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Perceptual Immersion, or What Computer Games Can Be Used for in Architectural Education

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Abstract

In this case study, the authors suggest that the introduction of computer games to architectural education may contribute to the broadening of architects' knowledge of the processes connected to sensory perception as well as the development of their perceptual awareness and sensory sensitivity. This thesis will be supported by the analysis of selected factors enabling sensory immersion (namely motor, vision and sound) in several fragments of two games: *Half-Life: Alyx* (three-dimensional game in Virtual Reality technology) and *Five Nights at Freddy's* (game for a desktop computer platform). The abovementioned competencies are essential in the process of designing both objects and spaces on a different scale and critical in projects for recipients, especially from the so-called spectrum of neurodiversity.

Keywords

immersion, sensory perception, neurodiversity, computer games, education

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Neuro-environment and Neurodiversity[1]

At the root of many failed implementations of contemporary architecture lie errors that arose at the stage of the design process. According to Krzysztof Kwiatkowski, among them are ineffective planning tools, the lack or inconsistency of objectivizing tools for the verification of design assumptions and the lack of verified (mainly empirically) theories explaining the interactions between the designed/built environment and users, including sensory awareness and perception (Kwiatkowski, 2015, p. 23).

The lack of understanding of the perception processes among representatives of the broadly understood design and the need to supplement the aforementioned areas of designers' education began to be commonly acknowledged at the turn of the 20th and 21st centuries. In 2003 American Institute of Architects in the United States established the Academy of Neuroscience for Architecture (ANFA).[2] In 2005, ANFA conducted research to assess the impact of office space on working conditions. As a result, eight indicators characterising the so-called neuro-environment (Security, Wayfinding, Cohesiveness, Outdoor Awareness, Ability to Retreat and Unwind, Expectations at Work, Support/Comfort, Pride of Work) have been added to the - Post Occupancy Evaluation (POE) procedure applicable in the USA (Kwiatkowski, 2015, pp. 31-32). It is suggested in post-occupancy documents, that the research in the field of cognitive neuroscience gives hope for a better understanding of sensory stimuli and their processing by the brain.

According to Hanna Bertilsdotter Rosqvist, Anna Stenning and Nick Chowan, in 20th and 21st centuries, science developed at least a few concepts/models of understanding and explaining human brains in terms of diversity in cognitive, affectual, sensory perception and behaviour of individuals in societies, which they collectively term as *neurodiversity* (2020, p. 1). The authors stress that the concept of neurodiversity is a reaction to medical models treating neurological differences in individuals' perception as defects, disorders or disabilities, which attempt to improve the "functioning" of individuals in terms of independence, economic productivity, and sociability and giving no attention to their lived experience, and well-being (Rosqvist, Stenning & Chowan, 2020, p. 4; see also Bowel, 2015; Carlson, 2010; Savulescu & Kahane, 2011;).

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[1] *Neurodiversity* as a concept originated as "(…) a movement among individuals labeled with autism spectrum disorders (ASDs) who wanted to be seen as different, not disabled. The first use of the word «neurodiversity» in print was in an article by journalist Harvey Blume published in the Atlantic, in September 1998." (Armstrong, 2010, p. 6).

[2] Further and more detailed information on the webside: https://www.anfarch.org/

Concerning the above arises a question: To what extent are architects familiar with sensory perception and neurodiversity and how is their knowledge implemented in architecture and urban planning? Is education on sensory perception present in the curriculum of architectural studies, and through what methods and technologies is it possible to implement such education? For user-friendly and just (in terms of justice, just cities) design, awareness of neurodiversity issues and sensory perception seem to be among the essential competencies that an architect should have. Advanced technologies such as eye tracking and neuroimaging (for example, fMRI - functional magnetic resonance or EEG - encephalographic measurement), used by scientists to collect data and study the perception processes, are expensive and not commonly accessible, which is a barrier in terms of introducing them into the education (Kwiatkowski, 2015, p. 31).

In this article, authors would like to argue that including computer games in architectural education, especially those in which immersion is possible (not only visual but also motor, sonic and affectual), is one of the available possibilities that could partially fill the existing lack, even if they were not created for that purpose.

Sensory Immersion/Emersion in Virtual Reality

Sensory immersion, in relation to computer games, means the phenomenon of arousing, through technological devices, sensory impressions in the user, accompanied by physiological body reactions (Fox & Bailenson, 2009, as cited in Koziński, 2016, p. 1). Various classifications of types of immersion can be found in the literature on the subject. For example, Staffan Björk and Jussi Holopainen distinguish four types of immersion: sensory-motor, cognitive, emotional, and spatial (Björk & Holopainen, 2005, p. 205, as cited in Auguścik, 2022, p. 8).

Immersing in computer games means cutting the connection with the physical world and diving, through sensory perception, into a virtually created environment (Heim, 1993, p. 153). The state of immersion does not only trigger a physiological reaction in the human body. The nature of perception is neurocognitive. Thus, in addition to sensory processes, the artificially created virtual and immersive reality also involves higher-order cognitive functions.

The opposite of immersion is emersion, the reverse phenomenon from the state of immersion (Kubiński, 2015, pp. 161-176).

The intensity of the immersive experience depends, among other things, on the technology (both hardware and software). In terms of hardware, for example, thanks to Data-Gloves, the user can provide a specific amount

of data to the game's virtual environment and interact with and in it. Currently, the most advanced technology is Virtual Reality (VR) generated with the help of Head-Mounted Display (HMD). It has a built-in display enhancing the stereoscopic vision of space, following the movements of the head. It also has touch controllers and speakers (Ryan, 1999). Space realism, in terms of the VR technology and perception, is based on adequately modelled lighting, which ensures the experience of depth (three-dimensionality; Visual Form, n.d.). The quality of graphics is both hardware and software dependent, as well as image rendering in real-time and intuitive movement mechanics (Epic VR, 2017).

According to researchers, immersion is also strengthened by the player's first-person perspective, enabling interaction (which means identifying players with the game's main character) in the generated game environment (first-person view). It is strengthened by the digital representation of the involved body parts (hands, face, feet), the dynamics of the characters' movements, simulations of environmental physics, and finally, sensory activity - the influence of the environment on the various senses of the individual, including realistic sounds dynamically reflecting current situations, spaces, phenomena, and experience (Malbos et al., 2012; Schubert et al., 2001, as cited in Koziński, 2016, pp. 2-5).

VR games differ significantly from games for desktop computers or consoles regarding the player's mobility, namely kinetic immersion. Moving in VR allows gaining knowledge about the nature of the neurocognition of perception, for example, in the form of the experience of the physiological sensation. An example of such embodied knowledge can be experienced by users nausea, comparable with motion sickness, related to contradictory information received by the player's brain at a given time, as in a situation when the player's eyes register their movement during the game because it changes its position in the virtual world. At the same time, the player's labyrinth signals that the body is standing still.

All kinds of immersion, similarly to the body receiving stimuli from the environment in the physical world, are accompanied by affective reactions (Koziński, 2016, pp. 2-5).

Sensory Immersion in Computer Games: Case Studies[3]

1. *Half-Life: Alyx* (only for VR)

In *Half-Life: Alyx*, a highly immersive factor is the intense action set in the ruined Black Mesa science research institute, invaded by newcomers from an alien dimension. The game's narration makes the user neurocognitively involved from the beginning. A kind of interdimensional police, named Combine, invaded the Earth and enslaved the entire planet. The official surrender of the people takes place at the UN building in New York (Borealis, n.d.). Since then, the human population has lived under the supervision of Combine. Its members oversee the streets and punish anyone who disobeys. They are brutal and unpredictable. The user takes on the role of Alyx Vance, who, together with her father, Elim Vance, tries to defeat the forces of Combine.

The environment of *Half-Life: Alyx* is highly educative regarding the in-depth kinetic, visual and sonic exploration of the environment (in terms of Gestalt principles) and direct interaction with items. The user is presented with a futuristic city with a giant tower in the middle - the Citadel. Its structure resembles a massive metallic skyscraper, and its height is about two kilometres. Many of Citadel's elements are movable (Borealis, n.d.). In the distance, one can hear people talking and robots working. The radio next to the player (main character) is the first thing that draws attention (cognitive function). The player can switch the station and pull the antenna out. Various cans, boxes and bottles are lying around. One can all pick it up, examine its textures and - finally - put it back in its place or throw it away. All these created sounds seem to be real for player. Bottles can be smashed against a wall, and larger boxes must be lifted with both hands as if they had their weight. The advanced physics of objects was used here and accurately visualised. Immersion here is strenghtened by the possibility of unlimited tactile exploration of the environment by the player, as they can interact with any object or surface, gaining physical impressions and strengthening emotional responses. The user is accompanied by the illusion of embodied presence in the game.

[3] The description of the both following case studies is a reworded and abridged excerpt of the description of the both games contained in Katarzyna Auguścik *Immersja w grach komputerowych i jej oddziaływanie na gracza* [*Immersion in Computer Games and Its Influence on Player*] (Auguścik, 2022, pp. 23-37). Permission by the author.

Sound Immersion: *Jeff* Level

At the *Jeff* level, player (main character) meets the blind zombie, titular Jeff. Due to impaired vision, Jeff has acute hearing. After entering the said level, in the safe distance position, the player becomes familiar with the opponent's mechanics and methods of operation: the sound of a crashing bottle makes Jeff follow the noise caused by it. Jeff is guided only by the sound source.

During the game, the player is forced, in search of these bottles, to move around the room filled with toxic vapours, which, when inhaled, cause the main character to choke and cough violently. The coughing simulation is designed in a way that causes immersed players to form a habit of covering their mouths in the physical world outside of the game (proof of immersion). Moreover, the player (overloaded with stimuli) outside the game/in the physical world holds their breath in a moment of accelerated action or tries to move to a minimum extent so as not to make noise.

In the game, the player is primarily forced to traverse tight, dark, claustrophobic rooms and corridors, which triggers highly emotional/affectional responses. If the player stays in one place for too long or makes too much noise, it will immediately attract the hostile aliens' attention. Ventilation shafts and cabinets may be used as hiding places for the player, but they are not always the safest option.

2. Sound in *Five Nights at Freddy's*

Five Nights at Freddy's series is a survival horror game by American game developer Scott Cawthon[4] (Augusik, 2022, p. 31). It consists of five games/episodes. The player takes on the role of a night watchman, who, during their watch, must defend themselves against the attacking ghost-like creatures (animatronics) for the titular five nights while not losing all electricity reserves in the dark spaces of the restaurant.

Sound listening, vision, and sensory information integration[5] are the most critical factors in the series. *Five Nights at Freddy's 1* (2014) does not use sound as a material for creating ambience or an atmosphere; it does not serve as entertainment or as a background - it is a key factor in the game, a way and a hint to deal with the challenges and puzzles in the game.

The most common and characteristic sounds that can be heard in the first part of the game are the sounds of breaking pots and pans. They are indispensable for completing the tasks set by the game, especially since

[4] According to produres's data retrived from https://m.imdb.com/name/nm6926569/ (accessed on 05.04.2022).

[5] The term explained in the article's conclusions.

the player is able to hear them without using the camera system. As the challenge begins, the intensive sounds are experienced as stressors. Still, as the player becomes accustomed to them, they start to serve the purpose of a source of information, as they get louder when the player looks at a kitchen camera. An example of a player using sound as a source of information may be a situation in which the Chica chicken, one of the four animatronics, is not visible on any of the cameras. By listening to the noise, coupled with the inability to see the animatronics with cameras, the player may come to the conclusion that Chica is currently in the kitchen and does not pose any threat to them yet. Another sound that is a potential source of information in the game is the laughter of the animatronic bear, Freddy, which signals him passaging between different rooms. The player can hear this sound regardless of the cameras. At first, players tend to perceive it as threatening because it resembles mockery. Seeing Freddy on cameras is challenging, so to save electricity, it is easier for players to focus on the sound of Freddy's laughter and count them to indicate how close he is to their position (Scruffy, 2020).

Other in-game sounds are intended to create patterns but not to give the player an advantage. Sounds of camera crushing occur as the animatronics suddenly move. Some sounds provide erroneous information or jam valuable sounds. For example, the sound from the camera is so distorted that it is difficult to conclude anything from it. Another distraction is the electric fan's sound in the office. The device makes a buzzing noise, stressing the player and preventing them from receiving the necessary information. If the player looks at the cameras, the fan will be muted, but such action costs the player valuable energy resources. Other sounds that are often confused with clues by the players are phone calls recorded by an employee named Phone Guy. On the first night, Phone Guy introduces the player to the general situation in the pizzeria and what actions must be performed to stop the animatronics. As the game progresses, the player recognises that during these phone calls, the game pauses for a few moments to increase the clarity of the content heard. However, in time, the player realises that the animatronics are moving during time spent on phone calls, and the calls are progressively providing less and less favourable information.

The sounds heard at the end of the game can be divided into three groups. The first occurs when, due to carelessness, the player allows animatronics to enter the office. The loss of the ability to turn on the light is signalled by a short, concise sound of a breaking switch and the sound of animatronics stepping into the room. The second group signals winning the game when the player is able to hear the bells, sounds of praise and children cheering, which are then cut off by silence as the next night (the

next stage of the game) begins. The last, third type of sound occurs when the remaining electricity supply is spent, turning off all electrical devices (accompanied by a long, disappearing hum). These sounds can be associated with comfort because they signal, that the player is free from the compulsion of constantly checking cameras and closing the door to stop the threat.

In *Five Nights at Freddy's 4* (2014), the player has to rely more on sound than in previous game versions. The game takes place at night in a children's bedroom, which is much quieter than the rooms in previous games. The player can only hear a soft hum, an old clock ticking in the distance, and a sound of breathing. If the player hears breathing while checking the door, this suggests that the animatronic is standing in front of it, so the door must be closed quickly. The difficulty in this game is determined by the volume of the sounds heard; for example, the breaths emitted by the animatronics are hushed; sometimes, it is challenging for the players to hear and identify them (Scruffy, 2020). These mechanics mean the player has to increase the sound volume, which causes even more anxiety and heightens player's awareness.

Conclusions

Selected Arguments for the Use of Computer Games for Architectural Education on Perception and Neurodiversity

1. As outlined above, the games can be used to enhance sensory integration or reduce sensory deprivation. Both processes take place in the brain without the participation of consciousness. *Sensory integration* enables the reception and interpretation, namely giving meaning, prioritising and evaluating sensory stimuli, both from the environment and one's own body, directing attention to them and enabling focus and action. It is the basis of social behaviour and education. Variation in any of these functions may indicate a neurodiversity case (in the social model, but in the medical model, it would be called *sensory processing disorder* or *sensory integration dysfunction)*, manifested by hypersensitivity (or too low sensitivity) to sensory stimuli. Computer games allow the architect to experience how the body reacts to high or low-intensity stimuli and observe the extent to which they affect the well-being of the body (Polskie Stowarzyszenie Terapeutów Integracji Sensorycznej, n.d.).

2. Joanna Erbel writes: "If we were to find one concept that could describe the problems experienced by atypical [normative term describ-

ing neurdiverse individuals in medical model – addition by authors] people, it would be stimulus intensity. The excess of stimuli can overwhelm you, (...) the lack of them - makes you dull." (Erbel, 2022, p. 89, transl. from Polish N. Cymorek). Computer games (as analysed above) may help direct architects' attention to the problem of cognitive overload, which is especially uncomfortable for neurodivergent individuals. Sensory factors in games, notes Koziński (2016, p. 2), stimulate various sensory channels simultaneously: the greater their diversity, the stronger the sensations and reactions of the organism, also in terms of distraction/dissociation. Both analysed games are rich in unpleasant sounds: shattered glass, flashes of light, computer equipment and machines causing clinks, squeaking equipment, humming and rumble of machine guns, screams and noises. All this makes us realise how important it is to regulate the sound environment due to psychosomatic reactions, which may also be accompanied by anxiety, leading to an impaired sense of security and communication problems.

3. Discomfort and distraction can also be caused by overly diverse and expressive textures, like those experienced in in-game environments. The stressed organism responds with irritation instead of relief, loss of attention, concentration and productivity.

4. Frequent surprising with stimuli (i.e., at the same time, the available visual richness of the designed architecture and spaces in virtual world of the games) allows drawing the architect's attention to the need for space sequencing, defined by Magda Mostafa as logical, predictable and legible sequences of space that allow predicting what will happen next. For some neurodivergent individuals, it is essential to transition from one type of space to another smoothly, to change from one kind of activity to another gradually, and to gain the possibility of getting used to the changing intensity of stimuli and sensorically neutral spaces with an adjusted level of stimuli (Aspectss, 2015).

The current architectural education emphasis is mainly on visual perception on a detailed characterisation of the formal properties of the environment, including the constructed objects. However, the formal functionality of objects and spaces do not coincide with the perceptual functionality of the human body. In contrast, technologies and computer games utilise knowledge of not only external but also internal body perception and cognitive processes, differentiated in every individual. Thus, they can facilitate architects' opening to cognitive diversity and sensory pluralism. "Opening up to neurodiversity is (...) accepting as the norm that different people feel differently, that is, there is no such thing as a normal [in the normative sense - addition by authors] feeling of physical or social space." (Erbel, 2022, p. 89).

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