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Do Simulated Gambling Activities Predict Gambling with Real Money During Adolescence? Empirical Findings from a Longitudinal Study

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Abstract As technology has developed, the international gambling market has changed markedly in recent years. The supply of internet-based gambling opportunities has become ever more significant. At the same time, the introduction of new gambling opportunities always brings a demand for evidence-based scientific evaluation, with regard to the associated risks of addiction. Simulated internet gambling, which is the focus of this study, represents a relatively new product group located at the interface between gambling and computer gaming. Concerns have been raised in scientific literature, especially with regard to the adolescent age group, as to whether participation in simulated internet gambling directly promotes recruitment to the world of monetary gambling, as defined in the gateway hypothesis. The research design was based on a standardized, representative longitudinal survey (over a 1-year period) with a total of 1178 school pupils from Northern Germany ($M = 13.6$ years; 47.5% male). It must be borne in mind that 12% of the adolescents belonged to the subgroup of "onset gamblers" and first reported experience with monetary gambling at the second stage of surveying. Logistic regression analysis demonstrates that this migration process is fostered by (1) participation from home in simulated gambling on social networks and (2) significant exposure to advertising (relating to both simulated and monetary gambling). Within the subgroup of simulated internet gamblers, variables such as particular patterns of use (including breadth and depth of involvement with simulated internet gambling, certain motives for participation, and microtransactions) do not serve as significant predictors. Despite this, important needs for action for the purposes of prevention and research can be identified.

Keywords Simulated gambling · Longitudinal study · Adolescence · School survey · Predictors · Gambling onset

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Introduction

Rapid developments in technology, including the increasing availability of broadband internet access, smartphones, social networks and similar, have in recent years led to a fundamental structural change in the international gambling market (Gainsbury 2012). Whereas in the past gambling necessarily required a visit to a lottery outlet, a betting shop, a casino or a gaming arcade, nowadays it is easily done at any time of day from the living room or workplace. In addition, commercial suppliers of gambling services have created innovative business models that, in particular, attract younger generations who have grown up in the digital world (Derevensky et al. 2013; King et al. 2014). The focus of this paper is on simulated internet gambling, comprising a group of products that lies at the interface between gambling and gaming and that bears both particular features in the activity itself and also specific potential risks (Armstrong et al. 2018; Derevensky and Gainsbury 2016; Gainsbury et al. 2014b; Hayer and Brosowski 2016; King and Delfabbro 2016a; King et al. 2010; Meyer et al. 2015; Wohl et al. 2017).

Simulated internet gambling represents a relatively recent subject for research. It is thus scarcely surprising that there is not as yet any consensus in academic literature regarding a uniform system of nomenclature. Initially recourse was made to the expression "social gambling", which in narrower terms refers to free gambling apps available on social networks. King et al. (2014) established a broader concept that they termed "simulated gambling on the internet". The authors used this term in contrast to monetary gambling to denote any form of digital interactive gambling activity that does not require direct use of money but that, on the basis of its use of virtual currency and the perceived chance outcome of playing, is structurally identical to classic forms of gambling. Unlike monetary gambling, however, the outcome of the game in simulated internet gambling may not involve random processes (Gainsbury et al. 2016b). Rather, the outcomes seem to be based on specific algorithms that primarily serve to foster involvement in playing. As Rose (2014) has argued from a regulatory perspective, game manufacturers are free to set the odds at any level they want, an automatic process known as "dynamic game balancing". As a consequence, winning and losing situations are adjusted according to individual playing behavior, with any number of wins deliberately inserted at carefully defined intervals, not least to discourage players from dropping out. Thus, it is not surprising that transparency about how game outcomes are determined does not exist (Gainsbury et al. 2016b). Despite these structural differences, simulated internet gambling mimic real gambling scenarios and thus may offer experiences similar to gambling from a subjective point of view. Its main categories include demo games on independent websites (e.g. typical casino games played for tokens, points or play-money, and so-called poker schools) and countless gambling simulations on social network sites such as Facebook.

Simulated Gambling Games: Review of Potential Risks and Dangers

Availability

While monetary gambling is as a rule subject to regulatory restrictions due to the (addictive) risks associated with it, video and computer games and consequently also simulated internet gambling can generally be offered without licenses or other constraints. Against

the background of an absence of youth protection regulations in general and age limits in particular, simulated internet gambling has thus proved readily accessible to underage consumers. This fact is clearly reflected in the prevalence of participation found in various research studies with minors, regardless of differences in methodology, sample structure and cultural context. King et al. (2014), amongst others, presented findings from Australia showing that 32% of school pupils aged 12–17 years who were surveyed had taken part in some form of simulated internet gambling at least once in their lives (12-month prevalence: 13%). The most common experience was related to gambling in video games (26%), followed by gambling applications on Facebook (10%), gambling applications on smartphones (6%) and free-play or demo modes of casino websites (5%). In Canada, prevalence of participation in the last 3 months among 13–19 year-old juveniles amounted to 9% each for poker and gambling simulations on Facebook, and 5% for internet slots (Elton-Marshall et al. 2016). Finally, current data for schoolchildren aged 11–16 years in Great Britain showed a lifetime prevalence of 11% for playing free gambling-style social games online (Gambling Commission 2017). Here, the by far most popular access to online gambling-style games—referring to the past week—was using an app on a smartphone or tablet (73% among all 74 current users). Other more seldom modes of play included using Facebook or other social networking sites (28%), other websites (20%) and free demo games on gambling websites (17%).

Advertisement

From a supplier's point of view, extensive advertising activity forms a central pillar of the business model. Similarly, largely unregulated product marketing via social network sites in particular may well represent a significant driver of demand among both juveniles and those of adult age (Abarbanel et al. 2017; Downs 2010; Jacques et al. 2016; Kim et al. 2017b). From the perspective of the psychology of addiction, the fact that direct advertising for monetary gambling products is placed alongside that for simulated internet gambling is one that must draw criticism. According to adult respondents who regularly seek out simulated internet gambling options, significant exposure to advertising has an important influence on gaming activity (Gainsbury et al. 2014a). During the development phase of adolescence, it may be surmised—against the background of increased group pressure through the interactive elements of social networks—that phenomena such as viral marketing have been shown to be effective and, while going virtually unnoticed, are gaining entry into everyday life, changing attitude patterns and contributing to a creeping normalization of (both simulated and monetary) gambling (see Meyer et al. 2015).

Monetization

Almost all simulated internet gambling options are based on the freemium business model, under which initial participation in the game is cost-free. While the basis content is free to access, users have the additional option to buy play-money currencies or virtual items in order to gain particular advantages during game-play (Gainsbury et al. 2016a; Parke et al. 2012). These advantages may include extending game play, reducing waiting times, simplifying the playing process and securing additional functional or non-material advantages over other players (e.g. to express oneself or to obtain very rare virtual goods for status reasons). The purchases of virtual goods via micropayments is also referred to as microtransactions and represents an essential source of income for the operators (Kim et al. 2017a).

There is evidence from the literature that participants in simulated internet gambling who are prepared to pay for microtransactions are markedly different from non-payers. First, according to Gainsbury et al. (2016a), adults prepared to pay show evidence of a higher base level of playing frequency and involvement with regard to simulated internet gambling. Second, this subgroup also shows evidence of having a different core motivation for playing, such as relieving or suppressing stress. In addition, Kim et al. (2017a) were able to show that paying gamblers ($M = 35$ years) had a more marked tendency toward impulsiveness, greater receptiveness to reward and either a higher affinity to games of chance in general or significantly more symptoms of a gambling disorder in particular. These findings are essentially confirmed in a study among young people aged 12–17 years (King et al. 2016): here, too, the subgroup of paying gamblers reported not only considerably more frequent involvement in both simulated and monetary gambling activities, but in addition exhibited far more frequently the symptoms of a gambling-related maladjustment.

Game Design

The specific gaming principles involved in simulated internet gambling, moreover, give rise to the suspicion that regular playing is associated with cognitive distortions and further encourages recruitment into the world of real gambling. From the player's point of view, simulated internet gambling games can be seen as the ideal practice ground on which to acquire, as if without risk, the supposed core skills required in poker, for example (Kim et al. 2016). The gaming processes themselves, which are controlled rather than determined by chance, could entail concrete effects at a cognitive level (e.g. promoting an illusion of control) or at a behavioral level (e.g. increasing the desire to play). Especially problematic in this context are the unrealistically high pay-out rates in demo games (Sévigny et al. 2005), which give rise to false notions regarding the true chances of winning when gambling for real. Experimental studies (Bednarz et al. 2013; Frahn et al. 2015) and questionnaire-based surveys with adult problem gamblers (Hollingshead et al. 2016) offer confirmatory indications on such mediation processes. However, there is obviously a wide array of possible reasons why people play gambling-type games without money on the internet including fun, entertainment, relaxation, or relieving negative mood states such as boredom or depression, each with differential impacts on subsequent gambling behaviour. For example, as McBride and Derevensky (2009) have shown, only a minority of internet gamblers use free demo games to practice and hone their gambling skills. It is therefore indicated to consider different playing motivations as risk or protective factors, respectively.

Gateway Effect

At the center of the discussion on the potential risks associated with simulated internet gambling is the question as to whether regular use of the latter brings with it a shift into real gambling (as set out in the "gateway hypothesis") or is even predictive of the manifestation of gambling-related problems. Originally, the idea of the gateway hypothesis stems from addiction research and postulates a specific sequential pattern of drug consumption (Nkansah-Amankra and Minelli 2016). This hypothesis was formulated for the first time in the 1970s and suggested that an adolescent experimentation with certain legal drugs such as alcohol or tobacco is followed by the use of hard or illicit drugs such as heroin or cocaine. In a similar vein, both Kim et al. (2015) and Dussault et al. (2017) posed the

question whether playing for fun money could indeed lead people to playing with real money. Although Kim et al. (2015) used the term "migration" and Dussault et al. (2017) preferred the term "transition", both constructs clearly reflect the core concept of the gateway hypothesis.

Taken together, empirical studies have so far repeatedly demonstrated either statistically positive associations between participation in simulated and in monetary gambling or the presence of gambling-related problems at various different stages of development (Elton-Marshall et al. 2016; Gainsbury et al. 2014c; King et al. 2014; McBride and Derevensky 2012). Beyond this, Gainsbury et al. (2016b) determined that almost one-fifth of adult users of simulated games of chance regarded gambling for real money as a direct consequence of simulated gambling activity. Among young people this percentage rises to almost two-thirds, in cases where microtransactions were already conducted in the course of simulated internet gambling (King et al. 2016). Overall, however, due to the design of the relevant studies involving just one stage of measurement and the collection of retrospective information, the question must remain open as to whether participation in simulated internet gambling games in fact functions as a door-opener as postulated by the gateway hypothesis, or whether young people with an affinity for gambling regard such products rather as additional types of gaming in their gambling portfolio that they fall back on only in particular situations (e.g. lack of money).

Supplementary to this, the literature also contains two longitudinal studies on this subject area. A pilot study among an initial sample of 409 adults who, at their first interview, reported experience with simulated internet gambling (but not with monetary internet gambling) provides support for such a migration effect: more than one-quarter of the subsequently re-contacted respondents (n = 99) had, 6 months later, begun to gamble on the internet for real money (Kim et al. 2015). The sole predictor for such migratory behavior lay in prior microtransactions. The only longitudinal study of young people comes from Canada (Dussault et al. 2017). Here the research design is founded on a probability sample and two-stage interviewing (over a 1-year period) of 1220 school pupils in the age range of 14–18 years. Those who had already participated in monetary gambling at the time of the initial interview were excluded from the analysis, regardless of whether they had also taken part in simulated internet gambling. At the second stage, nearly 29% of the pupils reported having had their first experience with real gambling, almost without exception in the terrestrial field. Regardless of the access route, scratchcards dominated the responses (12.6%), followed by poker (8.3%), lotteries (5.6%) and sports betting (4.4%). The predictive relationship between simulated and monetary gambling activities persists in a multivariate analysis model even when other personal predictive characteristics such as age, sex, impulsiveness and use of alcohol or cannabis are taken into account. Examination by particular game types, however, confirms that this relationship holds solely for poker and not for scratchcards or sports betting: thus participation in simulated games of poker represents a significant predictor of starting to play poker for real money.

Aims of the Study

Although research into gambling in recent years has increasingly taken as its subject "simulated gambling on the internet", significant knowledge deficits continue to be apparent. First and foremost, among these is the lack of longitudinal data that could adequately answer the cardinal question regarding migration and the underlying causal effect mechanisms. Similarly, widely neglected is research among young people, who

are not only at particular risk of developing gambling-related problems (see Hayer 2012) but are also among the main consumers of simulated internet gambling, due to the ease with which they can access it. It is also worth noting that empirical findings are available almost exclusively for non-European countries (notably Australia and Canada). The present study therefore pursues the overriding objective of exploring for the first time—empirically and longitudinally, on the basis of a representative sample of young people in Germany—whether participation in various forms of simulated internet gambling actually increases the likelihood of participation in monetary gambling.

According to the available evidence, it was hypothesized that taking part in simulated gambling activities predicts monetary gambling above and beyond other variables (hypothesis 1). To test this effect, a subsample of individuals who had no experience with monetary gambling at the first wave of the data collection served as the unit of analysis (as proposed by the gateway theory). Furthermore, it should be explored in detail, what factors can possibly be held responsible for this relationship (within the subgroup of individuals who already have experience with simulated internet gambling). In particular, it was assumed that the degree of simulated gambling involvement, spending money in the course of simulated internet gambling (i.e. microtransactions), and certain motivations increase the probability of becoming an "onset gambler" (hypothesis 2).

Method

Sample

The study design was based on a standardized written questionnaire administered to students. Young people from school classes 6–10 represented the target group for the longitudinal survey. Data collection took place in two waves at an interval of just under 12 months (first stage T0: 05/18/2015–07/20/2015; second stage T1: 04/04/2016–05/19/2016) in the North German cities of Hamburg ($n_{T0} = 435$), Bremen ($n_{T0} = 964$) and Lübeck ($n_{T0} = 506$) (N = 1905). The 25 participating schools were stratified within region by type of school and socioeconomic status, and were selected at random. The anonymized questionnaires were matched up between the T0 and T1 surveys on the basis of specified key variables (primarily the first two letters of the father's and mother's forename, along with sex and school class; and in ambiguous cases by additionally comparing details of star sign, favorite club and other preferences, including comparisons of handwriting at each of the two stages in answers to open-ended questions). Through this procedure, of the N = 1905 valid questionnaires available from the first stage, it was possible to match up reliably N = 1178 questionnaires from the second stage conducted almost 1 year later (match success rate: 61.8%; Hamburg 220 out of 435 = 50.6%; Bremen 589 of 964 = 61.0%; Lübeck 369 of 506 = 72.9%).

The sample included a total of n = 559 male pupils (47.5%); 9.8% of all respondents were from an immigrant background (with a place of birth outside Germany). The mean age of pupils at T0 was calculated to be M = 13.6 years (SD = 1.4; range 11–19 years). The sample included one person who was over the age of majority but who, since the original criterion for inclusion (attendance in school class 6–10) had been met, was not excluded from subsequent analysis.

Survey Instruments

Participation—Simulated Gambling on the Internet (T0)

The questionnaire at T0 covered a total of four different types of simulated internet gambling (on social networks, via apps, through video games, as demo games) and two different access routes per type (from home, while out and about). The questionnaire asked separately for frequency of participation in each of these eight possibilities over the last 12 months. The five answers available ranged from "not at all" to "more than eight times a month". At the data processing stage, these individual answers were aggregated firstly into "participation in any simulated internet gambling in the last 12 months" and secondly by the four categories of game types, combining both access routes in each case. In addition, the total number of gaming types used (*SG breadth*) and the maximum frequency of participation across all eight gaming types (*SG depth*) provided further key indicators of usage behavior (for similar operational methods regarding monetary gambling forms, see LaPlante et al. 2014).

Participation—Monetary Gambling (T0/T1)

Data on participation in monetary gambling (T0/T1) were collected in a similar manner. Six different types of gambling were examined, all of them enjoying particular popularity among young people and relatively easily accessible at their stage of life (see Hayer 2012): lotteries, scratchcards, sports betting (including betting on sports for money among friends), gaming machines, poker (including poker for money among friends), and card or dice games other than poker (including card or dice games for money among friends). Once again, the pupils were asked to rate their frequency of participation in these over the last 12 months, on a five-point scale ranging from "not at all" to "more than eight times a month". The questionnaire also asked for an estimate of expenditure on gambling in a typical month. In addition, at the first stage, lifetime prevalence of participation was collected for all types of gambling, as well as 12-month prevalence of participation in internet gambling. With the aid of the questionnaire on gambling-related problems among young people (FGP; Hayer et al. 2016), *potentially problematic gambling behavior* was also identified at T1.

Other Analysis Variables (T0)

Socio-demographics Further potential predictors related first of all to selected *key socio-demographic variables*. These included male (vs. female) sex, school class (6–10), attendance at an academic high school [*Gymnasium* in the German system] (vs. attendance at other types of school) and immigrant background (vs. German origin).

Individual characteristics On the basis of theoretical considerations and available empirical findings, it was also thought worthwhile to allow for *delay discounting* as an additional risk factor related to the individual. On the basis of Reimers et al. (2009), the pupils were asked if they would prefer to receive €25 in 3 days' time or €50 in 3 months' time. This question is generally a reliable indicator of impulsiveness. In addition, to represent *gambling-specific cognitive distortions*, eight items from the Gambling-Related Cognition Scale (GRCS; referring to the control illusion subscale and the predictive control

subscale, the latter reduced by two items; Raylu and Oei 2004) were used (generating a cumulative value). Finally, seven in-house designed, five-point Likert-scaled questions were used to collect *exposure to advertising* for simulated and for monetary gambling. Specifically, the focus was on frequency of observing advertising, from "not at all" to "very frequently", in the following scenarios: by email or WhatsApp, on web pages or game content, on Facebook, via inserts within games, on TV or radio, in newspapers or magazines, and on posters or advertising billboards. As a supplement to this, respondents were asked to provide a basic *evaluation of the advertising* ("What is your overall opinion of advertising for monetary or simulated gambling?") using a four-point scale (from "very unobtrusive" to "very obtrusive").

Internet activities Another subject area was the *extent of internet activities* including *problematic usage patterns*. For this topic, the pupils were first asked to provide details of the frequency with which they performed seven different internet activities (including watching videos/listening to music, conducting research on the internet, playing computer games) on a six-point scale from "have never done it" to "almost every day". This range of variables allowed the *internet breadth* (total number of internet activities) and *internet depth* (maximum frequency across all internet activities) to be calculated. The German version of the Compulsive Internet Use Scale (CIUS; Gürtler et al. 2014) containing 14 items was used to generate a cumulative value for measuring any *addiction problems related to internet activities*.

Video and computer gaming activities The process with regard to *use of video and computer games* was in principle very similar. Here, too, the pupils assessed their current frequency of consumption of each of ten genres (including first-person/third-person shooters, sports/racing games, adventures/role-playing games), on a six-point scale from "have never done it" to "almost every day". Once again, this allowed the consumption indicators *computer gaming breadth* (total number of video and computer games used) and *computer gaming depth* (maximum frequency across all video and computer game genres) to be derived. Using the research criteria recommended by Petry et al. (2014) for operationalizing an Internet Gaming Disorder (IGD), *computer gaming-related problems* could also be determined (9 items each with four answer options from "does not apply at all" to "applies completely") (generating a cumulative value).

Simulated internet gambling—microtransactions A final block of variables related to those who had participated in simulated internet gambling at T0. In this context, that subgroup was asked whether they had spent money in the last 12 months (in the form of microtransactions) in the course of simulated internet gambling. In particular, attention was paid to three popular activities: purchasing a virtual currency, making cash payments to improve chances of winning, and making cash payments to reduce waiting times or in order to continue playing straight away (each measured on an in-house designed 4-point scale from "never" to "very often"). Two analysis variables could be extracted from this information: *making any microtransaction* and a cumulative value as an indicator of *frequency of making microtransactions*.

Simulated internet gambling—motivation It was also of interest to discover the *motivations* that had driven the pupils to take part in simulated internet gambling. Inspired by Scharkow et al. (2012), a list was freshly compiled containing 17 statements, each with five possible responses (from "does not apply at all" to "applies completely"). An exploratory principal component analysis, using factor extraction according to the Kaiser criterion (eigenvalues of factors > 1) and subsequent orthogonal rotation (Varimax), was used for the purposes of data reduction. After excluding cross-loading items, three significant motivating factors were identified and compiled into cumulative scalar values: (1) *communication*

and friendship, (2) *distraction and negative reinforcement*, and (3) *competition and excitement*. All three scales showed encouraging levels of internal consistency (Cronbach's alpha $0.78 < \alpha < 0.81$).

Simulated internet gambling—duration of play Finally, *overall duration* of selected internet activities was recorded in minutes or hours. In a series of assessments, a question was posed in which the pupils were asked to state, for a typical school day, for how long they played on *simulated gambling games* (in each case in the last 12 months).

Procedure

The data were collected by means of paper questionnaires as a class activity. Trained investigators read out standardized instructions and remained in the classroom after the questionnaires had been distributed in order to be able to issue advice on completing them, if problems with understanding arose. At each data collection stage, the average time taken to complete the questionnaire was approximately 30 min. To avoid misunderstandings or confusion between simulated and real gambling games, precise definitions were given of both forms of gambling, together with the core differences between them, both in the standardized instructions and on both versions of the questionnaire. Only pupils whose parents had given prior written permission to complete the survey were included in the study.

Drop-Out Analysis

Given the response rate of 61.8% (see above), the question arises as to whether non-participation in the second stage of data collection gave rise to any systematic distortion. The drop-out of an individual at the second data collection stage was significantly associated (at a confidence level of $p = 0.1$ using a Chi Square Test) with the following five characteristics: (1) data collection in Hamburg ($p \leq 0.001$); (2) school type: Gymnasium ($p \leq 0.001$); (3) participation in simulated gambling in video games from home ($p \leq 0.001$); (4) immigrant background ($p = 0.07$) and (5) male sex ($p = 0.07$). In addition, significant correlations were also found with the following four ordinal characteristics (using the Mann–Whitney Test in each case): (6) school class ($p \leq 0.001$); (7) cumulative score on problematic gambling behavior ($p = 0.01$); (8) video gaming breadth ($p = 0.06$) and (9) internet usage breadth ($p = 0.098$).

Using a simultaneous estimate of probability of drop-out, however, only three significant predictors remained in the final model: (1) school class (rising) (OR = 1.49; 95% CI = 1.38–1.61; $p \leq 0.001$); (2) data collection in Hamburg (OR = 2.39; 95% CI = 1.89–3.04) and (3) Gymnasium (OR = 0.52; 95% CI = 0.42–0.65). Using this predictive model, drop-out was correctly forecast in 66% of cases. Based on Ahern and Le Brocque (2005), the forecast drop-out probability of each individual was entered as a variable in the data set and analyzed as a covariate in all subsequent calculated forecast models, in order to be able to monitor statistically the distorting effect of systematic drop-out at the second data collection stage.

Data Management and Statistical Approach

The primary objective of this study was to predict initial contact with monetary gambling at T1, on the basis of participation in simulated internet gambling at T0 (see hypothesis 1). Since four distinct processes are conceivable between T0 and T1 (onset of gambling:

11.9%, termination of gambling: 27.3%, consistent consumption: 27.7%, consistent non-consumption: 33.2%; see Table 1), a comparison of those commencing gambling against all other subgroups in total could, due to the heterogeneity of the latter, have reduced the predictive power of the analyses. For the purposes of comparison, therefore, particular subgroups were selected. In the analysis set out below, those persons who at T0 had never spent money on gambling were selected from the total sample (N = 1178) (lifetime prevalence; differentiated details on usage behavior and on specific cross-sectional patterns of consumption can be found in Hayer et al. 2018). This made it possible to contrast the consistently abstinent pupils, who had no experience of gambling at T0 nor at T1 (n = 391), with the "onset gamblers", who had no experience of real gambling at T0 but who did have such experience at T1 (n = 140). Table 1 provides a summary of the core characteristics of both subsamples.

Binary logical regression analyses were conducted to predict the probability of having participated in real gambling at the second data collection stage (T1) ("onset gamblers"). Missing values in individual variables in the model were compensated by means of multiple imputation (40 imputed datasets as per Graham 2009, with subsequent calculation of means for the estimated parameters). The highest proportion of missing values was found in assessment of advertising (2.8%), delay discounting (2.5%) and cognitive disturbances (2.0%); in all other cases without exception the proportion lay below 1%. In each of the following logistical regressions, as a first stage all predictors were tested for a correlation with the outcome (bivariate); all significant predictors ($p \leq 0.05$) were then transferred into a multivariate model. Whilst the initial analyses relate to the total subsample (n = 531), in order to determine the relative importance of the "participation in simulated internet gambling" predictor variables, the subsequent analysis steps included only those pupils in both comparison groups who had already participated in simulated internet gambling at T0 (n = 202). Behind this process lay the question as to whether particular factors increased the risk of recruitment among those who already had experience of simulated internet gambling (see hypothesis 2). At the end of the results section can be found a more detailed description of the "onset gamblers" subgroup (with prior experience relating to simulated internet gambling) on selected parameters. Data analysis was conducted using SPSS 18.

Results

Predictors of Monetary Gambling: The General Role of Simulated Gambling Activities

At a bivariate level, recruitment into monetary gambling is fostered to a significant degree by (1) participation in any form of simulated internet gambling (OR = 1.96), (2) participation in simulated gambling on social networks (OR = 2.87), (3) participation in simulated gambling via apps (OR = 1.98), (4) participation in simulated gambling on social networks from home (OR = 3.00), (5) participation in simulated gambling via apps from home (OR = 2.10), and (6) greater exposure to advertising for simulated or monetary gambling (OR = 4.44). No other predictors showed any significant correlation (see Table 2).

The next analysis step accounted for all statistically significant predictors in a joint prediction model. In order to prevent multicollinearity, however, only the two differentiated forms of simulated internet gambling were included in the computer model: combined versions (such as participation in any form of simulated internet gambling) were excluded from this step.

Table 1 Overview of subsamples and their core characteristics (N = 1178)

Participation in monetary gambling				Male	Immigrant background	Participation in simulated internet gambling at T0	Age (years)
T0 2015	T1 2016	Subgroup	n (% of total sample)	n (% of subgroup)	n (% of subgroup)	n (% of subgroup)	M (SD)
No	No	Consistent abstainers	391 (33.19)	156 (39.90)	41 (10.49)	132 (33.76)	13.83 (1.29)
No	Yes	Onset gamblers	140 (11.88)	68 (48.57)	18 (12.86)	70 (50.00)	13.54 (1.46)
			531 (45.08)	224 (42.18)	59 (11.11)	202 (38.04)	13.42 (1.34)
Yes	No	Leavers	321 (27.25)				
Yes	Yes	Consistent participants	326 (27.67)				
		Total sample	1178 (100.00)				

T0 first data collection stage, *T1* second data collection stage

Table 2 Results from logistic regression (bivariate and multivariate) in predicting recruitment to gambling with real money (n = 531)

Predictor at T0	OR (95% CI) Bivariate	OR (95% CI) Multivariate
Any simulated internet gambling	1.96 (1.33; 2.91)***	–
Any simulated gambling		
On social networks	2.87 (1.57; 5.26)***	–
Via apps	1.98 (1.14; 3.45)*	–
In video games	1.40 (0.92; 2.11) ns	–
As demo games	1.76 (0.71; 4.33) ns	–
Simulated gambling from home		
On social networks	3.00 (1.63; 5.52)***	2.42 (1.25; 4.69)**
Via apps	2.10 (1.20; 3.68)**	1.49 (0.80; 2.75) ns
In video games	1.45 (0.89; 2.35) ns	–
As demo games	1.52 (0.59; 3.90) ns	–
Simulated gambling when out and about		
On social networks	2.36 (0.71; 7.87) ns	–
Via apps	1.67 (0.77; 3.61) ns	–
In video games	1.22 (0.77; 1.94) ns	–
As demo games	0.92 (0.09; 8.90) ns	–
Male sex	1.42 (0.97; 2.10) ns	–
School class	0.99 (0.76; 1.29) ns	–
Academic high school [*Gymnasium*] (vs. others)	0.77 (0.50; 1.18) ns	–
Immigrant background	1.26 (0.70; 2.27) ns	–
Delay discounting	0.93 (0.62; 1.41) ns	–
Cognitive disturbances	1.97 (0.43; 8.98) ns	–
Exposure to advertising	4.44 (1.33; 14.78)*	3.53 (1.04; 12.00)*
Advertising evaluation	1.09 (0.89; 1.33) ns	–
Internet breadth	1.09 (0.93; 1.27) ns	–
Internet depth	1.09 (0.76; 1.55) ns	–
Internet-related problems	0.85 (0.23; 3.05) ns	–
Computer game breadth	1.00 (0.93; 1.09) ns	–
Computer game depth	1.08 (0.94; 1.24) ns	–
Computer gaming-related problems	1.02 (0.17; 6.10) ns	–

***$p \leq 0.001$; **$p \leq 0.01$; *$p \leq 0.05$; ns $p > 0.05$; – not assessed

In this simultaneous examination of all of the predictors found to be relevant at the bivariate stage, only (1) exposure to advertising (OR = 3.53) and—in line with the first hypothesis—(2) participation in simulated gambling on social networks from home (OR = 2.42) continued to be significant predictors. Participation in simulated gambling via apps from home was no longer significant here (OR = 1.49) (see Table 2). The accuracy of the model was calculated at 5% (Nagelkerke's R^2).

Are There any Distinctive Patterns of Simulated Gambling Activities that Predict Monetary Gambling?

In a detailed analysis, all pupils who had already participated in simulated internet gambling at T0 (n = 202) were examined to determine whether recruitment into monetary gambling was significantly associated at a bivariate level with particular types of, or motivations for, usage behavior. It can be seen from Table 3 that none of these characteristics was more than randomly correlated with recruitment. Hypothesis 2 therefore needed to be rejected.

Simulated Gamblers (T0) Who Start With Monetary Gambling (T1): Descriptive Parameters (n = 70)

In order to obtain a more precise picture of the new recruits (n = 70), the following core characteristics of this subgroup are worth mentioning. This subgroup included n = 39 male pupils (55.7%); a total of n = 9 pupils (12.9%) were from an immigrant background. Distribution across the different class grades at T0 appears unremarkable (class 6: n = 20 or 28.6%; class 7: n = 15 or 21.4%; class 8: n = 20 or 28.6%; class 9: n = 10 or 14.3%; class 10: n = 5 or 7.1%). Among the forms of gambling newly consumed at T1, the dominant versions were scratchcards (n = 34 or 48.6%), followed by sports betting (n = 19 or 27.5%), other card or dice games (n = 16 or 23.2%), gaming machines (n = 9 or 13.2%), poker (n = 8 or 11.6%) and lotteries (n = 7 or 10.1%). For recruitment into gambling, the internet plays a somewhat subordinate role (n = 13; 18.6%). Finally, 27 pupils (38.6%) reported that in a typical month they spent only a very small proportion of their own money (less than €5) on gambling. Only one pupil (1.4%) reported a sum in the range €5–€10; no information was available for the remainder (n = 42; 60.0%). Similarly, potentially problematic gambling behavior was identified through FGP-J in only one pupil (1.4%).

Discussion

This study represents the third time that longitudinal data from anywhere in the world have been presented, covering the issue of whether simulated internet gambling functions as a door opener and thus increases the likelihood of subsequent participation in monetary

Table 3 Results of bivariate logistic regression in predicting recruitment to gambling among participates in simulated internet gambling at T0 (n = 202)

Predictor at T0	OR (95% CI)
Simulated gambling—breadth	1.06 (0.84; 1.35) ns
Simulated gambling—depth	0.85 (0.65; 1.11) ns
Any microtransaction (in simulated gambling)	1.08 (0.51; 2.29) ns
Frequency of microtransactions (in simulated gambling)	1.02 (0.69; 1.50) ns
Duration of play on a typical school day (simulated gambling)	1.01 (0.74; 1.37) ns
Motivation (any simulated gambling): communication and friendship	1.05 (0.96; 1.16) ns
Motivation (any simulated gambling): distraction and negative reinforcement	0.99 (0.95; 1.04) ns
Motivation (any simulated gambling): competition and excitement	1.00 (0.91; 1.10) ns

gambling. Moreover, following on from Dussault et al. (2017), this is only the second time that underage juveniles have been the focus of research. Overall, the results show that a significant minority of the pupils questioned can be identified as being onset gamblers during the period of the survey and that—alongside exposure to advertising and above and beyond other variables—the consumption of a particular form of simulated internet gambling (on social networks, from home) indeed represents a significant predictor (see hypothesis 1). Further empirical indications of the specific mechanisms by which this occurs (i.e. risk-inducing factors within the subgroup of simulated gamblers) could not be determined (see hypothesis 2).

In the context of the deliberately broad definition selected, with four different forms of simulated internet gambling and two different access routes, it must first be noted that in Germany, one in every two school pupils aged 11–19 years has had experience of such gaming opportunities (12-month prevalence; cf. Hayer et al. 2018 in detail). Simulated internet gambling is currently a reality of life for many adolescents, above all due to its widespread presence within video games. At the same time, the longitudinal evidence shows a degree of fluctuation in consumption of monetary gambling: while 12% of the sample fell into the "onset gamblers" subgroup, 27% of respondents terminated their gambling activities during the period of the research ("leavers"). This finding suggests a certain amount of variability in the consumption behavior during adolescence and implies that a majority of school pupils do experiment with monetary gambling but do not take part regularly or to an intensive degree. Analogous data have been found in other research studies (e.g. Delfabbro et al. 2014), so it is hardly surprising that they appear here in a sample with a fairly low average age of $M = 13.6$ years. Further analysis—including analysis based on this present dataset—should tackle the question as to whether such trialing behavior can also be observed in the field of simulated internet gambling.

Aside from this, the proportion of onset gamblers seems markedly smaller than that found in either of the other longitudinal studies (26% in Kim et al. 2015; 29% in Dussault et al. 2017). A closer look at the methodological procedures in each study puts these differences into context, however. The proportion quoted in Kim et al. (2015), for example, relates solely to adults with experience in the field of simulated internet gambling (and with no experience of monetary internet gambling) and is consequently based on a restricted population. Moreover, only 24% of respondents were available for the second stage of data collection. The structure of the base sample in the youth study conducted by Dussault et al. (2017), and thus the calculation of this proportion, was similarly restricted, since in this study all respondents with experience of monetary gambling were excluded in advance. If such an exclusion criterion is applied to individuals in the present study's sample, the proportion of onset gamblers rises to 26% (140/531; see Table 1). The proportion of onset gamblers is thus broadly consistent across the studies.

In the context of the multivariate analysis, two variables emerged independently of one another as being predictive of participation in monetary gambling. First, participation in simulated gambling on social networks (from home) represents a significant predictor. This supports the empirical findings of Dussault et al. (2017) and can be seen as evidence of the gateway effect suggesting a sequential pattern of gambling participation from simulated to real forms of gambling (see hypothesis 1). In contrast to the Canadian working group, which sought to differentiate at the level of gaming type, the focus here was on four different forms of distribution of simulated internet gambling and two different access routes. Both studies indicate the necessity to determine more precisely the functional correlation (discussed mostly at an abstract level in the literature) between participation in simulated internet gambling and associated recruitment into the world of monetary gambling. Thus

Dussault et al. (2017) were able to provide empirical support for such a process only for poker playing; in the present study, this was the case only for participation in simulated gambling on social networks (from home). What forms of gambling are concealed behind this usage behavior must remain open at this point, as must comments regarding the specific effect mechanisms or effect chains. Interestingly, the first contact with real gambling—as in Dussault et al. (2017)—takes place primarily in the terrestrial area, and here chiefly via the purchase of scratchcards. In this respect, too, any attempts to explain possible causal mediation processes must at best remain speculative. In the meantime, the very low average expenditure on monetary gambling certainly suggests the scenario of onset gambling and/or somewhat sporadic gambling activities. This fact, combined with the almost universal absence of individual manifestations of problems (just one of the young persons showed signs of a gambling-related disorder), may well be due in particular to the narrow time frame available for inspection (1 year) and the relatively young average age of the sample. In any case, future studies must consider the complex notion of the gateway effect including (simulated/real) gambling type, mode of access and a more precise definition of migration (e.g.: Does the term "migration" mean to completely replace simulated gambling with monetary gambling or to additionally start with monetary gambling after having made experiences with non-monetary forms of gambling?; see for similar cautionary remarks Gainsbury et al. 2016b).

The second factor is the key role played by exposure to advertising for simulated or real games of chance, as operationalized by perceptions of its frequency, in the initial decision to gamble for real money. This finding is in line with corresponding correlations elsewhere (including Clemens et al. 2017; Gavriel Fried et al. 2010) and confirms the general receptiveness of young people to such promotional messages. Although no distinction was drawn in the present study between advertising for monetary and for simulated gambling, there is a clear suggestion that particularly the unregulated product marketing of simulated internet gambling, for example on social networking sites, is affecting adolescent demand (Abarbanel et al. 2017; Downs 2010; Jacques et al. 2016; Kim et al. 2017b). To summarize, it may be stated that advertising for (simulated) gambling products is not only being seen by adolescents but is also arousing, in a proportion of underage persons, a drive for monetary gambling activities. In particular, the almost unrestricted marketing opportunities offered by the internet may in the future provide a further impulse to this (e.g. through optimized exploitation of viral or individually tailored marketing strategies).

For the sake of completeness, reference should be made to the fact that the majority of all statistical tests revealed no significant correlations between the respective predictor and outcome variables (whether in comparisons between onset gamblers and gambling abstainers or—in every single case—within the subgroup of simulated gamblers; see hypothesis 2). Perhaps most interestingly, simulated internet gambling in the context of video games and thus the most frequently occurring form of play (Hayer et al. 2018; King et al. 2014) appears not to lead to gambling with real money. Since gambling in video games is most often a necessary accessory element of a highly complex gaming process, this raises a fundamental question about its nature as a stimulant to subsequent gambling activities. Future research should therefore ensure that, in the process of defining simulated gambling activities, more emphasis is placed on the centrality of the gambling element in video games, and that the perceived relevance of the gambling relationship with video games in general is more clearly explored (cf. Gainsbury et al. 2014b; Hayer et al. 2018). Furthermore, neither socio-demographic nor other personal factors covered by our investigation increased the likelihood of becoming a "real gambler". Given the very act of making microtransactions (cf. Kim et al. 2015) and the strong influence of the attribute "delay discounting" as

an indicator of impulsive behavior (Dussault et al. 2017), such factors would have been expected to have had an effect. Sample-specific aspects such as the relatively young age of the sample, the associated low level of variation by individual variables (the proportion of pupils who had spent money on simulated internet gambling, amongst others, was very low) and the lack of detail in the definition of constructs (e.g. using just one item for delay discounting) may have significantly affected these results.

Study Limitations

Undoubtedly the present study has many strengths, including the involvement of young persons in a longitudinal study, the representativeness and size of the sample, the innovative nature of the research subject and the inclusion of a wide range of potential predictors. This makes it possible to claim with some confidence that empirical findings that add to the fund of scientific knowledge have been made. Nonetheless, the findings must be evaluated against the background of certain study limitations. First, the results depend on self reports. Although in questionnaire development great value was placed on presenting unambiguous definitions of terms, misunderstandings and a tendency to answer according to social acceptability cannot be excluded, especially in this age group. Certainly the highly varied comprehension of the concept of simulated internet gambling (including its operationalization in the course of empirical studies) makes it more difficult to compare and evaluate the findings. Second, it must be noted that the questionnaire used included some items and elements that were formulated in-house. These had not been subjected to any psychometric evaluation, which in turn raises questions regarding the validity and reliability of the findings. Third, the investigation timescale of 1 year represents a clearly delimited portion of adolescent development. In particular, extending the design of the study to include additional stages of data collection, taking into account key transition stages of development (including reaching young adulthood) would improve the quality of the results still further. Fourth, certain aspects of the statistical process have to some extent a determining effect on the results: the statistical approach used here, for example, takes into account neither non-linear correlations nor specific cause-and-effect relationships (e.g. moderating and mediating effects). Finally, the modest level of accuracy of the model implies that variables not covered by this study might make an important contribution to understanding recruitment into the world of real gambling (e.g. parental upbringing; cf. King and Delfabbro 2016b).

Future Directions

Despite these limitations, the present findings offer a promising starting point for linked research studies. Alongside the knowledge deficits already raised, a primary task for the future is to determine the functional role played by scratchcards in recruitment, in association with prior participation in simulated internet gambling. Aside from this, there is a need for scientific research on the systematic development of the definition of the concept, on changes in consumption behavior at a population level (by means of a monitoring study) and on the use of simulated internet gambling as a pedagogic instrument or "serious game". From the perspective of prevention, due to the increasing blurring of the lines between computer games and gambling, it is suggested that existing, established programs designed to promote media skills should be expanded to cover elements relating to

gambling. There is additionally a need to develop informative and explanatory materials aimed at involved adults (parents and teachers, for example). Finally, the empirical findings and theoretical knowledge have the following implications for regulatory minimum standards in the field of simulated internet gambling: (1) a ban on advertising aimed directly at minors; (2) a general obligation to inform in relation to the controlled gaming processes and probabilities of winning; (3) limits on microtransactions and full transparency regarding all transactions involving real money (Derevensky and Gainsbury 2016; Hayer et al. 2018).

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Compliance with Ethical Standards

Conflict of interest Gerhard Meyer has received grants for gambling research from the German Research Foundation, the Federal Ministry of Health, the Ministries of Health of North Rhine-Westphalia, Hamburg and Bremen, the Ministry of the Interior of Hesse and Lower Saxony, and several gambling providers. Jens Kalke has received grants for gambling research from the Federal Ministry of Health, the Ministries of Health of Hamburg, Hesse and Schleswig-Holstein, several federal lottery companies and state-licenced casinos. Tobias Hayer and Tim Brosowski declare that they have no conflict of interest.

Ethical Approval All procedures performed were in accordance with the 1964 Helsinki declaration and its later amendments. A written declaration of agreement from parents was a general precondition of participation in the study. In addition and regardless of this, the young persons were able at any time to refuse to participate in the survey. Matching of an individual's questionnaires from different stages for data analysis purposes relied on a coding system that guaranteed the anonymity of participants in all cases.

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