

Protocol for Conducting Serious Games in Virtual Reality with VR Headsets

This protocol is intended for professionals working with children with communication disorders.

Regarding the use of conversational artificial intelligence in serious games in virtual reality, the key principles described in point 3 of the Ethical Framework under the ATLog project should be applied (<https://atlog.ir.bas.bg/en/resultati/etichna-ramka>).

Contraindications for the Use of Serious Games with VR Headsets:

The use of VR headsets is contraindicated or requires mandatory consultation with a physician in the following cases:

- *Epilepsy*: Light effects and 3D models may trigger seizures even in people without a history of the condition (more common in individuals under 20 years old).
- *Visual abnormalities*: Existing problems with binocular vision.
- *Medical conditions*: Heart diseases, psychiatric disorders, or vestibular system disorders.
- *Age*: The child must be at least 5 years old.

Preparation Before Conducting an Intervention Through Serious Games with VR Headsets

- **Informed Consent**: A parent/guardian must sign an informed consent form before the child participates in serious games with VR headsets. The document must include detailed information about the contraindications for virtual reality gameplay and a description of the game procedure.
- **Age**: VR headsets must not be used by children under 5 years of age, as this is a critical period for visual development.
- **Individual Configuration and Hardware Setup**: The VR headset lenses must be cleaned for maximum clarity. The interpupillary distance must be properly calibrated. The VR headset must be individually adjusted for each child using calibration software before the session begins. This includes precise IPD adjustment to prevent eye strain. If the VR headset supports eye-tracking calibration, this option should be used for more precise adjustment. The child's position during gameplay must remain static in a low-dynamic VR environment. Game objects should be at eye level, and the field of view should not be wide horizontally. The angular size of the visible virtual environment should range from 90° to 110°.
- **Health Condition Check (Preliminary Discussion with Parents)**: The child should not participate if they are tired, sleepy, experiencing digestive problems, under strong emotional stress or showing symptoms of a cold, flu, headache, ear pain, eye strain, difficulty focusing, or blurred vision.
- **Preparation and Safety of the Serious Game Environment**: During serious games, the child is fully isolated from the real world and may be easily injured. Therefore. Before putting on the VR headset, check for furniture, windows, or sharp objects nearby and remove them if necessary. The child must remain seated on a stationary chair throughout the game. The floor covering should be soft. The sound volume should be controlled at low to moderate levels so that the child can maintain communication with the professional and avoid hearing damage.
- **Instructions**: The child should be informed that they may remove the headset at any time, the session will be short (up to 5 minutes), the goals and tasks of the game will

be explained, and they may choose whether to use controllers or interact directly with their hands.

- **Monitoring for Cybersickness Symptoms:** The child should be told to stop playing if they experience discomfort or any symptoms of cybersickness, such as paleness or sweating, rubbing the eyes, headache or mild dizziness, loss of balance, impaired coordination or disorientation, nausea or vomiting urges, stomach discomfort, increased salivation, burping, eye strain, difficulty focusing, blurred vision.

During the Intervention Through Serious Games with VR Headsets:

- **Environment:** Use a quiet, clean, and safe area without furniture within the movement range and with soft flooring.
- **Position:** The child must play while seated on a stationary chair, reducing the risk of falling and helping easier adaptation of the vestibular system.
- **Hardware:** The VR headset must be securely and comfortably fastened so the child sees a single, clear image.
- **Constant Monitoring:** The professional must stay close to the child and actively observe to provide the child physical support, if necessary, to monitor the child's emotional state and actions and to observe the child's and the game's current condition via real-time streaming. Streaming helps the professional monitor exactly what the child sees through the VR headset. The sound volume should be adjusted by the professional if needed.
- **Frequency of Use:** Children up to 10 years old should not participate in more than 2 VR sessions per week (up to 5 minutes each), even if they wish to continue. For children over 10 years old, 30-minute breaks between sessions are recommended, with no more than 2 sessions per day (up to 20 minutes each).
- **End of the Serious Game in Case of Discomfort:** The game must be stopped immediately if the child reports any of the above-mentioned symptoms of cybersickness.
- **Movement Speed:** If the child becomes emotionally excited and starts moving more dynamically during the game, movement should be minimized as much as possible to prevent nausea.
- **Communication:** A dialogue with the child should be maintained throughout the session to preserve the connection with the professional and reality, and to help the child feel safer and more confident.

Symptoms of Cybersickness to Monitor:

- **Nausea:** stomach discomfort, increased salivation, burping, urge to vomit.
- **Oculomotor Problems:** eye strain, blurred vision, rubbing the eyes, tearing, headache, difficulty focusing, double vision.
- **Vestibular Discomfort:** dizziness, vertigo, disorientation, loss of balance.
- **Physiological Signs:** excessive sweating, paleness or drowsiness.

After the Intervention Through Serious Games with VR Headsets:

- **Recovery and Monitoring:** After the game session, to support adaptation and assess the child's condition, the professional conducts a quick test for cybersickness symptoms. The answers are structured as a three-level Likert scale using emoticons (sad face, neutral face, smiling face).

- After the VR Serious Game: After removing the headset, symptoms may continue or appear hours later. The child should not be considered fully recovered immediately after the end of the session.
- Coordination Check: Parents/caregivers should carefully monitor the child after gameplay for reduced hand-eye coordination, balance disturbances.