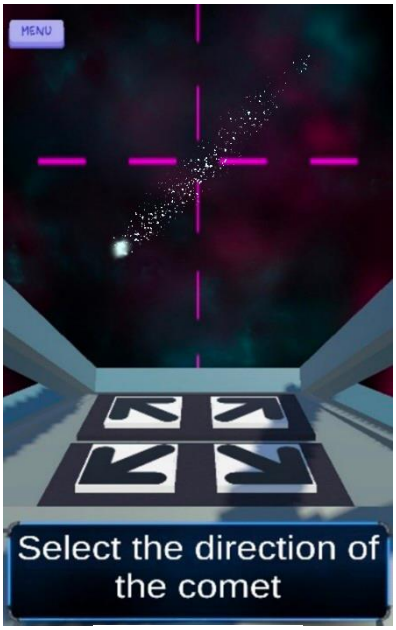

FIGURE 8: PHASE 3

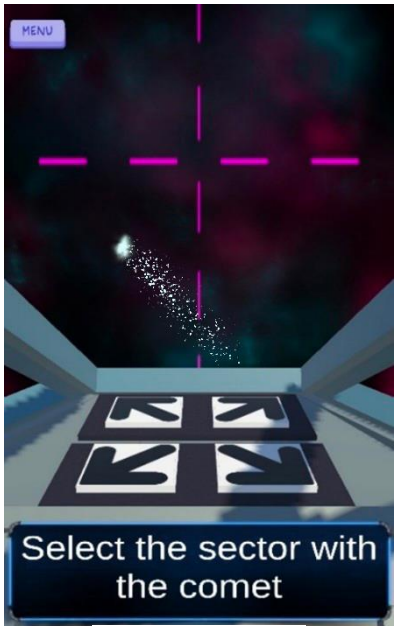

FIGURE 9: PHASE 4

Game Play Minigame2 – Fruit Game

Overview and guidelines of Gameplay

This minigame is an endless run game. It is a revisited version of the classic Stroop Colour and Word test, where the words are substituted by images of fruits and vegetables, to which a certain semantic colour is associated (e.g., the colour red is associated to strawberries). We developed the game dynamics taking inspiration from the Colour Kart Racing Game [5]. Since the game is created for children, it is characterized by non-violent content.

Player Experience

Get ready to blast off on a juicy adventure through the Fruit Planet! In this fast-paced game, you'll need quick reflexes and a keen eye to collect all the delicious fruits for the Green King's party. Fly your spaceship through the colourful portals using the fruit images and the instruction on the top of the screen to guide you. With each new phase, the challenges get tougher, but with the help of the handy tutorial robot, you'll have all the skills you need to succeed. At the end of the fourth phase, once you've received your score, it's time to fill out the questionnaire. Ready to become the ultimate fruit-collecting champion of the universe?

Game Objective

The objective of the game is to select the right portal in order to catch the correct fruit or vegetable. When the right choice is made, the player increases his personal score that will be visible just at the end of the four phases of the minigame.

Gameplay Mechanics

In this minigame, the player has control of the horizontal position of the spaceship, while it moves towards the pathway and to the portals with a constant velocity. The player's task is to fly through the correct portal in order to collect the fruit. On the top panel the rules for each phase are displayed and before every phase there is a small tutorial that helps understand how to select the right portal in relation to the fruit image. The game keeps moving on regardless of the selected portal. At each phase the user is informed of the correctness of his decisions by a distinct sound and an icon that appears next to the fruit.

Button / Touch Input	**Action Performed**
Touch or left/right keyboard arrows	Change the horizontal position of the spaceship
Scoring System	
Points	**Score formula for each portal passed through***
Phase one and two	$\text{score} \times (T - \text{reaction time[s]})$
Phase three and four	$2 \times \text{score} \times (T - \text{reaction time[s]})$
Errors	**Penalty for each wrong button selection**
All phases	Score is not affected but number of errors is stored for later analysis by the doctor.

*where score can be equal to 1 (correct answer) or 0 (wrong answer), and T is the time interval between two sets of portals spawns.

Phase Design

During the game phases, the fruit can be coloured with colours equal or different from its semantic one and the player needs to select one over three possible colour alternatives, depending on the request.

Phases	
Phase one: Congruent semantic colour (Figure 10)	This phase is the easiest one. It represents the first control environment. The fruit appearing on the panel is coloured with its real semantic colour (e.g., *bananas* are yellow). The player has to select the portal with that same semantic colour (e.g., *yellow*).
Phase two: Congruent visible colour (Figure 11)	This phase is also quite simple. It represents the second control phase. The fruit appearing on the panel is coloured with a different colour from its semantic one (e.g., cherries are *purple*). The player has to select the portal with that same visible colour (e.g., *purple*), regardless the semantic one.

Phase three: Incongruent semantic colour (Figure 12)	This phase represents the first incongruent phase and the difficulty increases. The fruit appearing on the panel is coloured with a different colour from its semantic one (e.g., the *carrot* is green), but the player has to select the portal with the real semantic colour of that fruit (e.g., *orange*). Hence, in this case the player needs to inhibit the stimulus given by the visible colour and choose the semantic one.
Phase four: Incongruent visible and semantic colour (Figure 13)	This phase represents the second incongruent phase and the most difficult one. Now the fruit appears both on the top panel and on the portals, for a total of 4 coloured fruits, with colours different from their semantic ones. The player has to choose the portal with the fruit that has its semantic colour like the one colouring the fruit on the top panel, without being distracted the by image of this fruit. Hence, in this case the player needs to inhibit the stimulus given by the image of the fruit in the top panel and focus on its visible colour. Instead, for the fruits in the portals he has to focus on their semantic colour and inhibit the visible one. For example: if on the panel there are *red* blueberries, the right portal will be the one with the *cherries*, as their semantic colour is red.

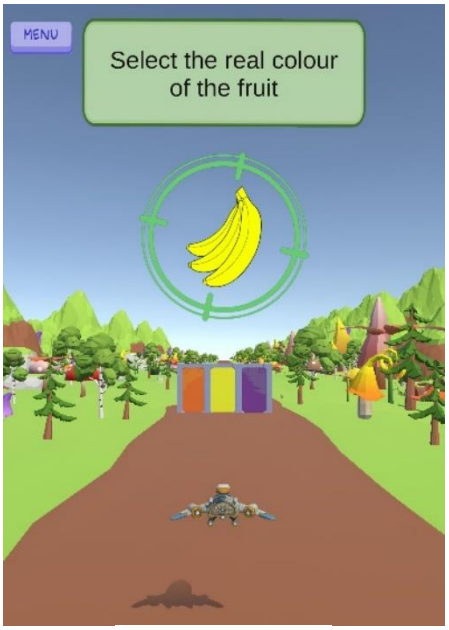

FIGURE 10: PHASE 1

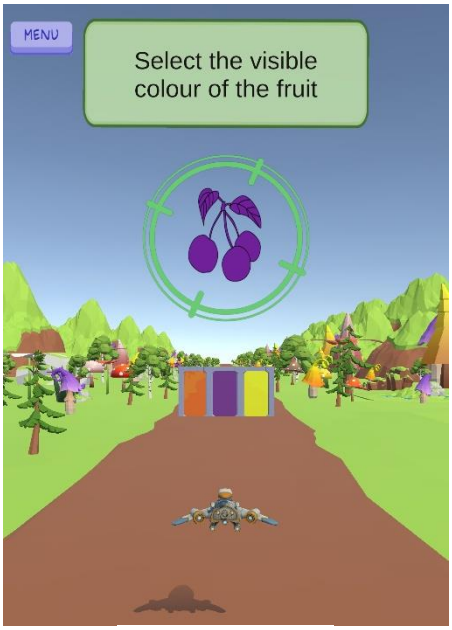

FIGURE 11: PHASE 2

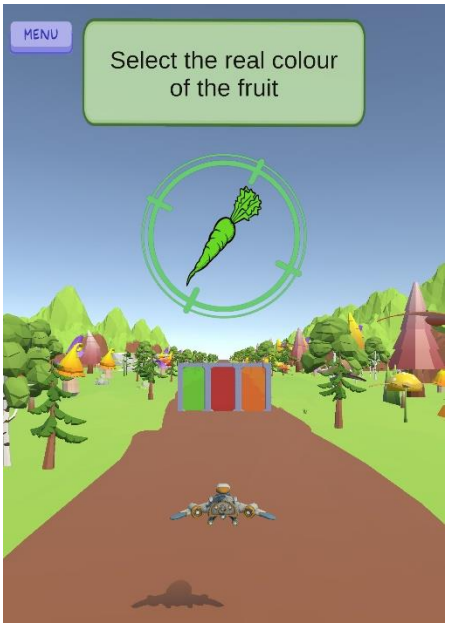

FIGURE 12: PHASE 3

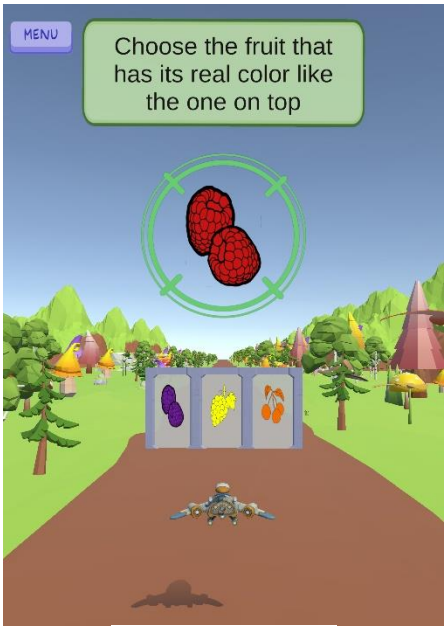

FIGURE 13: PHASE 4

References

[1] K. S. a. P. Verhaeghen, "ADHD and Stroop interference from age 9 to age 41," *Psychological Medicine,* vol. 11, no. 38, p. 1607–1616, 2008.

[2] C. Putnam, M. Puthenmadom, M. A. Curerdo, W. Wang and N. Paul, "Adaptation of the system usability scale for user testing with children.," in *Extended abstracts of the 2020 CHI conference on human factors in computing systems*, Honolulu, HI, USA, 2020.

[3] R. P. Gray-Mason, A. J. Coultas and A. T. Bayrak, "Observing the Stroop Effect within a First Person Shooter," in *Australasian Computer Science Week Multiconference*, Dunedin, New Zealand, 2021.

[4] C. M. MacLeod, "Encyclopedia of color science and technology," 2015, pp. 1-6.

[5] [Online]. Available: https://www.cokogames.com/color-kart-racing-game-stroop-effect/play/.

GitHub repository

https://github.com/DianaNigrisoli/AstroAttention.git