Concept of Ph.D. Dissertation

The role of player's flow in the complex skill learning

Justyna Józefowicz

Research goals

The purpose of the dissertation is to analyze the role of player's flow in the complex skill learning. Components of flow include intense and focused concentration, loss of reflective self-consciousness, a sense that time has passed faster than normal, “experience of the activity as rewarding, such that often the end goal is just an excuse for the process” (Nakamura and Csikszentmihalyi, 2014). From the beginning, flow research focused mainly on sports, which was justified by the measurability of the tasks. The first two decades of the 20th century has brought an equally attractive source of data - video games (Harris, 2021), which are highly engaging and overlap with many elements of sports, such as demands on perceptual, attentional and motor skills (Campbell et al., 2018; Pedraza-Ramirez et al., 2020). Investigating flow theory in games therefore seems a natural step. The question of to play or not to play no longer needs an answer. As homo ludens, we know: to play. All that remains is to answer the next two questions - *who* and *how*? The question: *who?* Does a person's "baseline setting" - cognitive function, personality, stress management, locus of control, intelligence or preference for the type of games - matter to his or her flow, and ultimately to the benefits he or she may derive from playing? The question: *how?* How to make games not only a stimulant (here we have success), but also, given their attractiveness and potential for engagement, an answer to learning difficulties or training of cognitive functions.

Therefore, the proposed dissertation focuses on three main research questions:

1. Will a player's level of flow be related to his RTS game performance measured by telemetric variables?
2. Are there behavioral and neurophysiological predictors that can identify a player's predisposition to achieve a higher level of flow?
3. Will the level of flow a player achieves during training implemented using an RTS game be related to the results obtained in a cognitive task?

Justification

The 21st century offers an unprecedented abundance of opportunities, among which - given the limited time of human life - we are trying to find our way. The consequences of this multiplicity are complex. The growth of choice skills is slower than the growth of options. Hence the search for mechanisms of functioning that will allow us to immerse ourselves in what we choose without a sense of loss and enjoy it fully, peacefully and without guilt. The holy grail of this search, one of the most positive and satisfying mental states, is flow (Jackson & Csikszentmihalyi, 1999), or the experience of being completely absorbed in the present activity, realized with a sense of lightness (effortlessness) and pleasure (Csikszentmihalyi & Lefevre, 1989). The person experiencing flow is focused, present in the here and now. Positive psychology's search has focused mainly on how this state can serve well-being and enrich people's lives (Csikszentmihalyi, 2000). Challenges generated by civilization changes over the past decades are expanding this area. Understanding the specifics of flow emergence, related to functional characteristics (motivation, sense of focus, self-confidence, among others), may be one of the answers to the question of how to manage one's own performance more effectively (Harris et al. 2021, Landhäußer & Keller, 2012), to switch off from activities other than the one chosen at a given moment - to the benefit of oneself and the tasks at hand. Flow can apply to a variety of life domains, but in the context of performance it has been studied most often in sports (Swann et al., 2016, 2017, Jackson & Kimiecik, 2008; Sinnamon et al., 2012), less often in music, chess, dance (Csíkszentmihályi and Larson, 1987; Csíkszentmihályi and Csíkszentmihályi, 1992; Csíkszentmihályi, 1993, 2000, 2014), or more recently also in the context of video games (Nah et al., 2014; Engeser & Rheinberg, 2008; Keller & Blomann, 2008, Campbell et al., 2018; Pedraza-Ramirez et al., 2020). Sports and video games combine demands on perceptual, attentional and motor skills. While sports are primarily based on physical activity, video game research offers hope for transfer, where the flow-performance relationship may apply to domains other than those based on physical exertion (Harris et al. 2021). Moreover, the issue of the specificity of computer games cannot be overlooked. Sports are available to everyone, but the effort required to put into them is sometimes disproportionate to the reward, which for many people is too high a threshold for entry. Meanwhile - often for these same people - the game rewards disproportionately to the effort. As a result, the game is an entity that can quickly

seize the player, remaining incomprehensible and inaccessible to non-players. It is not surprising, therefore, either the drastic pace of development of the game market (Limelight Networks, 2020, Acland 2020), or the fact that here, too, researchers - from psychologists to economists - are interested in trying to tease out answers from the game vs. player relationship, regarding the nuances of flow as knowledge that could become an element of rapid and powerful impact, including in fields far removed from games. Current research on games in the context of flow focuses specifically on 3 thematic areas: flow theory per se (Cowley et al., 2008; Su et al., 2016), addiction (Young 2017, Kuss 2013), and gamification, i.e. the application of game elements in non-game contexts (Deterding et al., 2011; Acland 2020). Regardless of the specific area of research, existing knowledge about the sources of flow and its effects, among other things, the flow-performance relationship does not provide clarity on either the strength, manner, or causal direction of the processes involved in the flow relationship (Moran & Toner, 2017; Swann et al., 2018). Given the potential for the weight of conclusions - both scientific and economic, e.g., what are the components of perfect performance (Swann et al., 2017), or whether flow can become the basis for interventions in sports (Aherne et al., 2011; Nicholls et al., 2005), researchers (Harris 2012) point to the need for an analysis focused on both the study of the history of flow and its directionality.

Scientific methodology

The longitudinal study included individuals recruited to participate in the bigger National Science Center project “Variability over time of neurocognitive effects of training with a complex task in the form of a strategic computer game” led by dr hab. Aneta Brzezicka (no. 2016/23/B/HS6/03843).

When deciding on the assumptions of the study, we tried to optimize its conditions:

- inviting participants who had no direct experience with video games
- a double-blind study
- an opportunity to look at participants' baseline settings (cognitive tests, fMRI, EEG, self-report questionnaires)

- an opportunity to look at the dynamics of changes that occur in their cognitive functioning while learning a video game (behavioral analyses, EEG)
- selection of a game, allowing analysis of specific components (StarCraft2)

Participants were randomly assigned to one of 3 groups (1 control group, 2 training groups). In the part of the study related to flow, only subjects from the training groups were included, since flow measurements were inseparable from game expierience . Thus, a total of 29 subjects participated in the study, randomly assigned to one of 2 training groups, differing in the complexity of the training environment: fixed (FEG) and variable (VEG).

At the outset of their approximately three-month stint in the project, participants underwent a series of behavioral, questionnaire, fMRI and EEG tests, and then entered the initial StarCraft2 training. After completing the training, they trained to play StarCraft2 for 30 hours over about four weeks. During the training, participants completed flow measurement questionnaires (up to 11 times, varied per person).

The project analyzed flow measurement data as astate (PFSS-2), with respect to:

- telemetry variables, indicating participants' behavior and progress in the game: control, total map explored, complex units made, minimaps right-click, unique hotkeys, workers made, actions in PAC, APM, perception action style, latency to first action, gap between PACs
- behavioral variables, indicating the dynamics of change in cognitive functioning: Task Switching, Stop Signal, Memory Updating, Visual Motion Direction Discrimination VMDD, Trial Making Test, d2-R, Visual Working Memory, Attention Window
- constants, positioning the participant as a person with certain predispositions: personality (NEOFFI), intelligence (Raven's matrix), copying with stress (CISS), locus of control (CwP), flow as a trait (DFSS)
- Star Craft II - video game, environment of the study
- variables, resulting from EEG and fMRI, which were also included as a baseline for behavioral data and declarative questionnaire studies.

The expected date of submission of the dissertation: February/ March 2023

References:

1. Acland, D.J. (2020). An Investigation of Flow Theory in an Online Game. Review of Behavioral Economics, 2020, 7: 317–336
2. Campbell, M. J., Toth, A. J., Moran, A. P., Kowal, M., & Exton, C. (2018). Esports: A new window on neurocognitive expertise? Progress in Brain Research, 240, 161–174. https://doi.org/10.1016/bs.pbr.2018.09.006
3. Csikszentmihalyi, M. (2000). The contribution of flow to positive psychology. In E. P. Seligman (Ed.), The science of optimism and hope: Research essays in honor of Martin (pp. 387–395). Templeton Foundation Press
4. Csikszentmihalyi, M., & Lefevre, J. (1989). Optimal experience in work and leisure. Journal of Personality and Social Psychology, 56, 815–822. https://doi.org/10.1037/0022-3514.56.5.815
5. Engeser, S., & Rheinberg, F. (2008). Flow, performance and moderators of challenge-skill balance. Motivation and Emotion, 32(3), 158–172. https://doi.org/10.1007/s11031-008-9102-4
6. Harris, D.J., Allen, K.,L., Vine, S.J. and Wilson, M.R. (2021). A systematic review and meta-analysis of the relationship between flow states and performance, International Review of Sport and Exercise Psychology, DOI: 10.1080/1750984X.2021.1929402
7. Jackson, S. A., & Csikszentmihalyi, M. (1999). Flow in sports. Human Kinetics.
8. Jackson, S. A., & Kimiecik, J. C. (2008). The flow perspective of optimal experience in sport and physical activity. In T.S. Horn (Ed.), Advances in sport psychology, 3rd ed (pp. 377–399, 474–477). Human Kinetics.
9. Landhäußer, A., & Keller, J. (2012). Flow and its affective, cognitive, and performance-related consequences. In S. Engeser (Ed.), Advances in flow research (pp. 65–85). Springer. https://doi.org/10. 1007/978-1-4614-2359-1_4
10. Keller, J., & Blomann, F. (2008). Locus of control and the flow experience: An experimental analysis. European Journal of Personality, 22(7), 589–607. https://doi.org/10.1002/per.692

11. Nah, F. F. H., Eschenbrenner, B., Zeng, Q., Telaprolu, V. R., & Sepehr, S. (2014). Flow in gaming: literature synthesis and framework development. International Journal of Information Systems and Management, 1(1/2), 83. https://doi.org/10.1504/IJISAM.2014.062288
12. Nakamura, J., & Csikszentmihalyi, M. (2014). The concept of flow. In *Flow and the Foundations of Positive Psychology: The Collected Works of Mihaly Csikszentmihalyi*. https://doi.org/10.1007/978-94-017-9088-8_16
13. Pedraza-Ramirez, I., Musculus, L., Raab, M., & Laborde, S. (2020). Setting the scientific stage for esports psychology: A systematic review. International Review of Sport and Exercise Psychology, 13(1), 319–352. https://doi.org/10.1080/1750984X.2020.1723122
14. Swann, C., Crust, L., Jackman, P., Vella, S. A., Allen, M. S., & Keegan, R. (2017). Psychological states underlying excellent performance in sport: Toward an integrated model of flow and clutch states. Journal of Applied Sport Psychology, 29(4), 375–401. https://doi.org/10.1080/10413200.2016.1272650
15. Swann, C., Keegan, R., Crust, L., & Piggott, D. (2016). Psychological states underlying excellent performance in professional golfers: “letting it happen” vs. “making it happen”. Psychology of Sport and Exercise, 23, 101–113. https://doi.org/10.1016/j.psychsport.2015.10.008