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A Genre-Specific Investigation of Video Game Engagement and Problem Play in the Early Life Course

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Abstract

This study explored predictors of engagement with specific video game genres, and degree of problem play experienced by players of specific genres, during the early life course. Video game players ages 18–29 (n = 692) were recruited in and around video game retail outlets, arcades, conventions, and other video game related contexts in New York City. Participants completed a Computer-Assisted Personal Interview (CAPI) of contemporaneous demographic and personality measures and a Life-History Calendar (LHC) measuring video gaming, school/work engagement, and caffeine and sugar consumption for each year of life ages 6 - present. Findings were that likelihood of engagement with most genres rose during childhood, peaked at some point during the second decade of life, and declined through emerging adulthood. Cohorts effects on engagement also emerged which were probably attributable to changes in the availability and popularity of various genres over the 12-year age range of our participants. The relationship between age and problem play of most genres was either negative or non-significant. Sensation-seeking was the only consistent positive predictor of problem play. Relationships between other variables and engagement with and problem play of specific genres are discussed in detail.

Keywords

Video games; Adolescence; Emerging adulthood; Life history calendar; Video game genre; Problem video game play

Video games are an indelible part of the modern American early life course. A 2008 Pew Research Center survey found 99% of males and 94% of females' ages 12–17 play video games [1]. Video gaming begins in early childhood and continues through adulthood [2,3]. Video games can be a modality for instruction and clinical intervention [4,5], when written for these purposes. Video games facilitate cognitive development [6]. They provide experiences of freedom and competence [7], opportunities to socialize, a sense of mastery, a medium for identity development, and - not least - fun [8]. Video games focus attention in ways that are palliative for and mood disorders [9–11].

There are also potential "downsides" to video gaming. It is hard to ignore that there is some association between violent entertainment video games and aggression, although the strong

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and deterministic connections often made in popular discourse (e.g., in the aftermath of school shootings) are probably not supported by the evidence [12,13]. Another issue, which is explored in research [14], addressed in clinical settings [15,16], and identified with by players themselves [17], is subjective experiences of video game "addiction." It is usually referred to as "Problem Video Game Play" (PVGP) or by similar terms to make it possible to discuss the phenomenon without implying a position about its status as a "real" addiction [18,19].

Given these connections between video games and health, there is naturally some interest in how video gaming behavior develops over time. One concept that may be useful for addressing this question is "role incompatibility." Role incompatibility has been used to explain the curvilinear relationship between substance use and age through the early life course [20]. From a role incompatibility perspective, substance use rises through adolescence and peaks during emerging adulthood as youth discover substances' potential for regulating negative emotions through usual adolescent experimentation and then use them explicitly for this purpose in emerging adulthood as a way of coping with stresses of identity development and experimentation with adult roles [21]. As emerging adults become young adults settled into adult roles with respect to school, work, and relationships, competing demands of those roles make previous use levels untenable and substance use decreases [22]. One study of the relationship between several video gaming indicators and age found a similar "role incompatibility" effect as several indicators of video game play (including PVGP) were observed to rise through childhood, peak in late adolescence, and either level off or fall through emerging adulthood, with an observed decrease in school/work night video game play through emerging adulthood statistically explained by entry into higher education and full-time employment [23]. Consistent with expectations under a role incompatibility perspective, other studies found that middle school students intentionally use video games to regulate negative emotions and PVGP significantly decreases over time for adult video game players [8,18].

Role incompatibility also suggests a rationale for focusing on development of PVGP. PVGP is distinct from merely liking video games or spending a lot of time playing them [24–26]. It is described as an addiction-like pattern of feeling out of control of time spent playing, neglecting normal responsibilities in order to play, using video game play to remediate negative emotions, feeling restless or irritable when video games are not available, and other experiences analogous to those of substance dependence [19,27–30] that develops among between 4.9% and 9% of video game players [31,32]. It is sometimes discussed in the context of other "behavioral addictions" like gambling, which share biological mechanisms with substance dependence [33–36] and are found in survey studies to be correlated with substance dependence [37–39]. A role incompatibility perspective applied to substance use implies the possibility that some users will come to prefer substance use over adult social roles, essentially self-medicating the "pain of growing up," with predictable health and developmental consequences [20,21,40]. Some findings suggest this aspect of role incompatibility might apply to video games. Certain players intentionally use video games to escape real-life problems [25,41] and adult video game players have lower mental and physical health than non-players [42].

Genre-Specific Concerns

A limitation of most of the above-cited research is that it considers video games in general without inquiring into specific genres or comparing genres to each other. Video game genres are actually richly diverse in their social, gameplay, narrative, identity, and reward/punishment features [43] as well as cognitive and emotional demands they make of users [6]. The Entertainment Software Association (ESA) recognizes as many as 14 different

genres [3]. Most (80%) of teen video game players play at least five different game genres. More than half (55%) of daily game players play at least eight different genres, but only 33% of less-frequent video game players do. Gender is also relevant; boys play an average of eight different genres while girls play six [1]. Genre may also be involved in the connection between personality and PVGP, as personality variables are associated with motivations for video game play [44] and motivation is associated with both genre preference and PVGP [45–47].

Existing studies which examine specific genres and differences between genres have yielded important results. For example, MMORPG's have especially high problem play potential, attributable to their lack of a distinct ending and within-game social reinforcement to keep playing [41,48,49]. Motion-control sports games are associated with increased physical activity in laboratory studies [50,51], but they are rated as less enjoyable than other genres [51]. One study of a national sample of video game players [52] found that, relative to action-adventure games, MMORPG's and gambling games were associated with higher use frequency, consumer involvement, and PVGP. Additionally, other Role-Playing Games (RPG's) and First-Person Shooters (FPS) were associated with higher consumer involvement and PVGP but not use frequency, real-time strategy games (RTS) were associated with higher use frequency and consumer involvement but not PVGP, and board/card and puzzle games were associated with higher use frequency and PVGP but not consumer involvement [16]. Among a subset of players who concurrently played video games and used substances, certain genres - non-MMO role-playing games, FPS, and board/card games - were uniquely associated with certain motivations for concurrent use, including regulation of negative emotions and enhancing positive experiences [53].

Another factor which, as far as we can tell, research has not yet taken into account is the rapidly evolving offerings of the video game industry. Since players' peak video gaming years coincide with certain genres' peak popularity, "cohort effects" may be observable in genre-specific analyses even within a short span of years [23]. For instance, motion-control devices only recently became broadly available for home use, which may lead to younger players being interested in motion-control sports games [54]. However, motion-control sports "exergames" are marketed toward adults [55], which may lead to interest in this genre increasing between adolescence and young adulthood. Massively Multiplayer Online Role-Playing Games (MMORPG's) and First-Person Shooters (FPS) have become more prominent in recent years with increasing technological sophistication of playing platforms and introduction of certain very popular titles [56,57], which could be expected to lead to greater interest among younger players and especially strong increases in engagement through adolescence. These trends have probably come at the expense of market share for classic non-FPS shooters, team sports simulators, puzzle, and platformer games [58–61] which include some of the best-recognized and most memorable titles ever [62], with the effect that the greatest interest in these games (including both past and present) is among players who are currently relatively older.

The present study, building upon earlier work that applied role incompatibility to the relationship between age and both video game engagement and PVGP [23], explores the relationship between age and both engagement with and problem play of specific video game genres among a sample of young adults who provided data on their video gaming behaviors in childhood, adolescence, and emerging adulthood. Like few studies before have ever done, it considers a full spectrum of video game genres. It also employs a life-course perspective, assessing effects not only of development (i.e., the year of their life for which they are providing the particular observation) but cohort effects (i.e., how old they were at the time of the interview). We expected, consistent with role incompatibility, that engagement with and problem play of most genres would peak in adolescence and fall in

emerging adulthood. We also expected cohort effects, in which players who were older at the time of the interview would be more engaged with older genres and younger players with newer genres. The study's aims were, however, primarily exploratory, so we included a wide range of covariates selected from variables correlated with video game engagement and PVGP in previous research, including gender [63,64], race [65], and personality variables like sensation-seeking [66]. We also included consumption of caffeine and sugar [38,67–69], not only to explore their potential genre-specific associations but because they are implicated in research exploring the "general tendency to become addicted" [70] and available to people of all ages, so controlling for them might help distinguish affinity for video games from general "addictive personality."

Methods

Participants and recruitment

Participants were emerging/young adults ages 18–29 recruited in and around 52 different video game stores, arcades, internet/cyber cafes, game-themed convention booths, and retail stores with large video game departments in New York City. Time and day of data collection were varied to obtain a diverse sample. Quota sampling was used to obtain at least 10 participants for every "cell" that would be created by cross tabulating gender, race, and illicit substance user status, with some participants screened out if they were not needed to meet a quota. Initial contact was made with 1090 potential participants. Of these, 150 were ineligible or screened out, and 238 declined to participate. If participants were interested but could not complete the interview at that time, interviewers set appointments. Response within our recruitment venues was often enthusiastic, with several potential participants approaching our interviewers. Since this enthusiasm was about the topic and not apparently related to any characteristic under study, we do not believe it caused self-selection bias that would influence our key findings. Ten cases were not valid for analysis because of incomplete responses. Our total valid sample size was 692, for a response rate of 74%.

Procedure

Field interviewers took participants to a mutually agreeable public location for the interview, often a park, fast-food restaurant, or coffee shop. Measures included a Computer-Assisted Personal Interview (CAPI) for time-invariant indicators, including demographics and personality variables. Time-varying variables including life-course indicators, caffeine and sugar consumption, and video game playing were measured via a quantitative life-history calendar [15,71,72]. The instrument itself was a computerized spreadsheet with a column for each year of life ages 6–29 and a row for each variable. To assist recall, the LHC was programmed to automatically calculate, from the participant's current age, calendar year ranges corresponding to each year of life and display them above the data entry rows. Participants were compensated $30 plus whatever refreshments interviewers bought for them with a $5 per interviewee budget. The protocol was approved by the investigators' institutional review boards.

Measures

Engagement and problem play—Our LHC was designed to capture a comprehensive record of participants' video gaming from age 6 to present. It included names of every video gaming platform that had been even moderately popular during participants' lifetimes pre-entered, with three rows initially visible (expandable to 10) under each platform. In choosing which titles to list, participants were invited to enter titles with which they associated particularly high significance engagement, attachment, or enjoyment. Each row began with a cell for entry of a game title followed by cells for entry of degree of problem play of that title (response choices were 0 for "none," 1 for "slight," 2 for "moderate," 3 for "high," and

4 for “extreme”) for every year of life from age 6 onward. For each title, interviewers only filled in data for years in which participants played the title and left other cells in that title’s row blank. Participants were considered to be “engaged” with a title if there was any entry (including 0), and the entry (0, 1, 2, 3, or 4) operationalized their degree of problem play for that title. We are confident that participants had a fairly firm and accurate idea of what we meant by problem play because, by this point in the interview, participants had already answered a complete measure about present-day PVGP and longitudinal questions about PVGP in general [19]. Our interviewers also referred them back to those questions to keep them mindful of the concept. Interviewers carried catalog-like color “game guides” produced for this study of popular titles for each platform with release dates to aid memory, i.e., if a respondent bought a certain game as soon as it came out, the precise year could be obtained from the game guide. LHC’s captured a total of 3,596 unique titles that could be positively matched to entries in GameFAQs.com [73], an exhaustive database of user-generated content maintained and edited by industry moderators.

Genre categories—Genre categories were adapted from GameFAQs.com, as follows:

- MMORPG: Massively multiplayer online role-playing games.
- Other Role-Playing: Usually single player games focused on rich narrative and character-building.
- First-Person Shooter: Fast, violent action, usually with military or science fiction themes.
- Other Shooter: Shooting-type games in third-person perspective.
- Action-Adventure: A broad category of games oriented toward action and exploration, mostly third person.
- Real-Time Strategy: Strategic combat from an aerial perspective with no wait between moves.
- Other Strategy: Turn-based (i.e., waiting on the player to act) and other strategic simulations.
- Team sports Simulation: Excluding the “General” sub-category from the “Sports” category in GameFAQs left simulations of primarily team sports.
- Motion-Control Sports: The “General” subcategory within GameFAQs’ “Sports” category contained mostly motion-controlled sports.
- Fighting: A martial arts duel or tag-team match against character(s) controlled by the computer or another player.
- Driving: Primarily car racing games.
- Puzzle: Matching, logic, deductive reasoning, object manipulation, and other puzzles.
- Platformer: Precision movement and jumping in two or three dimensions.
- Rhythm: Music and dance, often with a unique controller like a guitar or dance pad.
- Other Genres: Distinct titles belonging to categories that were not large enough for valid analysis, e.g., survival-horror.

For each genre, engagement during a year of life was coded 1 if there was any entry (including 0) for any game of that genre and 0 otherwise. Degree of problem play of each genre for each year was the average of all entries for games of that genre for that year. We

believe that, since participants had the option to enter 0 for problem play of all games that they played, using the same row of data for both variables did not conflate constructs of problem play and engagement but actually forced participants to thoughtfully distinguish between engagement and problem play for each response. Although this single-item measure is limited, it was the only way we could have collected year-level problem play data on the large number of titles captured from most participants given that median number of valid titles was 28, 90% of participants provided more than 10, and the maximum was 285.

Sugar/junk food consumption—This was the average of responses to one question about sugar drinks and another about high-sugar food, each on a 6-point Likert scale ranging from 0 = "never or less than once a week" to 5 = "exclusively - it was almost all I [ate/drank]" for the proportion of the respondent's diet it represented during that year.

Caffeine consumption—This was the numerical response to, "On days that you used caffeine, how many caffeinated drinks or caffeine pills did you have?" The range was 0–7, with fractional entries allowed. Zeroes were imputed for participants who reported no caffeine use.

Personality—Personality measures were adapted from the National Longitudinal Survey of Adolescent Health [74]. They included sensation-seeking, 13 items, Cronbach's $\alpha = 0.64$, shyness, seven items, $\alpha = 0.73$, and sociability, three items, $\alpha = 0.69$. We presented these scales in the CAPI as a single battery with items from all three mingled. We believe this increased response validity by making participants think through each item and that scales had modest α statistics because participants could not fall into response sets. This probably does not threaten the validity of our main findings, as the personality measures are neither key variable nor strongly correlated with key variables. However, the modest α's do make these variables less competitive for variance in multivariate models and create the potential for type II error in interpreting their coefficients.

Life-course factors—These were coded 1 if they applied to the participant for more than half of the year and 0 if not. They included higher education involvement (2-year school, 4-year school, or graduate school), whether they lived away from home (i.e., not with biological, adoptive, or foster family), and whether they held a full-time, part-time job, or "off-books" job.

Demographics—These included race, gender, and age at the time of the interview.

Data analysis

Analyses followed an existing example of Multi-Level Modeling (MLM) for LHC data [72]. For each genre, we conducted a multi-level logistic regression including all observations predicting engagement with that genre, and a multi-level linear regression predicting degree of problem play including only observations for years during which participants were engaged with that genre. Because few participants were older than 25 at the time of the interview, making data for those ages sparse and subject to apparent selection biases, and this study was only concerned with emerging adulthood and earlier life stages, only data for ages ≤ 25 are used. Tables 1–3 are presented without correction for multiple tests in assigning significance flags because non-findings turned out to be as important as findings, but the results narrative still only foregrounds coefficients as significant if $p<0.01$. The linear term was standardized year of life and the quadratic term was the square of that standardized variable, so the linear term for age is interpretable as its effect at its mean

(about 15). Graphs describe uncontrolled linear relationships to which, in order to improve interpretability, moderate degrees of LOWESS smoothing were applied.

Results

Descriptive statistics

Participants were 22% white, 24% African-American/Black, 20% Latino, 20% Asian, and 14% Other/Mixed. About two-thirds (66%) were male. Mean age at the time of the interview was 21.2, *SD* = 3.1. At least half a year of full-time employment during any year was reported by 42%, part-time employment by 64%, off-books employment by 41%, and higher education involvement by 59%. Only 1% of participants had never lived away from home at the time of the interview. Five percent were not living at home at age 17, 14% at age 18, 49% at 19, 63% at 20, 76% at 21, 84% at 22, 88% at 23, and >90% after age 23. Personality variables were roughly normally distributed and average scores were close to scales' middle ranges.

Model fit and general findings

Figure 1 and 2 present uncontrolled associations between year of life and (respectively) genre-specific engagement and problem play. Tables 1–3 describe results of multilevel logistic and linear regression models predicting engagement and problem play. Intra-class correlations were high for all analyses. In models predicting engagement, this indicated that participants who became engaged with a genre tended to stay engaged with it. In models predicting problem play, it indicated that problem play during years of engagement with a genre tended to remain stable. Although all fit statistics were significant, R-squared statistics were modest. This was not, at least within-level, unexpected, as responses' stability over time left little variance to explain.

For most genres, the relationship between engagement and age was consistent with hypotheses, trending upward through childhood, reaching an inflection point somewhere in the second decade of life, and then leveling off or trended downward in emerging adulthood. Coefficients for linear and quadratic terms for age in Tables 1–3 confirm the statistical significance of these trends, and Figure 1 describes the raw data. Something that Figure 1 suggests, although there is probably not a statistical procedure that would validate this insight, is that age of peak engagement varies by genre, ranging from about age 10 for Platformer games and over 20 for Motion-Control Sports. Problem play, however, had a linear negative or non-significant relationship with age for most genres. Figure 2 is suggestive of any of several different genre-specific shapes for this relationship, but the most common trend was simply linear negative, as described in Tables 1–3. This was at variance with hypotheses. Problem play's most consistent predictor was sensation-seeking. There was also either a positive or negative relationship between ages at the time of the interview (Tables 1–3) or likelihood of engagement with most genres, which upheld our expectation of cohort effects. Males were more likely to be engaged with most genres than females.

Genre-Specific Results and Discussion

What follows is a discussion of genre-specific findings which, in the interest of space, skips those genres for which findings other than the aforementioned general trends are unremarkable. Some explanations we offer for significant findings are somewhat speculative and assume a casual working knowledge of video games. We also do not highlight race differences because they would probably not be generalizable from this location-specific non-probability sample. We use the shorthand "younger players" and "older players" to

refer, respectively, to players who are younger (closer to 18) and players who are older (closer to 29) at the time of the interview.

Massively Multiplayer Online Role-Playing Game (MMORPG) engagement (Table 1) was higher among younger players, but MMORPG problem play was higher among older players. MMORPG engagement was also associated with sociability, which was understandable as these games involve plenty of interaction with human and computer-controlled characters, some “quests” can only be completed in teams, and durable “guilds” of human players are common [49]. MMORPG engagement also had a curvilinear relationship with age (Table 1 and Figure 1), which was consistent with hypotheses and with findings for most genres as discussed above. Inconsistent with findings for most genres, MMORPG problem play was unrelated to sensation-seeking. Other (meaning non-MMO, as per the genre list above) Role-Playing Games (RPG)’s, despite being one of the oldest genres, were also preferred by younger players. Similarly to other genres, Other RPG engagement had a curvilinear relationship with age, and problem play of Other RPGs was negatively related to age (Table 1 and light gray diamonds on Figures 1 and 2). Other RPG engagement, like MMORPG engagement, was positively associated with sociability, which was understandable as many Other RPGs require careful management of relationships among characters. Other RPG engagement was negatively associated with sensation-seeking, perhaps because sensation-seeking players are more attracted to games that do not require the deliberate, planful approach necessary for success at Other RPGs.

The First-Person Shooter (FPS) genre, with its increasingly popular offerings in recent years [56], was preferred by younger players (Table 1). FPS was also one of only two genres for which the relationship between problem play and age was consistent with hypotheses (Figure 2). That FPS games were preferred by players who were still living at home and/or employed full-time while full-time employment mitigated against problem play suggests, consistent with role incompatibility theory, that there are players who would engage on the level of problem players but cannot because of work. Other (again, meaning non-FPS) Shooters, in contrast to FPS, were an exception to the general finding of a curvilinear relationship between age and engagement, as both engagement with and problem play of this classic genre exhibited positive linear relationships with age (Table 1 and Figure 1 and 2). Other Shooters were similar to FPS for higher engagement among participants still living at home or employed full-time. Other Shooters were also the only genre for which there was a negative relationship between higher education involvement and problem play.

Among RTS players, there was a unique *convex* curvilinear relationship between problem play and age (Table 2), which Figure 2 suggests is actually leveling off of a downward trend. RTS engagement was positively associated with employment, perhaps because employed players have an affinity for these games’ resource management and acquisition components which make them a simulacrum of workplace achievement and advancement, or because employed players are better able to afford the upgraded personal computer components necessary to be competitive at these games which are often played on personal computers against other players. Engagement in both RTS and the comparably time-consuming Other Strategy were negatively associated with higher education involvement.

Team Sports Simulators are an older genre which was, unsurprisingly, preferred by older players. Team Sports Simulators were also the only genre other than the Other Shooters, another older genre, for which problem play trended upward at baseline (see significant coefficients for linear terms in Table 2 and 1, respectively, and note hollow diamonds and dark gray triangles in Figure 1 and 2). Male Team Sports Simulator players reported significantly higher problem play than females, perhaps because males more easily identify with this genre’s mostly male characters playing men’s sports [60]. Motion-Control Sports

are a newer genre preferred by younger players. They were the only genre for which the relationship between engagement and age curved upward rather than downward (see Table 2 and Figure 2), perhaps reflecting this genre's recent exponentially increasing popularity or affinity for "exergames" increasing with age [55].

Puzzle games (Table 3 and Figure 2) were an exception to the usual curvilinear relationship between engagement and age. Puzzle game engagement was also associated with older players, involvement in higher education, and full-time employment. Higher education involvement was also correlated with problem Puzzle game play. The combination of significant coefficients suggests college students or underutilized office workers procrastinating or passing time with either web browser games or games that are packaged with most computers' operating systems.

Caffeine consumption was uniquely associated with engagement in Driving, Rhythm, and Team Sports Simulator games, perhaps because caffeine is generally associated with enhancement of physical performance and these games simulate activities which many players have performed in real life. Only Rhythm and Puzzle games had greater engagement among females than males, possibly because Rhythm and Puzzle games are particularly unlikely to involve combat. The relationship between engagement and age trended downward at baseline for only Platformer and Puzzle games (Table 3 and Figure 1), which may reflect high popularity of certain titles several years ago. Sociability was associated with engagement in Rhythm games, perhaps because they are often played in groups taking turns. Although sugar consumption was associated with engagement in several genres, there does not seem to be a specific feature that all of these genres have in common.

General Discussion

General study hypotheses

The hypothesis that engagement with most genres would rise in childhood, peak at some point during the second decade of life, and decrease through emerging adulthood was generally upheld, as this relationship emerged in 12 of our 15 genre categories [23]. Findings about the relationship between problem play and age were, however, at variance with hypotheses. This relationship was curvilinear as predicted for two genres, non-significant for three genres, and negative for seven. One possible explanation for this is that, although players may become increasingly absorbed in video gaming in general, they get bored playing single games or genres. This would be consistent with what we already know based on earlier evidence that more-frequent video game players are those who play a greater variety of genres [1]. The implication of this is that, although research focusing attention on health issues with particular genres [41] is definitely helpful, the usual context of PVGP is probably not playing *single* games or genres for long hours. Rather, potential for PVGP develops in a context of sustained engagement with multiple genres of video games with an industry that is always developing, and players who are always trying, new things [74,75]. Players at risk for PVGP may be those who turn to other games rather than other activities once a game becomes boring. Our findings, taken together with earlier research, reinforce the need to discuss development of video game engagement in context, not only of human development and individual differences but the complex and dynamic environments of video games themselves.

Strengths and limitations

This study's primary strength was its developmental/life-course perspective. Although video gaming studies usually focus on children and adolescents [14], they generally do not apply a developmental perspective. Strength was face-to-face interviewing methodology, which held

participants to task to complete the survey and not contrive responses. Although our LHC was more demanding for both participants and interviewers than measures about broad life stages would have been, it allowed for operationalization of age as a continuous independent variable, without which some of our key results could never have emerged.

Our study shares the limitation with other LHC studies [15,71] that interviews were retrospective, not prospective. Our participants often gave single responses for several-year increments, essentially imputing an average across several years instead of the randomly varying responses of a true longitudinal measure. Assuming these averages were not actually biased, our use of MLM [72] gave us the best chance for valid results in spite of this limitation, as one of MLM's most important features is compensating for inflated likelihood of type I error due to correlated responses within-subject. However, the limitation remains that there were fewer distinct time points in the minds of participants than there were in the analyses. This study also has the aforementioned limitations of reliance on single-item indicators to obtain year-level data for a large number of titles, as well as limited generalizability of our results beyond the population of emerging adults who frequent venues for video game play or sales in NYC.

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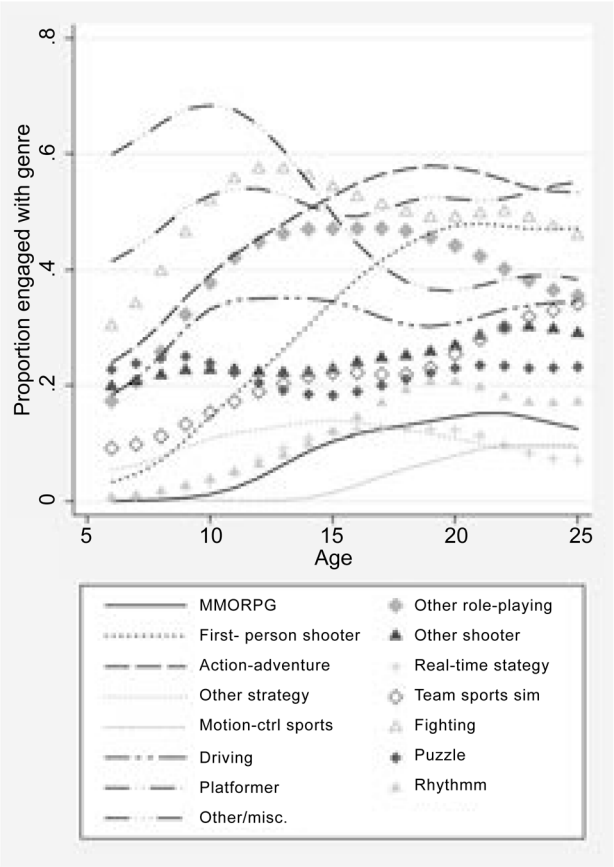

Figure 1.
Proportion of participants engaged with each genre as a function of age (uncontrolled associations, LOWESS smoothing applied).

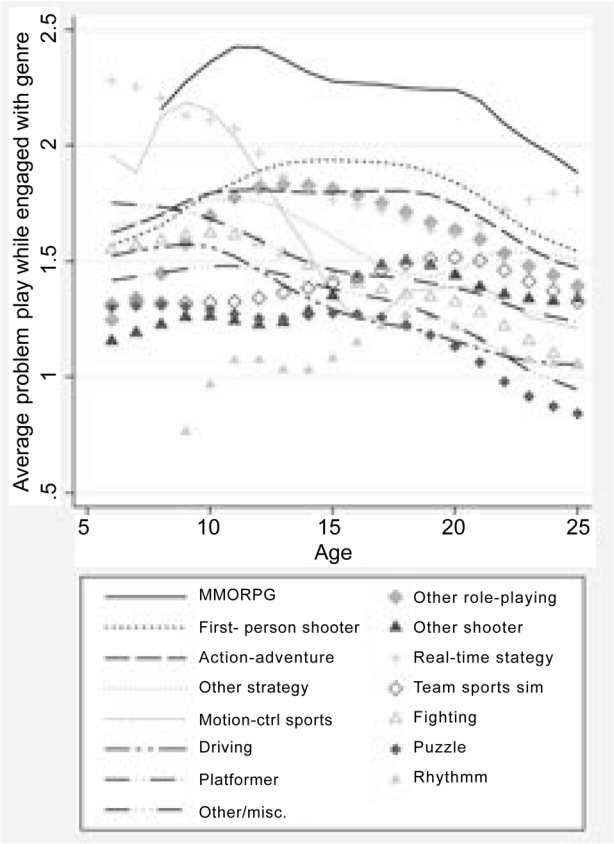

Figure 2.
Degree of problem play among of participants engaged with each genre as a function of age (uncontrolled associations, LOWESS smoothing applied).

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Table 1

Multi-level models predicting engagement with genre and problem play while engaged with genre from study variables (part 1).

	MMORPG		Other role-playing		First-person shooter (FPS)		Other shooter		Action-adventure	
	Engaged (lnOR)	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**
Age at interview	−1.30 ***	0.50 ***	−0.74 ***	−0.04	−0.61 ***	−0.12	0.30 *	−0.14 +	−0.11	−0.12 +
Age (linear)	2.99 ***	−0.61 ***	0.83 ***	−0.07 ***	2.00 ***	0.08 **	0.21 ***	0.08 ***	0.88 ***	−0.08 ***
Age (quadratic)	−0.61 ***	−0.07	−0.54 ***	−0.02	−0.47 ***	−0.05 **	−0.01	−0.03 +	−0.39 ***	−0.03 *
Caffeine consumption	0.10	0.03	−0.06	0.01	0.06	−0.03	−0.02	0.02	0.05	0.03 *
Sugar consumption	0.47 ***	0.06	0.25 ***	−0.04 +	0.03	0.03	0.17 **	−0.04 +	0.08	−0.03
Sensation-seeking	−0.20	0.06	−0.29 **	0.18 **	0.04	0.28 ***	−0.13	0.25 ***	<.01	0.24 ***
Sociability	0.65 ***	−0.18	0.34 **	−0.11	0.04	−0.10	0.10	−0.02	0.03	−0.06
Shyness	0.19	−0.06	0.12	−0.05	−0.23 *	0.05	−0.18	−0.02	−0.09	0.02
Live away from home	<.01	−0.02	0.06	−0.10 *	−0.73 ***	−0.10 *	−0.61 ***	0.08	−0.25 *	−0.07 +
Higher education	−0.32 +	−0.05	0.06	0.04	−0.03	0.01	−0.12	−0.19 ***	0.09	0.03
Part-time job	−0.18	0.03	−0.23 *	−0.09 *	−0.12	−0.05	0.07	0.04	−0.09	−0.03
Full-time job	0.14	−0.18	0.32 *	−0.04	0.53 ***	−0.14 **	0.50 ***	0.04	0.17	0.02
Off-books job	0.22	0.11	−0.02	−0.07	0.26 *	<.01	0.31 *	−0.08	0.10	−0.06
Gender: female	−1.26 ***	−0.19	−0.71 ***	0.09	−2.67 ***	−0.22	−2.00 ***	−0.10	−0.57 **	−0.03
Race: Black	−2.25 ***	−1.04 **	−0.82 **	−0.08	−0.52 +	−0.03	−0.08	−0.07	−0.28	−0.15
Race: Latino	−0.99 *	−0.05	−0.02	−0.01	0.62 *	−0.20	0.79 *	−0.12	0.88 ***	−0.24
Race: Asian	0.81 +	−0.16	0.10	0.32 +	0.38	0.11	−0.11	0.14	−0.52 +	0.08
Race: Other	−0.40	−0.93 *	0.58 +	−0.57 **	−0.02	−0.75 **	0.81 +	−0.74 **	0.50	−0.93 ***
Constant	−4.54 ***	3.34 ***	0.62 +	1.83 ***	1.70 ***	2.24 ***	−0.13	1.73 ***	0.75 *	2.10 ***
Intra-class correlation	0.80	0.79	0.63	0.83	0.59	0.84	0.73	0.83	0.58	0.83
Model fit Wald χ^2 (18df)	504.0 ***	123.5 ***	829.8 ***	108.2 ***	1493.5 ***	69.0 ***	153.3 ***	72.5 ***	897.4 ***	126.3 ***
R-squared overall		0.10		0.05		0.07		0.04		0.06

Coefficients for multi-level binary logistic (predicting play of any game within the genre) and linear regression (predicting average problem play of all games reported within that genre for each year) models significant at

+ $p < .10$,

* $p < .05$,

** $p < .01$,

*** $p < .001$

Table 2

Multi-level models predicting engagement with genre and problem play while engaged with genre from study variables (part 2).

	Real-time strategy		Other strategy		Team sports sim		Motion-ctrl sports		Fighting	
	Engaged (lnOR)	**Problem play (B)**	**Engaged (lnOR)**	**Avg. prob use (B)**	**Engaged (lnOR)**	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**
Age at interview	−0.16	−0.28 +	−0.34 *	−0.06	0.36 **	−0.13 +	−1.74 ***	0.35 +	−0.05	−0.14 *
Age (linear)	1.71 ***	−0.33 ***	0.41 ***	−0.05	0.74 ***	0.09 ***	2.52 ***	−0.25	0.52 ***	−0.04 *
Age (quadratic)	−1.00 ***	0.15 ***	−0.39 ***	−0.05	−0.25 ***	−0.04 *	0.41 **	−0.06	−0.56 ***	<.01
Caffeine consumption	0.02	<.01	0.04	<.01	0.15 **	0.01	0.24 *	−0.07	0.04	0.01
Sugar consumption	0.38 ***	−0.06	0.07	0.04	0.12 +	−0.14 ***	0.06	0.02	0.28 ***	−0.02
Sensation-seeking	−0.45 *	0.19	−0.27 +	0.07	−0.14	0.27 **	−0.09	0.39 **	−0.17	0.20 **
Sociability	0.40 *	−0.01	0.08	0.07	0.22	−0.13	−0.03	−0.26 *	0.32 *	<.01
Shyness	0.16	−0.15	0.05	<.01	−0.24 +	0.04	−0.06	−0.29 *	−0.05	<.01
Live away from home	−0.39 +	−0.14	0.09	−0.03	−0.06	−0.13 *	−0.19	−0.03	−0.13	0.03
Higher education	−0.38 *	0.09	−0.33 *	−0.07	−0.18	0.04	0.25	−0.01	−0.51 ***	0.02
Part-time job	0.45 **	−0.09	−0.14	−0.03	−0.26 *	−0.08 +	0.17	−0.27 **	−0.13	−0.01
Full-time job	0.88 ***	0.04	0.31 +	<.01	−0.11	−0.03	0.70 *	−0.19 *	0.08	0.05
Off-books job	−0.04	0.09	0.04	−0.18 *	0.31 *	0.12 *	0.24	−0.09	−0.15	0.05
Gender: female	−2.43 ***	0.11	−0.51 +	−0.09	−2.31 ***	−0.82 ***	−0.13	0.06	−2.24 ***	−0.29 *
Race: Black	−1.28 *	0.25	−0.88 *	0.20	0.04	−0.24	−1.51 *	−0.77	0.65 +	0.08
Race: Latino	−0.47	−0.09	0.58	−0.06	0.23	−0.10	1.00 +	0.29	1.44 ***	−0.12
Race: Asian	2.92 ***	0.59 +	0.99 *	0.62 *	−0.59	0.31	1.24 *	0.95 *	−0.05	0.19
Race: Other	1.00 +	−0.23	1.17 *	−0.24	0.49	−0.60 *	0.68	−0.56	1.75 ***	−0.58 **
Constant	−2.74 ***	1.46 ***	−3.72 ***	1.67 ***	0.05	2.66 ***	−9.40 ***	1.62 ***	2.68 ***	1.91 ***
Intra-class correlation	0.77	0.85	0.74	0.86	0.72	0.85	0.75	0.91	0.71	0.85
Model fit Wald χ^2 (18 df)	438.2 ***	60.4 ***	162.3 ***	38.0 **	416.4 ***	88.7 ***	276.0 ***	56.0 ***	623.8 ***	49.2 ***
R-squared overall		0.12		0.06		0.11		0.23		0.05

Coefficients for multi-level binary logistic (predicting play of any game within the genre) and linear regression (predicting average problem play of all games reported within that genre for each year) models significant at

+ p < .10,

* $p < .05$,

** $p < .01$,

*** $p < .001$

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Table 3

Multi-level models predicting engagement with genre and problem play while engaged with genre from study variables (part 3).

	Driving		Puzzle		Platformer		Rhythm		Other/misc.	
	Engaged (lnOR)	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**	**Engaged (lnOR)**	**Problem play (B)**
Age at interview	0.22 +	−0.08	0.61 ***	−0.11	0.65 ***	−0.17 **	−1.22 ***	−0.02	0.24 *	−0.09
Age (linear)	0.33 ***	−0.12 ***	−0.33 ***	−0.06 **	−0.89 ***	−0.18 ***	2.41 ***	−0.07	0.12 **	−0.08 ***
Age (quadratic)	−0.36 ***	<.01	0.02	0.01	−0.29 ***	0.03 *	−0.37 ***	0.05	−0.15 ***	−0.01
Caffeine consumption	0.15 ***	−0.01	0.03	0.04	0.00	0.05 ***	0.34 ***	−0.02	0.22 ***	0.03 *
Sugar consumption	0.24 ***	0.01	−0.06	−0.04	0.13 *	<.01	−0.14	0.02	0.18 ***	−0.06 **
Sensation-seeking	−0.10	0.14 *	−0.08	0.23 **	−0.03	0.24 ***	−0.19	0.18 +	−0.10	0.19 ***
Sociability	0.20	−0.09	0.17	−0.05	0.18	−0.09	0.61 ***	0.01	0.18	−0.05
Shyness	0.03	0.02	0.15	<.01	0.06	0.01	0.08	0.01	−0.02	−0.03
Live away from home	−0.38 **	0.08 +	−0.06	−0.09	0.18	−0.07	0.19	−0.04	−0.37 ***	−0.04
Higher education	−0.23 *	−0.07 +	0.50 ***	0.19 ***	−0.22 +	0.05	0.01	−0.01	0.14	−0.08 *
Part-time job	−0.36 ***	0.07 *	0.03	−0.09 *	−0.41 ***	0.06 +	0.12	0.03	−0.06	0.07 *
Full-time job	0.23 +	0.17 ***	0.53 ***	−0.07	0.15	0.11 *	0.08	−0.26 ***	0.34 **	0.07
Off-books job	0.06	−0.11 *	0.28 +	−0.01	−0.27 *	0.03	−0.24	0.05	−0.05	0.02
Gender: female	−1.01 ***	−0.23	1.03 ***	0.11	0.27	0.11	1.64 ***	0.07	−0.05	−0.02
Race: Black	−0.51	−0.22	−0.59	−0.03	−0.82 **	−0.14	0.33	0.15	−0.13	−0.06
Race: Latino	0.65 *	−0.03	0.56	−0.37	0.51 +	−0.33 +	1.51 **	0.20	0.96 ***	−0.04
Race: Asian	0.12	0.36 +	0.23	0.14	−0.61 *	0.19	0.23	0.62 +	0.20	0.39 *
Race: Other	0.41	−0.73 **	−0.01	−0.90 ***	0.21	−0.78 ***	1.93 ***	−0.17	0.59 +	−0.52 **
Constant	−0.04	1.85 ***	−4.46 ***	1.37 ***	0.41	1.56 ***	−8.65 ***	1.12 **	−0.01	1.50 ***
Intra-class correlation	0.67	0.87	0.76	0.85	0.64	0.83	0.79	0.89	0.62	0.80
Model fit Wald χ^2 (18 df)	314.0 ***	114.5 ***	90.8 ***	61.1 ***	965.9 ***	282.9 ***	696.5 ***	35.4 **	105.3 ***	104.3 ***
R-squared overall		0.08		0.07		0.05		0.04		0.05

Coefficients for multi-level binary logistic (predicting play of any game within the genre) and linear regression (predicting average problem play of all games reported within that genre for each year) models significant at

+ p < .10,

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*** $p < .001$