Think Aloud-method during fMRI to determine neuronal correlates of subjective experience of video game playing

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The subjective experience of video games and its consequences have been subject of public debate as well as of scientific research. Recently, neuroimaging has been applied to study the neural correlates of behaviour during video games [1]. Nevertheless, systematic research on game experience in general and the search for its neural correlates in special is still at its starting point and remains a fascinating topic for future investigations. To investigate central dimensions of video game experience we applied Think Aloud (TA), i.e. an introspective method to assess structured retrospective reflections on thoughts and feelings while re-watching one's own playing [2]. Originating from psychological research, the TA was developed from the much older introspection method. Introspection is based on the assumption that a person is able to observe his or her thoughts, feelings, and cognitive processes, as well as one is able to observe processes in the outside world. These skills can also be trained so that the subject can observe them in a systematic way and make them accessible to others by verbalizing them.

In 18 subjects we recorded functional magnetic resonance (fMRI) data during playing a first-person shooter game (Counter Strike: Source). In simple terms, fMRI is a technology in which the amount of blood flow in circumscribed brain areas is calculated on the basis of magnetic responses of hemoglobin. Blood flow in brain areas is closely correlated with neural activity in those areas, and increase or decrease of blood flow therefore indicates increasing or decreasing brain activation, respectively. After some training time outside the scanner room the subjects played a total of three game sessions (12 minutes each) during fMRI measurement. The TA sessions on the recently played game content took place directly after each session inside the scanner. This technique has three main advantages: First, it does not interrupt or disturb the game play itself as it would be the case if the players performed TA simultaneously during the play; second, the player still has the immediate impression of the recently finished session and can perform the TA in the same setting as the game play which facilitates memory effects; and third, fMRI can be measured during the TA session itself, giving insight into neural correlates of speech production, memory, and empathy. Participants were instructed to report whatever they want, but not to fall into a "description mode", i.e., to describe what is visible or audible in the game recording. We instructed them to focus mainly on two aspects: the difficulty of the game (*How hard/easy was the game play in the respective situation?*) and the aspect of subjective game enjoyment (*How much did you enjoy the game play in the respective situation?)*. At the end of each gaming block, the subjects watched a recording of their recently played sequence. They were instructed to verbally report continuously their estimation of difficulty and the amount of enjoyment they had during playing the respective scenes. The speech was recorded with an MR compatible optical microphone built as a prototype from the company Sennheiser Electronics (Wedemark, Germany). The microphone was attached to the radiofrequency head coil and its signal was filtered online to reduce the EPI noise of the scanning sequences. To this end the experimenter could listen to the speech in on-line mode and deliver visual prompts if necessary ("Please speak up!", "Please keep on talking!", and "Please focus on game enjoyment and game difficulty!"). The experimenter registered all commented events but also non-commented game events if they appeared relevant for the challenge and enjoyment of the game.

Since expressing one's thoughts verbally is not a common behavior, a 12 minutes test block outside the scanner took place, including detailed instructions and a training phase. The test block consisted of a 6 minutes playing session followed by a 6 minutes Think Aloud phase on the recently played sequence which could be repeated if necessary. The experimenter ensured that the subject had understood the instructions and was able to complete the task.

Evaluation of the Think Aloud was done by three independent raters (three undergraduate students at the RWTH Aachen University Hospital) and one supervisor independently to avoid subjective interpretation biases. For testing inter-coder reliability we used Krippendorff`s Alpha coefficient [4]. Intensive trainings yielded an overall inter-coder reliability of .70 - .80. The Flow concept [3] guided the content analysis of the game play recordings and of the Think Aloud comments. With statistical parametric mapping (SPM5), we determined neuronal networks involved in major experiential dimensions. Predominant cerebro-thalamic motor and visual networks reflected the categories, but experiential factures such as failure were associated with inhibition of the reward system (e.g., caudate nucleus). Positive and negative appraisal as reported in the TA also revealed circumscribed brain activation patterns. Thus the findings present a neurophysiological observer-independent validation of the method and the underlying psychological methods. We conclude that the Think Aloud method may help to disentangle the link between basic neuronal subsystems and human subjective experience as reflected by Think Aloud by offering a way to assess thoughts and feelings of a person during complex and interactive tasks and providing the basis for a structured, content-oriented data analysis.

References

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