

**Are Video Games and School Conflictual or Complementary Contexts for Affording Psychological Need Fulfillment? Implications for Adolescent Gamers' Problematic Gaming and School Adjustment**

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### **Abstract**

According to the need density hypothesis, adolescents are at risk for problematic gaming when they only experience satisfaction of their basic psychological needs within, but not outside, the gaming context. This cross-sectional study among daily gamers ( $N = 309$ ,  $M$  age = 15.63, 94.8% boys) is the first to examine this hypothesis in adolescence, thereby comparing adolescents' need fulfillment between the contexts of video games and school and examining the role of need fulfillment in both contexts in relation to problematic gaming and school outcomes. Response surface analysis showed that adolescents' overall need satisfaction (across the two contexts) was related to lower problematic gaming and less maladaptive school outcomes. Consistent with the need density hypothesis, adolescents reported more problematic gaming, school disengagement and school burnout when high need satisfaction in the gaming context co-occurred with either low need satisfaction or high need frustration at school. Directions for future research are discussed.

*Keywords:* self-determination theory; psychological needs; need density hypothesis; adolescence; school; video gaming

### **Research Highlights**

- The need density hypothesis states that adolescents experiencing a lack of basic psychological need fulfillment outside the gaming context, but strong fulfillment within the gaming context, are at risk for problematic gaming behaviors.
- This is the first study on the need density hypothesis in adolescence and contrasting the video gaming context with a specific alternative context (i.e., school).
- Adolescents reported more problematic gaming and maladaptive school outcomes when they experienced low need fulfillment at school.
- The risk for problematic gaming and maladaptive school outcomes was even more elevated when adolescents did experience need fulfillment in gaming.
- Results indicate that, to fully understand adolescents' problematic gaming, it is important to consider not only their in-game experiences but also their experiences in the school context.

Video gaming is a prevalent leisure time activity among adolescents (Vanwynsberghe et al., 2022). Although gaming may help develop several important cognitive, emotional, and social skills (Granic et al., 2014) and can provide adolescents with meaningful friendships (Domahidi et al., 2014), gaming behavior can also be problematic. In particular when gaming interferes with adolescents' functioning in other important contexts such as school, gaming can become a source of mental health problems and maladaptive developmental outcomes (e.g., underachievement in school and social withdrawal) (Männikkö et al., 2020).

To understand the motivational pull of video games and to gain more insight in the question when gaming is (mal)adaptive, it has been argued from the perspective of Self-Determination Theory (SDT; Ryan & Deci, 2017) that individuals' experiences of autonomy, relatedness, and competence are key. According to SDT, these experiences denote three basic psychological needs that are essential for people's mental health and adjustment (Vansteenkiste et al., 2020). From this perspective, playing video games is an attractive activity because games provide many affordances to fulfill individuals' psychological needs (Adachi & Rigby, 2023; Rigby & Ryan, 2011).

However, to obtain a comprehensive picture of the role of gaming in adolescents' functioning, it is important to also consider adolescents' experiences of autonomy, competence, and relatedness outside the gaming context, such as in school or during leisure activities. The question then becomes whether adolescents' psychological needs are fulfilled inside and outside the gaming context and how these domain-specific experiences of need fulfillment play a role in developmental outcomes across domains. According to the need density hypothesis (Rigby & Ryan, 2011), adolescents who experience a lack of psychological need fulfillment outside the gaming context but strong need fulfillment within the gaming context are particularly at risk for problematic gaming behaviors. These adolescents are expected to develop a rather one-sided passion for gaming that results in excessive playing.

The few studies that already tested the need density hypothesis revealed rather inconsistent findings (Allen & Anderson, 2018; Przybylski & Weinstein, 2019). This study is the first to contrast the gaming context specifically with school as an offline -context when examining the need density hypothesis. This comparison is important because school plays a major role in adolescents' life (Eccles & Roeser, 2011) and because gaming can interfere with adolescents' school involvement.

### **Video Games and the Need Density Hypothesis**

According to SDT (Ryan & Deci, 2017), people have three basic psychological needs that serve as necessary nutrients for healthy psychosocial development and well-being (Ryan, 1995; Vansteenkiste et al., 2020, 2023). First, autonomy refers to the need to experience a sense of volition, psychological freedom, and authenticity in one's actions, thoughts, and feelings. Second, the need for relatedness involves the need for people to feel closeness towards and warmth from others they care about. Third, the need for competence entails the need to feel capable to meet challenges, to experience effectiveness in one's actions, and to master new skills. These needs can be more or less satisfied, and can also be frustrated, which happens when a need is actively undermined. Need frustration manifests in experiences of pressure and obligation (autonomy need frustration), isolation and loneliness (relatedness need frustration), and failure and inadequacy (competence need frustration) (Vansteenkiste & Ryan, 2013). Research has shown that psychological need satisfaction is generally beneficial for individuals' mental health and for adolescents' development in particular, as evidenced in associations with better emotion regulation (Benita et al., 2020) and the development of a solid identity (Luyckx et al., 2009). By contrast, psychological need frustration increases risk for maladjustment and psychopathology, with adolescents experiencing more need frustration being more vulnerable to internalizing distress and externalizing problems (Bartholomew et

al., 2011; Vansteenkiste & Ryan, 2013), sleep disturbances (Campbell et al., 2021), and even suicidal cognitions (Nieto-Cascado et al., 2023).

Games have much potential to satisfy individuals' basic psychological needs, with the degree of need satisfaction encountered within games in turn influencing game players' experiences (Adachi & Rigby, 2023; Ryan & Rigby, 2011). Studies have indeed shown that players reported greater enjoyment, less aggression, and better overall mental health when they experience more in-game psychological need satisfaction (Przybylski et al., 2014; Ryan et al., 2006). Experiments manipulating the need-satisfying potential of video games found further evidence for a causal role of in-game psychological need satisfaction for players' game enjoyment (Peng et al., 2012; Tamborini et al., 2010, 2011).

At first sight, it may seem as if in-game psychological need satisfaction is entirely beneficial. However, to see the full picture, it is important to consider adolescents' in-game psychological need satisfaction in conjunction with their need-based experiences outside the gaming context. The fulfillment of the psychological needs can indeed differ between life domains (Milyavskaya et al., 2009) and when individuals' psychological need satisfaction in one life domain is severely out of balance with need satisfaction in other life domains, people may be more prone to problematic (e.g., addictive) behaviors. To understand the effects of an imbalance in need fulfillment between digital and offline contexts, the need density hypothesis was forwarded (Rigby & Ryan, 2011). This hypothesis states that people with strong experiences of in-game need satisfaction, yet who experience low need satisfaction, or even need frustration, outside the gaming context may be more prone to problematic gaming behaviors. Indeed, previous research already showed that people may compensate for a lack of need fulfillment in a certain domain, by engaging obsessively in activities in other domains (Lalande et al., 2017).

In the video gaming context, the risk for such an imbalance is particularly enhanced by the fact that video games are often replete with opportunities for need satisfaction (Rigby, 2023). Players have much freedom to choose their course of action in the game (autonomy), the difficulty level is ongoingly tailored towards the player's abilities (thereby creating optimal challenge and fostering competence), and in many games it is possible to interact with virtual or real other players (relatedness). Because games offer so many opportunities for immediate need satisfaction, the offline world can be experienced by some players as bleak in terms of opportunities for need satisfaction. When experiences of need satisfaction are solely present in the gaming context, gaming may serve as a compensatory mechanism or escape route for the lack of need satisfaction experienced offline (for example at school or in other leisure time activities). Consequently, gaming behavior can get problematic, which may in turn have a negative influence on other life domains (Griffiths et al., 2017), with people investing less in offline social relationships, work, health behaviors, and school.

To date, only a few studies directly compared in-game and real-life need satisfaction and these studies showed mixed results for the need density hypothesis. Consistent with the need density hypothesis, Allen and Anderson (2018) found that undergraduate university students displayed the highest risk for problematic gaming when their psychological needs were satisfied only in but not outside of the gaming context. Also consistent with this hypothesis, Mills et al. (2018) found in a sample of adults that need satisfaction in games had a stronger positive effect on problematic gaming behavior when offline need frustration was high. Qualitative research confirmed that players sometimes use games as a compensatory escape routes for a lack of need satisfaction experienced offline (Ballou et al., 2022). By contrast, Przybylski and Weinstein (2019) found no significant moderation effect between general need frustration and in-game need satisfaction in predicting problematic gaming behavior in a sample of 14- and 15-year-olds. Similarly, using a sample of undergraduate

university students, Bender and Gentile (2020) found no evidence for an interactive interplay between in-game and real-life need satisfaction in the prediction of problematic gaming behavior.

Whereas previous studies used generic measures of offline need-based experiences (asking participants about any context other than games), the current study focuses on a more specific comparative context that is known to be very important for adolescents' functioning, that is, the school context.

### **School as a Key Developmental Context**

Apart from home, adolescents spend the most time at school, making school one of the most crucial social contexts that can either facilitate or hinder adolescents' cognitive, emotional, and social development (Eccles & Roeser, 2011). An important factor determining students' educational outcomes and development is how they perceive their school environment in terms of their basic psychological needs. Both cross-sectional (Tian et al., 2014) and longitudinal (Wang et al., 2019; Ratelle & Duchesne, 2014; Vandekerckhove et al., 2019) studies have shown that experiences of need satisfaction in school relate to higher school well-being (Taylor & Lonsdale, 2010), greater engagement (Jang et al., 2016), more high-quality motivation for studying (Bureau et al., 2022), more deep-level learning (Mouratidis et al., 2013), higher grades (Zhou et al., 2021), and higher overall adjustment (Ahmad et al., 2013).

However, not all adolescents perceive school as a context with opportunities for need fulfillment and some of them even experience substantial need frustration in the school context (e.g., Haerens et al., 2015; Vandekerckhove et al., 2019). When students' needs are frustrated, they feel pressure to comply with requests from teachers or classmates (autonomy frustration), they feel incapable to tackle the challenges of school (competence frustration), and they feel disconnected or isolated from their peers or teachers (relatedness frustration).

Experiences of need frustration come with a cost in the school context, being associated with maladaptive academic outcomes such as test anxiety (Bartholomew et al., 2018), amotivation (Cohen et al., 2023) and disengagement (Zou et al., 2023).

The school context has often been studied in isolation from other social ecologies that matter for adolescents, such as the home context, peers, but also the gaming context (but see Milyavskaya et al., 2009). As such, the possibility that there are carry-over effects between school and the gaming context has not been verified systematically. A few studies did begin to show that need-based experiences in school relate not only to school outcomes but also to outcomes in the gaming domain. Specifically, when adolescents experienced the school climate as unsupportive (likely reflecting a lack of need fulfillment at school), they were more engaged in problematic gaming (Rehbein & Baier, 2013; Yu et al., 2015, 2019; Zou et al., 2022). These studies provide some initial evidence that problematic gaming can indeed be a compensatory response to negative experiences in the school context. To provide more direct support for the need density hypothesis, however, it is important to additionally consider adolescents' need-based experiences in the gaming context and to examine the joint and unique effects of need-based experiences in school and the gaming context on outcomes that are central to each specific context. Indeed, rather than examining only whether the interplay between need-based experiences in games and school has repercussions for problematic gaming, it is important to examine this interplay also in relation to problematic school outcomes. When adolescents uniquely experience need satisfaction during gaming, but not in school, they may not only be drawn excessively towards gaming. They may at the same time lose interest for school and doubt the value of school, with this devaluation of school manifesting in behavioral disengagement in the classroom, and ultimately even school burnout.

## **The Present Study**

Because previous research showed mixed results regarding the need density hypothesis, this study aims to further clarify the nature of the interaction between in-game and offline psychological need satisfaction in relation to (problematic) gaming behavior. In doing so, this study contributes to the literature in three important ways. First, whereas the age range of participants in most of the studies on the need density hypothesis was limited to (young) adults (Allen & Anderson, 2018; Bender & Gentile, 2020; Mills et al., 2018), the current study focuses specifically on early to middle adolescence because this is the age period in which gaming involvement begins to peak (Paulus et al., 2018), with many adolescents struggling to find a balance between gaming and other activities in life. Another important reason to focus on this age period is that adolescents are highly sensitive to reward cues (Galvan et al., 2007), with the psychological incentives provided by games (in terms of psychological need satisfaction) perhaps pulling them even more strongly towards intensive gaming and creating an imbalance with rivaling contexts (such as school) that are less dense with immediate rewards. Second, rather than contrasting psychological need satisfaction in the gaming context with psychological need satisfaction in all other life domains outside of gaming, this study focused specifically on the school context as an alternative and important domain in adolescents' lives. This specific focus on school increases the potential applied value of the research. Many adolescents are indeed confronted with potential trade-offs between school involvement and investment in leisure-time activities such as gaming. Because both gaming and the school context play major roles in many adolescents' life and psychosocial adjustment, the interactive interplay between these two contexts in terms of psychological need satisfaction is of great interest for prevention efforts aimed at supporting adolescents' healthy psychosocial adjustment. Third, the current study went beyond a focus on problematic gaming as an outcome of in-game and real-life psychological need satisfaction.

The interplay between the contexts of video games and school likely has broader repercussions for adolescents' adjustment to school, with imbalanced need-based experiences resulting in problematic gaming but also disengagement at school and school exhaustion.

The first research question of this study is how need satisfaction (or the lack of need frustration) across domains is related to the three outcomes (i.e., problematic gaming, school disengagement and school exhaustion). The hypothesis is that higher need satisfaction across domains is related to less problematic outcomes (**Hypothesis 1a**). Conversely, the combined presence of high need frustration in school and low need satisfaction in video gaming is expected to be related to more problematic outcomes (**Hypothesis 1b**). The second research question is whether discrepancies between adolescents' need-based experiences in school and in the video gaming context relate to problematic gaming, school disengagement, and burnout. In line with the need density hypothesis, we expect that adolescents are more at risk for domain-specific problematic outcomes when they experience psychological need satisfaction only in the gaming context but not in the school context (**Hypothesis 2a**). Further, when adolescents experience not just low need satisfaction in school but even need frustration, the imbalance with the need satisfaction experienced in the gaming context would also be related to problematic gaming and maladaptive school outcomes (disengagement, and school exhaustion; **Hypothesis 2b**).

Prior to testing the need density hypothesis, we will for descriptive purposes also examine mean-level differences in terms of psychological need satisfaction between the school and gaming contexts. An important assumption underlying the need density hypothesis is that digital contexts are more replete with need-satisfying experiences than offline contexts. If this is true, the overall level of need satisfaction experienced by adolescents should be higher in the gaming context compared to school.

In testing these hypotheses, we will take into account the amount of time adolescents spend gaming and for school activities. It is particularly important to control for the amount of time spent gaming because adolescents who game more frequently are, on average, more prone to problematic gaming (King & Delfabbro, 2017; Paschke et al., 2020, 2021). The association between gaming duration and problematic gaming is far from perfect, however, indicating that frequent gaming is not inherently problematic. To ensure that the effects observed in the current study, if any, are specific to problematic gaming (not just higher gaming frequency), we controlled for gaming duration (as well as time involved in school activities, to be consistent). We also took into account gender differences because boys are known to be more involved in gaming than girls (Fam, 2018). We also considered the role of adolescents' age, family structure, adolescents' type of education, and family income because previous research has shown that the risk for problematic gaming decreases with age (Hawi et al., 2017), is greater among non-intact families (Rehbein & Baier, 2013) and is bigger in children following a non-academic track in school (Esposito et al., 2020). Income status of the family was also included in the upcoming analyses as a control variable because previous research already found problematic gaming is more prevalent among families with a lower socio-economic status (Toker & Baturay, 2016).

## **Method**

### **Participants and Procedure**

The data collection was done with the assistance of university students who followed a course on developmental psychology. As such, the sample size depended on how much students were following the course. These students were instructed to recruit one participant, they did not know personally, but were connected to indirectly, via friends or family. In October 2022, a first group of students was asked to contact an adolescent between 14 and 16 years old. Participants were eligible for inclusion in the study if they gamed on a daily basis.

This procedure was repeated in October 2023. Because some students in the first group had difficulty to recruit an adolescent who was suitable for the study, the age criterion for recruitment was somewhat broader in the second group (i.e., 14 to 18 years old). Apart from this, the procedure of the study was identical in both parts of the data collection.

The person who was recruited received a letter with information about the study and was invited to participate. The participants and one of their parents were asked to give their active, informed consent before they completed a cross-sectional online survey on gaming, school and parenting. Together with the adolescent, the parent who gave consent for their adolescent to complete the study also filled out a questionnaire on the same topic. From this parental questionnaire, the data on family income were used; this was assessed by asking the parents how easily they got around financially. The median duration of the adolescents' questionnaire was around 58 minutes, of which some constructs were the focus of this study (see Measures). The study was approved by the faculty's ethical committee (EC 2022 – 091).

We excluded participants with incomplete data on the study variables ( $n = 26$ ). The final sample consists of 309 adolescents with the Belgian nationality (94.8% who identified as boys, 4.9% as girls and 0.3% as another gender). There was one person who identified as another gender in the sample. Because it is statistically impossible to treat this one person as a separate group in the analyses, analyses were done to check whether this person's scores mostly resembled the ones of the boys or the girls. Solely for statistical purposes, this person was added to the girls' group in all further analyses. Because of the very small number of non-male gamers that are included in this sample, findings related to gender differences should be interpreted with caution. The mean age of the participants was 15.63 years, with a standard deviation of 1.46. Most participants (72.17%) reported living in an intact family with parents being married or living together. Regarding educational background, 55.02% of the participants followed the academic track in secondary education, whereas the other

participants followed a technical or vocational track. 81.25% of the adolescents' parents indicated that they did not have difficulties to get by financially. The data that are used in this study are openly available in OSF at

[https://osf.io/2duy4/?view\\_only=1194f6ed5566481aadb9914d4dedff38](https://osf.io/2duy4/?view_only=1194f6ed5566481aadb9914d4dedff38) .

## **Measures**

### ***Psychological Needs in Gaming and School***

In-game and school-based psychological need fulfillment was measured with a shortened version of the widely used and validated Basic Psychological Need Satisfaction and Need Frustration Scale (BPNSFS; Chen et al., 2015). This scale consists of 12 items: six items for need satisfaction (e.g., “I feel confident that I can do things well”) and six items for need frustration (e.g., “I feel the relationships I have are just superficial”). The items for need satisfaction and frustration were identical across domains. Only the prefix differed between the gaming context (“While playing video games...”) and the school context (“In school ...”). Items were rated on a 5-point Likert scale, ranging from “*not true at all*” to “*completely true*”. We calculated scores for need satisfaction in gaming and for need satisfaction and need frustration in school. Although we also had a score available for need frustration experienced in video gaming, this score was not used in this study because the need density hypothesis does not make predictions regarding the role of in-game need frustration. Cronbach's alpha was .72 for in-game need satisfaction, .82 for need satisfaction in school, and .72 for need frustration in school.

### ***Problematic Gaming***

Problematic gaming was assessed with the well-validated GADIS-A scale (Paschke et al., 2020), which was originally developed to measure internet gaming addiction, as conceptualized by the ICD-11 (World Health Organization, 2022). This scale contains nine items that had to be rated on a scale from 0 (“*completely disagree*”) to 4 (“*completely agree*”).

A sample item is “Due to gaming, I have disadvantages at school/apprenticeship/job (e.g., bad grades, inability to continue to the next grade/no graduation, no apprenticeship or university spot, poor reference, warning/dismissal)”). The scale had good reliability in this study ( $\alpha = .78$ ).

### ***School Disengagement***

School behavioral disengagement was assessed with a well-validated scale (Skinner et al., 2008) consisting of five items. Items were rated on a 5-point scale, ranging from “*totally not applicable*” to “*totally applicable*”. An example item is “When I am in class, I think about other things.” The reliability of the scale was good ( $\alpha = .79$ ).

### ***School Exhaustion***

School exhaustion was measured with the exhaustion subscale from the School Burnout Inventory (SBI; Salmela-Aro et al., 2009), that consists of four items (e.g., “I feel overwhelmed by my schoolwork”). Items for this scale were rated from 1 (“*totally not applicable*”) to 5 (“*totally applicable*”). The reliability of this scale was good ( $\alpha = .80$ ).

### ***Mean Gaming and School Work Duration Per Day***

We measured the average gaming and school work duration per day by asking respondents the following question: “Over the past few weeks, how much time did you usually spend gaming / working for school each day?”. Participants were asked to answer the question both for regular weekdays and days when they did not have to attend school. We then averaged the mean amount of time spent gaming on weekdays and during days on which there was no school. This variable is expressed in hours.

### ***Plan of Analysis***

Polynomial regression analyses with response surface analysis (RSA) were used for the main analyses. This statistical method uses the degree and direction of congruence and incongruence between two variables to predict differences in an outcome variable (Shanock et

al., 2010). In this case, to test the need density hypothesis, the (in)congruence between need satisfaction in school and need satisfaction in gaming and between need frustration in school and need satisfaction in gaming will be used as predictors for problematic gaming, school disengagement, and school exhaustion. This statistical approach allows us to examine whether the effect of need satisfaction in gaming depends on how participants' needs are fulfilled in school. As such, RSA is a suitable method for testing the need density hypothesis that was applied also in previous studies (e.g., Allen & Anderson, 2018). Rather than adding simple interaction terms or difference scores in a linear regression, polynomial regression using RSA analyses show how all possible combinations of the predictors statistically predict variation in the dependent variables (Barranti et al., 2017; Van Petegem et al., 2020). This study uses the RSA package (Schönbrodt & Humberg, 2018) in R (version 4.2.3) to perform the analyses.

Before polynomial regression analyses can be executed, all predictors have to be centered. Then, a response surface is created, simulating how the two given predictors relate to an outcome in a three-dimensional environment. The X-axis represents the first predictor variable (in this study, school-specific need satisfaction or frustration), the Y-axis represents the second predictor variable (in this study, gaming-specific need satisfaction), and the Z-axis represents the outcomes (in this study, problematic gaming, school disengagement, or school exhaustion). An example of a response surface can be seen in Figure 1. The response surface is formed based on the line of congruence (LOC) and the line of incongruence (LOIC). The LOC represents how values on the outcome depend on the scores of both predictors, given that both predictors are equal. The LOIC represents how values on the outcome depend on how both predictors differ from each other.

In the first step of each polynomial regression analysis (one per dependent variable), school need satisfaction or frustration (b1), gaming need satisfaction (b2), the squared terms of both school need satisfaction or frustration (b3) and gaming need satisfaction (b5), and the

interaction between both domain-specific need fulfillments (b4) are inserted as predictors of the outcomes. The b-parameters then are used to calculate four different a-parameters indicative of the response surface pattern (Barranti et al., 2017).

The parameters representing the line of congruence are a1 and a2. The a1 parameter refers to the slope of the line of congruence. It indicates how the outcome relates to both predictors, given that the (centered) values on the predictors are equal (i.e., school satisfaction or frustration = game satisfaction). Thus, if a1 is positive, scores on the outcome are higher (smaller if a1 is negative) when scores on both need predictors are higher, given that both predictors are equal. This parameter is key when assessing school frustration and gaming satisfaction as predictors in testing the need density hypothesis. According to the need density hypothesis, problems occur when need fulfillment is high in gaming and low outside of gaming. Consequently, a positive a1 parameter in the polynomial analyses with school frustration can be seen as evidence of the need density hypothesis, because a significant a1 parameter then confirms that problems are most prevalent when school frustration is high, while gaming satisfaction is also high. Parameter a2 refers to the curvature of the LOC. It indicates how matching values on the predictors (i.e., school satisfaction or frustration = game satisfaction) relate differently to the outcome, depending on how extreme the values on both predictors are. A positive a2 indicates that the outcome is higher when both need predictors are either high or low in comparison with both predictors having midrange levels, while a negative a2 indicates that the outcome is higher when both need predictors have midrange levels in comparison with both predictors having high or low levels.

The statistical parameters of the line of incongruence are a3 and a4. The a3 parameter (representing the slope of the LOIC) indicates whether a mismatch between the two predictors (e.g., school satisfaction or frustration > game satisfaction) is related to the outcomes. A positive value of a3 indicates that scores on the outcome are higher when need satisfaction (or

frustration) in school is higher compared with need satisfaction in gaming. A negative value of  $a_3$  indicates a higher outcome when in-game need satisfaction is higher compared with satisfaction (or frustration) in the school domain. The  $a_3$  parameter is key in testing the need density hypothesis when the two domain-specific measures of need satisfaction are the predictors. Namely, a negative  $a_3$  parameter then indicates that the problematic outcomes are higher when need satisfaction in gaming is higher than need satisfaction in school. Finally,  $a_4$  is the parameter representing the curvature of the LOIC. It indicates the degree to which values on the outcome change depending on how much they differ from one another, regardless of the direction in which they differ. In this study, a positive  $a_4$  parameter shows that scores on the outcome are higher when both domain-specific (centered) scores on need fulfillment differ more strongly from one another. A negative  $a_4$  parameter shows that scores on the outcome are higher when both scores on need fulfillment differ less from one another.

The RSA package (Schönbrodt & Humberg, 2018) will also be used to create figures to illustrate these effects. In these figures, where the response surface is colored green, outcome values are highest, while outcome values are lower where the response surface is colored orange and lowest where it is colored red. Only the part of the response surface inside the biggest polygon should be interpreted because the part outside of this figure is the statistically expected extension of the response surface pattern and is not based on many observed values. To make these figures more clear, we also added a top view of this figure (Figure 3 for problematic gaming, Figure 5 for school disengagement, and Figure 7 for school exhaustion). Further explanation of and figures on the interpretation of these parameters can be found in Barranti et al. (2017).

## Results

### Descriptives, Correlations, and Background Variables

Table 1 shows the correlations, means, and standard deviations of all study variables.

There was a positive association between need satisfaction in the two domains. Moreover, a paired-samples t-test showed that adolescents did not experience significantly more need satisfaction in gaming ( $M = 3.95$ ;  $SD = 0.63$ ) than in school ( $M = 3.85$ ;  $SD = 0.75$ ). Gaming-specific need satisfaction was slightly positively related to mean gaming time per day, but was unrelated to any of the other substantive variables. Need satisfaction in school was correlated negatively with school need frustration, problematic gaming, school disengagement, and school exhaustion and correlated positively with schoolwork time per day. Need frustration in the school domain was positively correlated with problematic gaming, school disengagement, and school exhaustion. The average daily gaming time was, albeit only moderately, positively correlated with problematic gaming. Schoolwork time was negatively correlated with problematic gaming and school disengagement. Problematic gaming, school disengagement, and school exhaustion were all positively interrelated.

In the main analyses, we controlled for adolescents' gender, age, family status and type of education. Detailed information about the associations between the background variables and the study variables is provided In the Supplementary Materials. Boys scored higher than girls and adolescents identifying as non-binary on need satisfaction in school ( $b = -.12$ ,  $p < .05$ ,  $\eta^2 = .02$ .) and lower on need frustration in school ( $b = -.15$ ,  $p < .01$ ,  $\eta^2 = .02$ ). Adolescents in a non-intact family (compared to those in an intact family) scored lower on school specific need satisfaction ( $b = -.15$ ,  $p < .01$ ,  $\eta^2 = .02$ ) and higher on problematic gaming ( $b = .12$ ,  $p < .05$ ,  $\eta^2 = .01$ ) disengagement ( $b = .12$ ,  $p < .05$ ,  $\eta^2 = .01$ ), and school exhaustion ( $b = .13$ ,  $p < .05$ ,  $\eta^2 = .02$ ). Adolescents following an academic track scored higher on exhaustion ( $b = -.14$ ,  $p < .05$ ,  $\eta^2 = .01$ ) and lower on mean gaming time per day ( $b = .20$ ,  $p < .001$ ,  $\eta^2 = .05$ ) than students following a technical or vocational track on school. Finally, older adolescents had higher scores on school disengagement.

### **Polynomial Regression Analysis**

The response surface pattern was generated after controlling for age, gender, education type, mean gaming time per day, and mean school time per day. All a- and b-parameters are provided in Table 2, and the corresponding graphs are shown in Figure 2 to Figure 7.

### ***Problematic Gaming***

When using school-specific and gaming-specific need satisfaction as predictors, a significant and negative  $a_1$  was found for problematic gaming. Consistent with Hypothesis 1a, this means that if need satisfaction is equal and high in both domains, problematic gaming was lower. The other LOC parameter,  $a_2$ , was not significant, which means there was no curvature on the line of congruence. Parameter  $a_3$  was significant and negative for problematic gaming. Consistent with Hypothesis 2a, higher scores were observed for problematic gaming when need satisfaction in gaming was higher compared with need satisfaction in the school domain. There was no evidence for a curvature pattern in the LOIC because  $a_4$  was not significant.

The same analyses were done with school-specific need frustration and gaming-specific need satisfaction as predictors. The slope of the LOC ( $a_1$ ) was significant and positive for problematic gaming. So, at equally high levels of need frustration in school and need satisfaction in gaming, higher scores on these predictors predict more problematic gaming. These findings are again consistent with the need density hypothesis and with Hypothesis 2b in particular. The curvature of the slope of LOC ( $a_2$ ) was not significant. The slope of the line of incongruence ( $a_3$ ) was significant and positive: consistent with Hypothesis 1b, the combined presence of higher need frustration in school and lower need satisfaction in gaming, was related to higher scores on problematic gaming (hypothesis 1b). Finally, the LOIC ( $a_4$ ) curvature indicator was not significant for problematic gaming. Illustrations of all these effects can be found in Figure 2 and 3.

### ***School Disengagement***

When using both domain-specific need satisfaction scores as predictors, a significant and negative  $a_1$  was found for school disengagement. Consistent with Hypothesis 1a, this means that if need satisfaction is equal and high in both domains, school disengagement was lower. Parameter  $a_3$  was significant and negative: consistent with Hypothesis 2a, higher scores were observed for school disengagement when need satisfaction in gaming was higher compared with need satisfaction in the school domain. Both the  $a_2$  and  $a_4$  parameters were not significant.

When school-specific need frustration and game-specific need satisfaction were used as predictors,  $a_1$  was significant. So, at high levels of need frustration in school and need satisfaction in gaming, higher scores on these predictors predict more school disengagement. These findings are again consistent with Hypothesis 2b. Also, parameter  $a_3$  was significant and positive: consistent with Hypothesis 1b, the co-occurrence of higher need frustration in school and lower need satisfaction in gaming, was related to higher scores on school disengagement. Both the  $a_2$  and  $a_4$  parameters were not significant. Illustrations of these effects can be found in Figure 4 and 5.

### ***School Exhaustion***

When using both domain-specific need satisfaction as predictors, a significant and negative  $a_1$  was found when predicting school exhaustion. Consistent with Hypothesis 1a, this means that if need satisfaction is equal and high in both domains, participants indicated feeling less exhausted at school. Parameter  $a_3$  was significant and negative: consistent with Hypothesis 2a, higher scores were observed for school exhaustion when need satisfaction in gaming was higher compared with need satisfaction in the school domain. Both the  $a_2$  and  $a_4$  parameters were not significant.

When using school-specific need frustration and game-specific need satisfaction as predictors,  $\beta_1$  was significant. This means that at equally high levels of need frustration in school and need satisfaction in gaming, higher scores on these predictors predict more school exhaustion. These findings are again in line with Hypothesis 2b. Also, parameter  $\beta_3$  was significant and positive: the combined presence of higher need frustration in school and lower need satisfaction in gaming, was linked to higher scores on school exhaustion (hypothesis 1b). The  $\beta_2$  and  $\beta_4$  parameters were not significant in predicting school exhaustion. Illustrations of these effects can be found in Figure 6 and 7.

### **Discussion**

This study examined how adolescents' need-based experiences in video gaming and in school played joint and unique roles in problematic gaming and school outcomes, thereby testing the need density hypothesis. This hypothesis states that individuals' video gaming behaviors risk becoming more problematic when they only get their basic psychological needs (autonomy, relatedness and competence; Ryan & Deci, 2017) strongly fulfilled in the video gaming domain, but not in offline domains, where need satisfaction may be low or where people may even experience need frustration. Whereas previous studies tested this hypothesis by comparing need-based experiences in the video gaming context with general need fulfillment outside of the gaming context (Allen & Anderson, 2018; Bender & Gentile, 2020; Przybylski & Weinstein, 2019; Mills et al., 2018), we compared the video gaming domain with the school domain specifically, while looking at school-specific outcomes as well.

### **Main Findings**

Whereas video games are designed to include multiple and fast routes towards experiences of need satisfaction (Rigby & Ryan, 2011), school is often considered a more mixed blessing for need-based experiences, with school yielding a need-frustrating effect for at least some adolescents (Vandenkerckhove et al., 2019). Surprisingly, in the current study

adolescents' mean level of need satisfaction in the video gaming domain was not significantly higher than their average need satisfaction in the school domain. We provide a number of possible explanations. One possibility is that the less frequent gamers in this study experienced less need satisfaction in video games because they did not spend enough time video gaming to come into contact with all the need satisfying opportunities that are implemented into video games. Also, although games may be more replete with opportunities for need satisfaction, this does not guarantee greater actual satisfaction as such. Second, it is important to note that we asked adolescents about their experiences in school in general and not specifically about their experiences in the classroom during educational activities. When filling out the measure on need satisfaction in school, quite a few adolescents may have had in mind activities unrelated to education, including time spent with peers and leisure activities within the school context. Future research could specify even further the kind of school-related activities when comparing adolescents' need-based experiences with the gaming context. Finally, although no domain differences were noted for need satisfaction, such differences may exist for need frustration, with school on average being more undermining of adolescents' basic needs.

When experiencing a lack of need satisfaction (or even need frustration) in the school context, some adolescents may look for compensating need-satisfying experiences in video gaming (Ballou et al., 2022). Based on this compensation hypothesis, one might expect a negative association between need satisfaction in both domains. However, the correlation between school- and gaming-specific need satisfaction was positive in the current study. On average, adolescents who experience more need satisfaction during gaming also experience more need satisfaction in school. One potential explanation is that adolescents differ in their appraisal of events, with some adolescents having more benign interpretations of events across contexts and more easily perceiving satisfaction of their psychological needs both in

games and school. Another explanation is that adolescents to some extent proactively shape their own need-based experiences in different contexts. Research on the concept of need crafting has indeed shown that adolescents differ in the extent to which they are aware of what is truly need satisfying to them and the extent to which they take action to engage in activities that enhance need satisfaction (Laporte et al., 2021). Adolescents with greater need crafting abilities are probably better able to attain experiences of need satisfaction across life domains. It should be noted, however, that the cross-domain correlation in need satisfaction was far from perfect, indicating that there is still room for some adolescents to experience need satisfaction in one domain but not in the other. Therefore, it remained useful to examine the joint and unique effects of gaming-specific and school-based need fulfillment.

The joint effect of need satisfaction across domains was captured by the  $\alpha_1$  parameter in the polynomial regression analyses. This parameter was significant for all three outcomes when using the two domain-specific need satisfaction scores as predictors. This finding suggests that, when adolescents experience more overall need satisfaction across the two domains, they are less likely to display problematic gaming and maladaptive school outcomes (confirming Hypothesis 1a). Also, scores on all problematic outcomes were higher when adolescents simultaneously experienced high school-specific need frustration and low gaming-specific need satisfaction (confirming Hypothesis 2b). Consistent with SDT, adolescents' domain-overarching experiences of need satisfaction thus seemed to play a protective role against problems within both domains. Conversely, the combined presence of need frustration in one domain and low need satisfaction in another domain was related to more problematic outcomes. Overall, these findings testify to the importance of need-based experiences across domains.

The crucial and most innovative question in this study was whether, consistent with the need density hypothesis, an imbalance between the two contexts in terms of need

satisfaction would matter on top of the overall effect of need satisfaction. We found evidence for the need density hypothesis, with this hypothesis being confirmed for both the school outcomes and for problematic gaming. For all three outcomes, there was a significant effect of incongruence between need satisfaction in gaming and school. This effect implied that when adolescents experienced more need satisfaction in gaming than in school they scored higher on school disengagement, exhaustion, and problematic gaming (confirming Hypothesis 2a). Thus, when adolescents' need satisfaction at school was severely out of touch with their need satisfaction in the gaming context, adolescents reported having less control over their gaming behavior, being disengaged in the classroom and being depleted of energy to invest in school. Also confirming the need density hypothesis, there was a significant effect of congruence between need frustration in school and need satisfaction in gaming on the three outcomes. Thus, when adolescents experienced high levels of need satisfaction in the video gaming context, while experiencing high levels of need frustration in school, they also reported more problematic gaming, disengagement and school burnout (confirming Hypothesis 2b). Apparently then, adolescents' school adjustment can deteriorate when their basic psychological needs are frustrated at school but are satisfied in the video gaming domain. School may become a comparatively more bleak and disparaging social context when adolescents find need-rewarding experiences in video games but do not get their needs fulfilled at school.

Apart from the interplay between school-specific and gaming-specific need satisfaction, experiences in the school context appeared to be more decisive in predicting all outcomes than experiences in the gaming context. Most strikingly, school-specific need-based experiences had a significant effect on problematic gaming when looking at the b-parameters (see Table 2), while need satisfaction in gaming was essentially unrelated to problematic gaming behavior. Intriguingly, need-based experiences in school appear to be more important

for problematic gaming than within-game need-based experiences. These findings highlight the centrality of school as a developmental context in adolescents' lives (Eccles & Roeser, 2011). In many cases, problematic gaming may represent a compensatory mechanism to cope with low need satisfaction (or even need frustration) in social contexts outside of gaming. This observation is important from a prevention point of view. It indicates that, in addition to interventions targeting adolescents' gaming behavior per se (e.g., by increasing media literacy), it will be important to consider adolescents' broader functioning in diverse social ecologies. Tailored interventions aimed at improving adolescents' need fulfillment at school could be helpful, not only because they facilitate better adjustment at school (Jang et al., 2016; Standage et al., 2005), but also because they possibly reduce problematic gaming behaviors. Examples of such interventions include the training of teachers in their need-supportive motivation styles or programs including psycho-education such as LifeCraft which help adolescents in satisfying their basic psychological needs, including at school (Van den Bogaard et al., 2024).

### **Limitations and Directions for Future research**

This study has some limitations. First, the sample size for the present study was not based on an a priori calculation of statistical power. The sample size was comparable to a previous study that tested the need density hypothesis by using RSA (Allen & Anderson, 2018) and the fact that most of the expected findings were significant indicates no major problems with statistical power. Still, similar studies with larger and more heterogeneous samples are needed. In this study, we deliberately recruited adolescents who played video games daily, resulting perhaps in reduced variance in gaming behaviors. Although this resulted in a sample of adolescents for whom gaming represented an important activity, future research would do well to use broader sampling strategies that better capture the extremes of the spectrum, including very low and excessively high gaming frequency. Future research

would also do well to include more female participants than the current study, which was very imbalanced in terms of the gender distribution (Fam, 2018; Herrmann et al., 2019). The current study was ill-suited to document the gaming and school-specific experiences of female adolescents playing video games. It should also be noted that the adolescents in this study generally had a rather high socio-economic status.

Another limitation of this study is that the results are based on cross-sectional, self-reported data. This rendered the data sensitive to shared method variance and made it impossible to draw causal conclusions about the need density hypothesis. Longitudinal research on this topic is very much needed. Diary and experience sampling studies on the need density hypothesis in particular can provide more in vivo insight into the interplay between gaming and school. Ideally, adolescents' gaming time and frequency would then also be recorded objectively, instead of relying on self-reported assessments.

## **Conclusion**

This study indicates that, to fully understand problematic gaming, it is essential to take into account not only adolescents' experiences within the gaming context but also in other important contexts such as school. First, our findings showed that adolescents' overall need satisfaction (across both contexts) was related to less problematic gaming and less school disengagement and exhaustion. Second, confirming the need density hypothesis, adolescents reported the most problematic gaming and were most disengaged and prone to school burnout when they only experienced need satisfaction in gaming, yet did not experience need satisfaction at school (or even experienced need frustration at school). Third, the results in this study indicated that, apart from the interplay between need fulfillment in school and gaming, need-based experiences at school are more predictive of problematic gaming behaviors and maladjustment at school than their need-based experiences while playing video games. Given these findings, prevention programs aimed at reducing problematic gaming and

associated problems at school may consider not only the gaming context but also the school context. If replicated, the current findings suggest that interventions aimed at helping adolescents to get their needs more sufficiently met at school (either through teachers' need support or through proactive need crafting) could help to protect adolescents against both problematic gaming behaviors and school maladjustment.

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**Table 1***Descriptive Statistics and Correlations between Study Variables*

	<i>M</i>	<i>SD</i>	1.	2.	3.	4.	5.	6.	7.	8.
1. Game need satisfaction	3.95	0.63								
2. School need satisfaction	3.85	0.70	.32***							
3. School need frustration	1.94	0.66	-.10	-.70***						
4. Mean gaming time per day	182.20	110.3	.13*	-.06	.06					
5. Mean school work time per day	89.44	107.7	.09	.11*	-.07	-.02				
6. Problematic gaming	2.15	0.64	-.05	-.33***	.45***	.21***	-.12*			
7. School disengagement	2.75	0.78	-.05	-.33***	.32***	-.04	-.18**	.35***		
8. School exhaustion	2.30	0.88	-.02	-.46***	.51***	-.07	.09	.27***	.29***	
9. Age	15.63	1.46	.08	-.09	.07	.03	-.04	.04	.17**	.01

*Note.* \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .00$

**Table 2**

*Results of Polynomial Regression Analysis with Response Surface Analyses Predicting Gaming and School Outcomes based on Need Satisfaction and Frustration scores in Gaming and School.*

	Satisfaction school – Satisfaction gaming			Frustration school – Satisfaction gaming		
	Problem gaming	Disengagement	Exhaustion	Problem gaming	Disengagement	Exhaustion
<i>Polynomial regression coefficients</i>						
<i>b1 school</i>	-.19** (.04)	-.27*** (.05)	-.44*** (.05)	.27*** (.04)	.24*** (.04)	.45*** (.05)
<i>b2 gaming</i>	-.01 (.04)	.08 (.05)	.15 (.06)	-.04 (.04)	.00 (.05)	.02 (.05)
<i>b3 school<sup>2</sup></i>	-.04 (.03)	-.05 (.03)	-.03 (.03)	-.04 (.03)	-.02 (.02)	-.01 (.03)
<i>b4 school x gaming</i>	-.01 (.04)	-.04 (.04)	-.02 (.04)	-.01 (.03)	.05 (.04)	.02 (.04)
<i>b5 gaming<sup>2</sup></i>	-.03 (.02)	.03 (.03)	.01 (.02)	-.03 (.02)	.01 (.02)	-.02 (.03)
<i>Response surface parameters</i>						
<i>a1 slope LOC</i>	-.20*** (.05)	-.19* (.06)	-.29** (.06)	.23*** (.06)	.24*** (.07)	.47*** (.08)
<i>a2 curve LOC</i>	-.06 (.04)	-.05 (.04)	-.05 (.04)	-.07 (.04)	.03 (.04)	.00 (.05)
<i>a3 slope LOIC</i>	-.18* (.07)	-.35*** (.08)	-.59*** (.09)	.32*** (.05)	.24*** (.07)	.43*** (.06)
<i>a4 curve LOIC</i>	-.07 (.06)	-.02 (.06)	-.01 (.07)	-.14 (.04)	-.06 (.06)	-.05 (.06)
<i>R<sup>2</sup></i>	.10***	.11***	.24***	.19***	.10***	.28***

*Note.* Coefficients are unstandardized, variables are centered. \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

Figure 1. Example of Response Surface, adapted from Barranti et al. (2017)

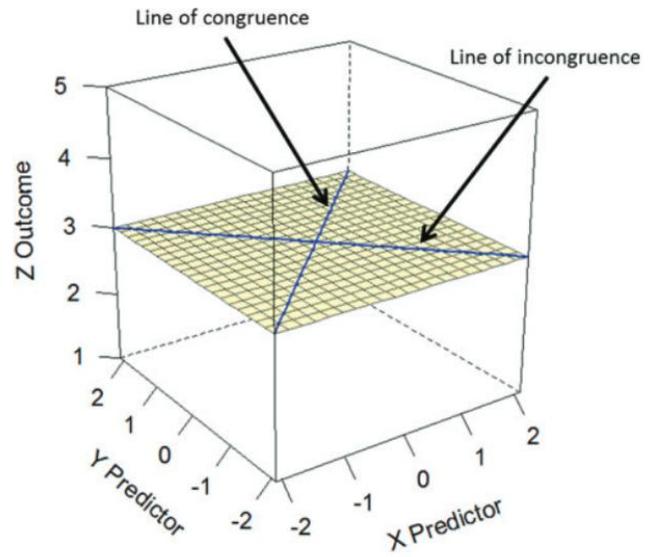


Figure 2A. RSA with game satisfaction and school satisfaction as predictors and problematic gaming as outcome, 3D view

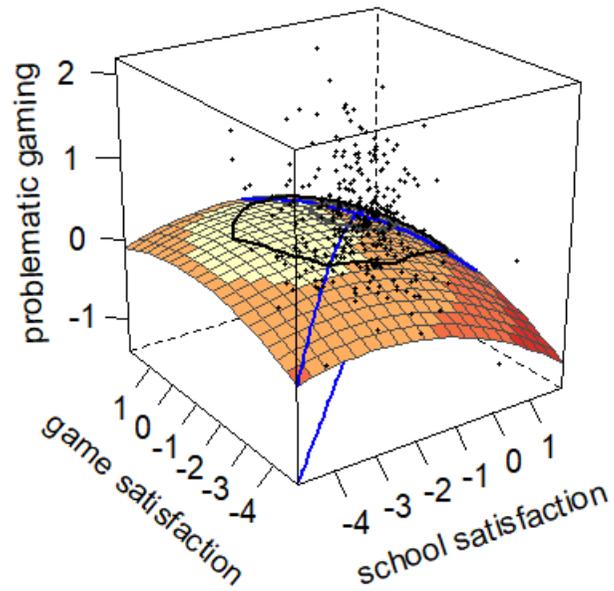


Figure 2B. RSA with game satisfaction and school satisfaction as predictors and problematic gaming as outcome, top view

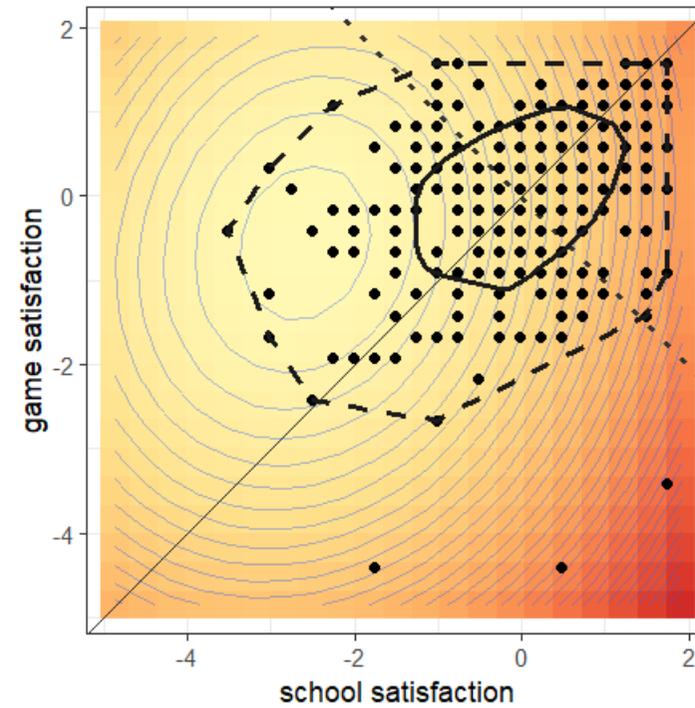


Figure 3A. RSA with game frustration and school satisfaction as predictors and problematic gaming as outcome, 3D view

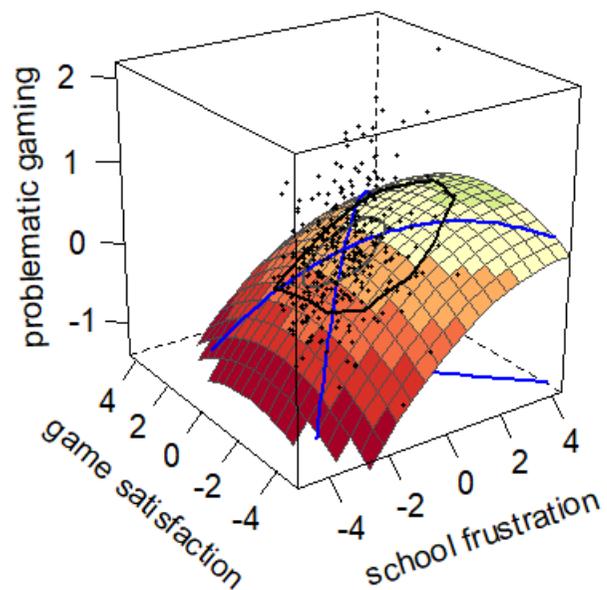


Figure 3B. RSA with game frustration and school satisfaction as predictors and problematic gaming as outcome, top view

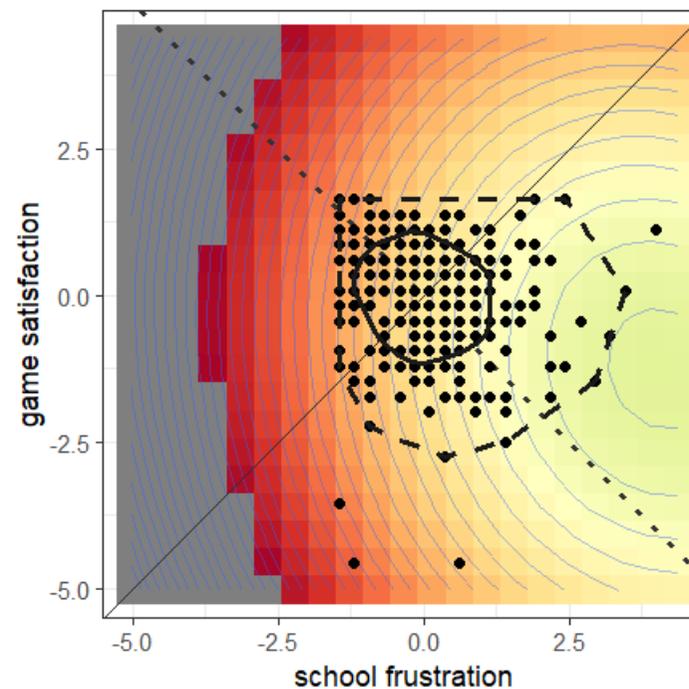


Figure 4A. RSA with game satisfaction and school satisfaction as predictors and school disengagement as outcome, 3D view

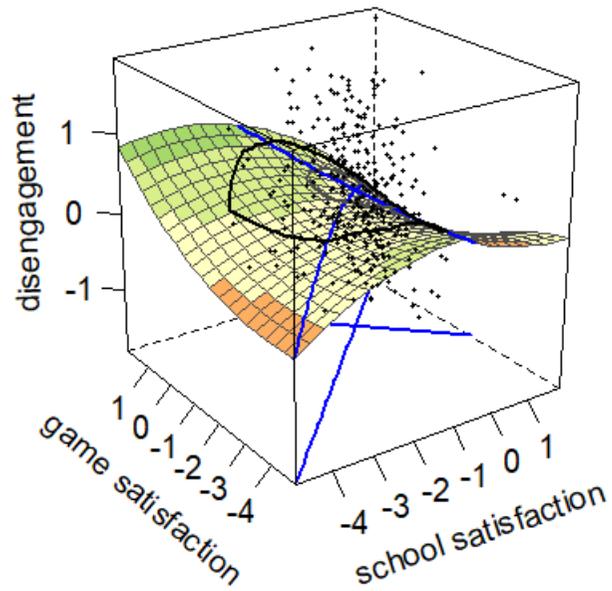


Figure 4B. RSA with game satisfaction and school satisfaction as predictors and school disengagement as outcome, top view

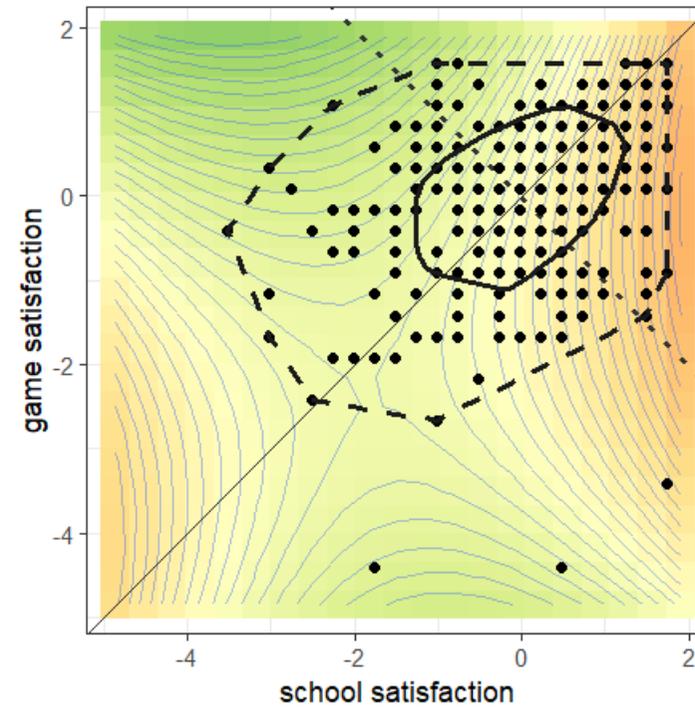


Figure 5A. RSA with game frustration and school satisfaction as predictors and school disengagement as outcome, 3D view

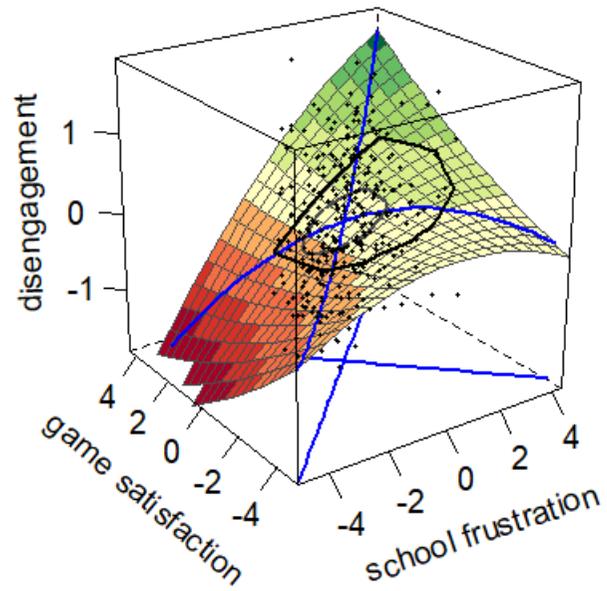


Figure 5B. RSA with game frustration and school satisfaction as predictors and school disengagement as outcome, top view

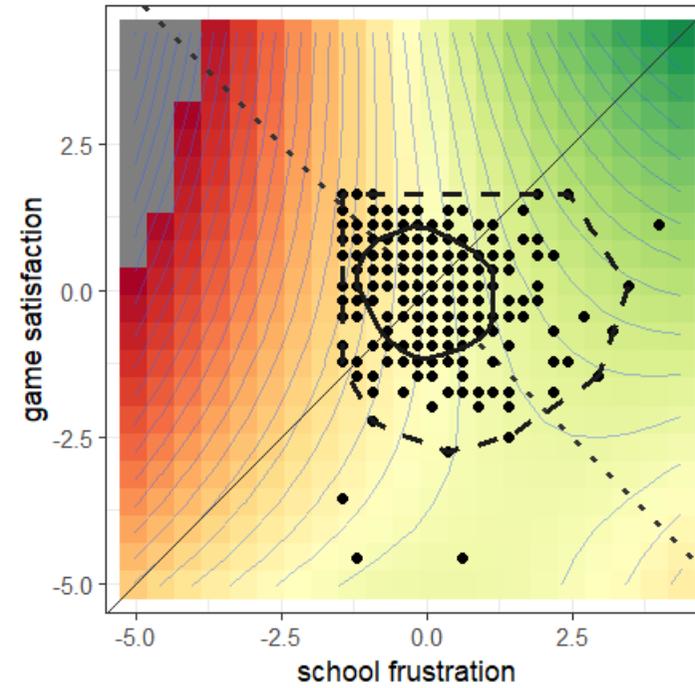


Figure 6A. RSA with game satisfaction and school satisfaction as predictors and school exhaustion as outcome, 3D view

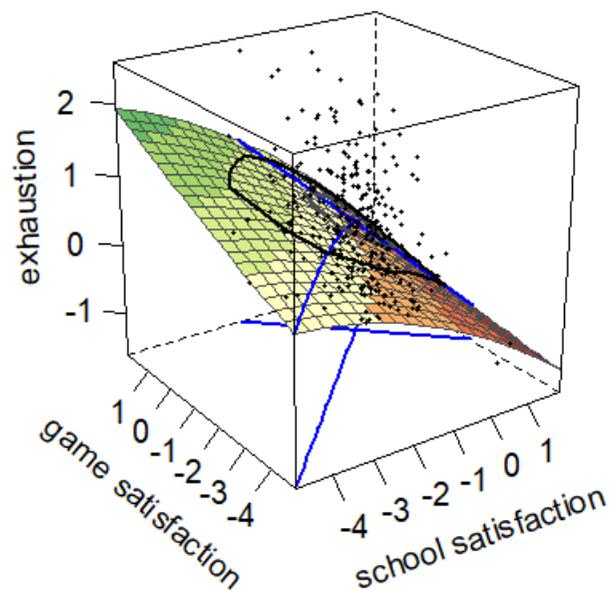


Figure 6B. RSA with game satisfaction and school satisfaction as predictors and school exhaustion as outcome, top view

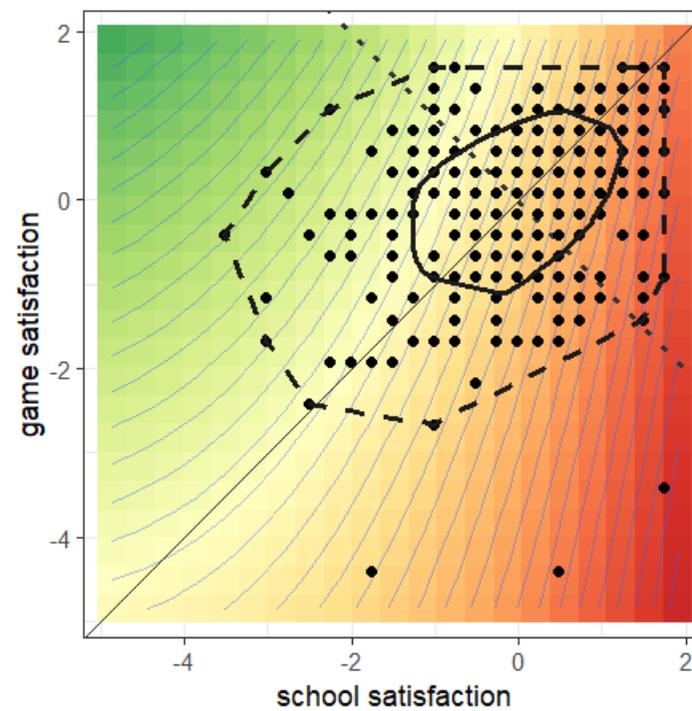


Figure 7A. RSA with game frustration and school satisfaction as predictors and school exhaustion as outcome, 3D view

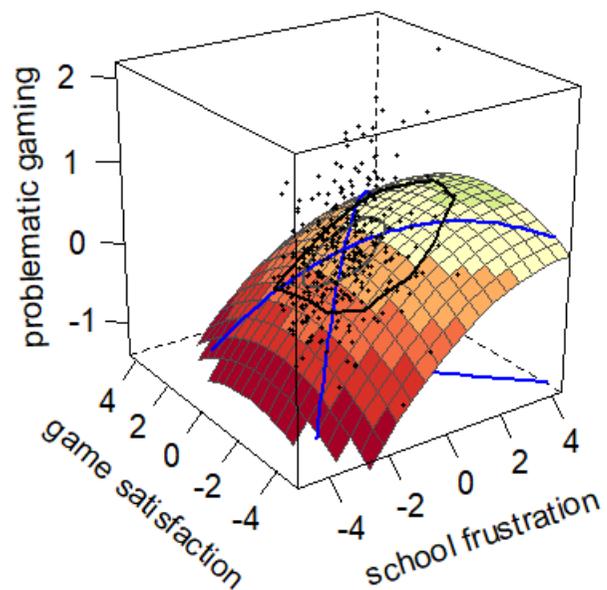


Figure 7B. RSA with game frustration and school satisfaction as predictors and school exhaustion as outcome, top view

