Challenge Types in Videogame play

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INTRODUCTION
"Challenge" is a central play rhetoric from traditional schoolyard games to contemporary videogames. Additionally, challenge is often perceived a necessary constituent of games to begin with (see Avedon & Sutton-Smith 1971; Crawford 1982; Salen & Zimmerman 2004; Juul 2005). As a concept, it can be considered a type of task or problem, the difficulty of which depends on the performing person's skills, abilities, motivations and knowledge. Challenge denotes to the definitional element of uncertainty in all games, and to how player's performance is evaluated during gameplay and its activities. (Cf. Malone 1980; Iversen 2010; Costikyan 2013; Linderoth 2013; Karhulahti 2015; Vahlo et al. 2018)

The study at hand develops a Videogame Challenge Preference (CHA) inventory and reports results from an exploratory factor analysis (EFA) of the scale with survey data of 813 respondents. Its utmost aim is to construct and validate notions of videogame challenge preference categories, and discuss how they relate to videogame research in general. Meanwhile, a validated tool for measuring players' challenge preferences would be valuable for making sense of the gaming phenomenon more broadly, and it would also aid player-centric videogame development and targeted marketing.

Our work is related to what Denisova et al. (2017) have done in their attempt to develop a scale for measuring *experience of challenge* in videogames. The present study differs from Denisova et al. (2017) by not including items that measure how challenges are experienced by players (e.g. perceived difficulty, experienced flow and immersion). In contrast to this, we aim to put forward a comprehensive and rigorous survey inventory for studying players' preferences in prevalent challenge types.

VIDEOGAME CHALLENGE TYPES
Overcoming challenges requires physical kinesthetic or mental non-kinesthetic effort, or combination of both physical and mental work (Sutton-Smith 2001[1997]; Ermi & Mäyrä 2007; Järvinen 2007; Cox et al. 2012; Karhulahti 2013a; Adams 2014;

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Denisova et al. 2017). Physical challenges put players' reaction time, accuracy and endurance in a test. In contrast to this, cognitive challenges require memorization, problem-solving skills, planning and comprehension. Karhulahti (2013b) has argued that physical and mental challenges of videogames can be further analyzed by investigating their relationships to temporal and vicarious elements: kinesthetic challenges with and without time pressure, and nonkinesthetic challenges with and without time pressure.

Recently, Cole et al. (2015) have argued that emotional challenges should be separated from physical and cognitive challenges. In contrast to physical and cognitive challenges, emotional challenges deal with ambiguous elements in the representational and semiotic levels. Cole et al. thus suggest that emotional challenges are about resolution of tension within fictive settings of the gameworld, its characters, and plot. Also emotional challenges are non-trivial from the perspective of the player because these challenges elicit emotionally ambivalent experiences.

Accordingly, we drew numerous items for the CHA scale from the previously cited play and games research literature as well as from other related studies. Next, we made a matrix comparison between the surveyed research literature and neuropsychological literature review on effects of gaming on cognition (e.g. Boot et al. 2008; Barlett, Anderson & Swing 2009; Granic et al. 2013; Dale & Green 2016). The rationale for this comparison and triangulation was that neuropsychological tests are designed to measure the effectiveness of player efforts. As a result of the triangulation, we formulated a preliminary inventory of 38 challenge types in videogames (Appendix).

EXPLORATORY FACTOR ANALYSIS

An exploratory factor analysis (EFA) was made to investigate latent structures of the preliminary scale. EFA is a not a theory-driven method but an exploratory approach for identifying possible factors measured by an inventory. For conducting an EFA, we designed a survey on players' challenge preferences in videogames. The data was collected with a web-based survey, which took about 20 minutes to complete. Before opening the survey, we piloted it with 41 university students. Respondents were recruited from social media platforms such as Facebook groups and Reddit threads. A total of 1,397 participants opened the survey, of which 813 (mean age 28.9, 59.4% men) submitted completed responses.

The analysis yielded five distinct factors as identified with the Parallel Analysis method (Henson & Roberts 2006). A total of four items showed low factor loadings (<0.4) and were excluded from the final analysis.

Six items [1, 3, 6–7, 16, 28] loaded on the first factor (α=0.84). Of these items, challenges of creative problem solving and thinking out-of-the-box showed the highest loadings. Challenges of logical problem-solving, imagination and improvising loaded on this factor too. These challenge types require cognitive effort and reflective understanding from the player, and thus we name the factor ***Analytical***.

Ten items [17–19, 21–27] loaded on the second factor (α=0.87). These items describe preference on challenges which require fast reaction, dexterity and precision, mastering of complex controls, and acting under a time pressure. These challenges cohere with earlier research on challenges of kinesthetic action, and we call the factor accordingly ***Physical***.

The eight items [8–13, 15, 35] that loaded on the third factor (α=0.80) include word puzzles, quizzes, memory puzzles, riddles, jigsaws as well as challenges of

mathematics, mazes, and hidden objects. All of these challenge types can be solved by figuring out or knowing the one correct solution, that is, by insight thinking (Danesi 2004). Correspondingly, we name the factor ***Insight***.

Five items [2, 4–5, 33, 36] loaded on the fourth factor (α=0.86). These items describe a preference in challenges of moral and ethics, emotionally difficult subjects and themes, diplomacy, negotiating, and in-depth understanding. These ***Socio-Emotional*** challenges necessitate that the player explores their own feelings, responsibilities, and values.

Finally, five items [20, 29–30, 32, 34] of the challenge types of strategy, tactics, optimizing, leadership, and considering probabilities loaded on the fifth factor (α=0.77). All of these challenges require the cognitive ability of planning and ***Foresight***.

The presentation provides both an analysis and an elaboration of the results. The five identified factors are discussed in relation to follow-up studies and future research.

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APPENDIX

Challenges of…	Item	Mean	SD
… creative problem-solving	1	3.88	0.98
… moral and ethics	2	3.80	1.21
… using imagination	3	3.78	1.03
… dealing with emotionally difficult subjects and themes	4	3.51	1.29
… in-depth understanding	5	3.63	1.08
… thinking out-of-the-box	6	3.69	1.04
… improvising	7	3.57	1.01
… construction (e.g, jigsaws)	8	3.12	1.14
… quizzes and knowledge tests	9	2.91	1.26
… crosswords and other word puzzles	10	2.74	1.25
… finding hidden objects	11	3.31	1.17
… mazes and labyrinths	12	2.97	1.10
… memorizing	13	2.70	1.06
…pattern recognition and finding out correct combinations	14	3.06	1.10
… riddle solving	15	3.45	1.14
… spatial puzzles of mental or psychical rotation	16	3.17	1.13
… fast reaction	17	2.87	1.12
… precision and accuracy	18	3.32	1.01
… dexterity and agility	19	3.17	1.10
… tactics (e.g. battle tactics)	20	3.41	1.19
… acting in a constant hurry	21	2.28	1.09

… endurance and stamina	22	3.00	1.08
… mastering complex controls	23	2.51	1.17
… rapid and repetitive input (e.g. button-mashing)	24	2.00	1.05
… timing and rhythm	25	2.62	1.13
… performing a set of actions in sequence (i.e. combos)	26	2.76	1.15
… multitasking skills	27	2.92	1.02
… logical problem-solving	28	3.89	0.98
… strategy and strategic planning	29	3.56	1.15
… optimizing (finding the most useful solution or combination)	30	3.22	1.09
… cause-and-effect reasoning (e.g. "if I do this, that will happen")	31	3.88	0.97
… considering probabilities (e.g., "how likely something is")	32	3.09	1.08
… diplomacy	33	3.24	1.16
… leadership and delegating	34	3.19	1.14
… mathematics	35	2.69	1.22
… negotiating	36	3.29	1.11
… reasoning and predicting	37	3.76	0.97
… teamwork	38	3.04	1.24

Appendix 1: The CHA Scale, first iteration. Thirty-eight digital game challenge types, and their mean preference scores and standard deviations (N=813).