Tampere University

JOSEPH MACEY

A Whole New Ball Game

The growing prevalence of video game-related gambling

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ACADEMIC DISSERTATION
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When I moved to Finland in 2011, I could not have predicted that ten years later I would be adding a few extra letters to my name; that, if desired, I could refer to myself as "Dr. Macey", "Joseph Macey, PhD" or whatever combination took my fancy. But these few letters represent a period of significant change in my life, since I applied to resume my studies I have become a father, I have become a Finn, and now I have become a Doctor of Philosophy.

For this latter achievement I give heartfelt thanks to my supervisor Professor Juho Hamari, without whom it would not have been possible. I am hugely grateful to Juho, not only for the advice and the guidance which he has provided, but for his faith and his support. Working alongside Juho has been a steep learning curve and we have developed not only a great working relationship, but a real friendship.

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value, I am privileged to be able to count not just on your knowledge and expertise but also on your friendship.

I am the person I am today thanks to my parents, Jane and Terry, and to the rest of my family, thank you for providing me with the courage to explore the world and the confidence to take on any challenge that lies in my path. Thanks also for raising me in the middle of the countryside where there was little else to do other than read and play computer games.

In a very literal way, I would not be here today were it not for my wife and partner, Anna-Leena: I would not be in Finland if I had not met you, and I would not have known about the Esports research project had you not noticed the advert. And, most importantly, I would not have been able to pursue an academic career without a loving and supportive home; we have spent most of our adult lives together and I honestly cannot imagine being without you. Finally, I want to express my love and gratitude to Onni, thank you for being you, for bringing such light and happiness into our lives and for ensuring that I do not have the spare time to work on evenings or weekends. Also, don't worry: most people will have got bored by now and are unlikely to read your name.

Tampere, November 2021.
Joseph Macey

ABSTRACT

Recent decades have seen the parallel trends of the growing liberalisation of gambling practices and the increasing significance of games as both entertainment media and cultural reference points. It is, therefore, unsurprising that there has been a rapid convergence between video game play and gambling; it is a process in which traditional distinctions are becoming increasingly blurred, creating not only new activities and driving the development of new social relationships and consumption practices.

The convergence of gaming and gambling facilitated by digital technologies has become the subject of growing academic attention in in recent years, spurred by the rapidly growing social and economic impact of these digital media products. Much attention has been focused on the in-game items known as loot boxes, however, there are many more examples of gambling, and gambling-like mechanics, being used to drive player engagement and, consequently, monetisation. Concerns have been raised about such developments, with commentators arguing that they are inherently exploitative, that they normalise gambling and gambling-like interactions, and that they encourage problematic consumption.

At the time this research was conducted, there existed a significant and notable dearth of empirical work addressing video games and gambling, with what published works there were predominantly focusing on legal and regulatory issues. The aim of this dissertation, therefore, is to investigate the emerging phenomenon of video game-related gambling (such as esports betting, virtual item lotteries, loot boxes, and other emergent practices) and its connection to video gaming habits, maladaptive cognitions, and motivations for consumption of online services. The work is divided into a series of complementary perspectives that, in unison, provide both depth and breadth to the investigation.

This dissertation constitutes the first empirical work dedicated to the study of video game-related gambling as a distinct topic; previously, work in this area had addressed individual activities, for example SCG or esports betting. In particular, the articles included as part of this work were among the first to address the role of loot boxes and other virtual items in facilitating gambling related to video games, an issue which has since gathered significant attention from within academia and beyond. Furthermore, this work provides a record of video game-related gambling at a key period of its

development, a time of significant change and increased attention from those both inside and outside of the video game ecosystem.

Whereas prior works had examined populations of video game players, esports fans, or gamblers, this work is the first to identify those who reside at the intersection of these groups: those who participate in video game-related gambling specifically. A particular contribution of this work has been to highlight the presence of under-age individuals in the video game-gambling ecosystem. This is a group who are often absent from such studies, despite the increased risks known to be associated with early exposure to gambling.

Building upon these areas, this dissertation includes one of the first studies of gambling-related cognitions among video gamers who gamble; as a result of this work it developed the first measure for identifying such cognitions in this population. At the same time providing knowledge which can improve established measures used to identify gambling-related cognitions in traditional gambling populations, for example in reference to the ways in which luck and skill are conceptualised.

The knowledge generated by this body of work, both practical and theoretical, has contributed greatly to understanding the relationships between video game play and gambling behaviour. It has added to the growing body of evidence which questions the perspective that playing video games contributes directly to the development of problematic gambling. Instead, it highlights the influence of contextual factors, such as the surrounding consumption cultures associated with particular games or media formats, which are of greater significance to the development of gambling behaviours, rather than simply playing games.

All four articles included in this work employ quantitative methodologies in order to gain high-level insights into the phenomenon; they are among the first empirical investigations of video game-related gambling and its varied manifestations and, as such, provide a foundation upon which further research into specific phenomena can be built, while also serving as a record of activities and behaviours during a period of notable change in the field.

TIIVISTELMÄ

Viime vuosikymmenten aikana esiin on noussut kaksi rinnakkaista suuntausta, rahapelikäytäntöjen lisääntynyt vapauttaminen sekä pelien kasvanut merkitys viihdemedioina ja kulttuurisina kiinnekohtina. Näistä suuntauksista johtuen video- ja rahapelien välillä tapahtunut nopea lähentyminen ei siis ole yllättävää. Prosessin aikana perinteiset erot ovat yhä enemmän hämärtyneet, luoneet uusia toimintoja sekä vaikuttaneet uudenlaisten sosiaalisten suhteiden ja kulutuskäytäntöjen kehittymiseen.

Digitaaliteknologian mahdollistama pelaamisen ja rahapelien lähentyminen on saanut viime vuosina yhä enemmän huomiota myös akateemisessa yhteisössä, näiden digitaalisten mediatuotteiden nopeasti kasvavien sosiaalisten ja taloudellisten vaikutusten vuoksi. Pelien sisäisiin kohteisiin, yllätyslaatikoihin (eng. loot boxes), on kiinnitetty paljon huomiota, mutta esimerkkejä rahapelien kaltaisesta mekaniikasta pelaajien sitouttamiseksi ja siten taloudellisen kannattavuuden edistämiseksi on olemassa paljon enemmän. Tämän kaltainen kehitys on herättänyt huolta ja nostanut esiin väitteitä ilmiön hyväksikäyttävästä luonteesta, rahapelien ja rahapelimäisten piirteiden normalisoinnista sekä ongelmalliseen kulutukseen kannustamisesta.

Tätä tutkimusta tehtäessä esiin nousi huomattava, video- ja rahapelejä käsittelevän empiirisen tutkimuksen puute. Aiheesta aiemmin julkaistu tutkimus on keskittynyt pääasiassa pelaamisen oikeudellisiin näkökulmiin ja säännöstelyyn liittyviin kysymyksiin. Tämän väitöskirjatyön tavoitteena onkin siis tutkia videopeleihin liittyvää rahapelaamista (kuten e-urheiluvedonlyöntiä, virtuaalisia arpajaisia ja yllätyslaatikoita) ja sen yhteyttä videopelien pelaamistottumuksiin, virheellisiin uskomuksiin sekä motiiveihin verkkopalveluiden kuluttamisesta. Tämä väitöskirjatyö on jaettu sarjaksi toisiaan täydentäviä näkökulmia, jotka yhdessä tuovat tutkimukseen syvyyttä ja laajuutta.

Tämä väitöskirja muodostaa ensimmäisen empiirisen tutkimuksen, joka keskittyy erillisenä aiheenaan nimenomaan videopeleihin liittyvän rahapelaamisen tarkasteluun. Aiemmin tällä kentällä tehdyt tutkimukset ovat tarkastelleet yksittäisiä käytäntöjä, esimerkiksi sosiaalisessa mediassa pelattavia kasinopelejä (eng. social casino games, SCG) tai e-urheiluvedonlyöntiä. Erityisesti mainittakoon, että tähän työhön sisällytetyt artikkelit käsittelivät ensimmäisten joukossa yllätyslaatikoiden ja muiden virtuaalisten tuotteiden roolia videopeleihin liittyvän rahapelaamisen mahdollistajina. Aihe on sittemmin saanut merkittävää huomiota paitsi akateemisen yhteisön sisällä, myös sen

ulkopuolella. Lisäksi tämä työ muodostaa kuvan videopeleihin liittyvän rahapelaamisen kehityksen avainaikakaudesta, sen aikana tapahtuneista merkittävistä muutoksista sekä aiheen saamasta, lisääntyneestä huomiosta niin videopeliekosysteemin sisä- kuin ulkopuolellakin.

Aikaisempien töiden keskittyessä tutkimaan videopelien pelaajia, e-urheilun seuraajia tai rahapelaajia, tämä työ tunnistaa ensimmäistä kertaa näiden ryhmien leikkauspisteissä olevat henkilöt: ne, jotka erityisesti osallistuvat videopeleihin liittyvään rahapelaamiseen. Erityishuomio tässä työssä on ollut tuoda esiin alaikäisten henkilöiden läsnäolo videopelien ja rahapelien ekosysteemissä. Tämä ryhmä on usein poissa vastaavanlaisista tutkimuksista, vaikka varhaiseen rahapelaamiselle altistumiseen tiedetäänkin liittyvän lisääntyneitä riskejä.

Edellä kuvattuihin aihealueisiin pohjautuen tämä väitöskirjatyö pitää sisällään yhden ensimmäisistä tutkimuksista, joka käsittelee rahapelaamiseen liittyviä uskomuksia rahapelejä harrastavien videopelaajien keskuudessa. Tutkimuksen tulosten perusteella kehitettiin myös ensimmäinen mittari tunnistamaan kyseisiä uskomuksia kyseisessä pelaajien joukossa. Samaan aikaan tutkimuksen tulokset tarjoavat tietoa, jonka avulla voidaan parantaa jo vakiintuneita, rahapelaamiseen liittyviä uskomuksia perinteisissä rahapelaajaryhmissä tarkastelevia mittareita.

Tämän väitöskirjatyön tuottama teoreettinen ja käytännön tieto on auttanut suuresti videopelien pelaamisen ja rahapelikäyttäytymisen välisten suhteiden ymmärtämistä. Se liittyy osaksi tutkimusten sarjaa, jotka osaltaan kyseenalaistavat polkuteorian näkemyksen videopelien pelaamisen suorasta myötävaikutuksesta ongelmallisen rahapelaamisen kehittymiseen. Sen sijaan tämä työ korostaa asiayhteyden, esimerkiksi pelaajayhteisöjen ja mediamuotojen vaikutuksen tärkeyttä. Näiden yhteyksien merkitys rahapelikäyttäytymisen kehittymiselle on pelkkää pelaamista suurempi.

Kaikissa neljässä tähän väitöskirjatyöhön sisältyvässä artikkelissa käytetään kvantitatiivisia menetelmiä ilmiön tarkastelemiseksi ja korkeatasoisen näkemyksen saavuttamiseksi. Kaikki artikkelit ovat ensimmäisten empiiristen tutkimusten joukossa tarkastelemassa videopeleihin liittyvää rahapelaamista ja sen erilaisia ilmenemismuotoja. Tutkimukset luovat perustan, jonka varaan kyseisiä ilmiöitä tarkasteleva jatkotutkimus voi rakentua, ja ne toimivat myös tallenteena toiminnoista ja käytänteistä kentällä tapahtuneen, merkittävän muutoksen aikana.

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ABBREVIATIONS

1.1 Methodological abbreviations:

AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
EFA	Exploratory Factor Analysis
GoF	Goodness-of-fit
PA	Parallel Analysis
PCLOSE	p of Close fit
PLS-SEM	Partial Least Squares Structural Equation Modelling
RMSEA	Root Mean Square Error of Approximation
SRMR	Standardised Root Mean Residual
VIF	Variance Inflation Factor

1.2 Other Abbreviations:

API	Access Protocol Interface
EGM	Electronic Gambling Machine
F2P	Free-to-Play
FPS	First-person Shooter
GaaS	Games-as-a-Service
GAS	Game Addiction Scale
GRCS	Gambling Related Cognitions Scale
LAN	Local Area Network
MMORPG	Massively Multiplayer Online Role-Playing Game
MOBA	Multiplayer Online Battle Arena
MSSC	Motivation Scale for Sports Consumption
PGSI	Problem Gambling Severity Index
RTS	Real-Time Strategy
SCG	Social Casino Game

ORIGINAL PUBLICATIONS

Publication I. Macey, J., & Hamari, J. (2019). eSports, skins and loot boxes: Participants, practices and problematic behaviour associated with emergent forms of gambling. New Media & Society, 21(1), 20-41. https://doi.org/10.1177/1461444818786216

Publication II. Macey, J., & Hamari, J. (2018). Investigating relationships between video gaming, spectating esports, and gambling. Computers in Human Behavior, 80, 344-353. https://doi.org/10.1016/j.chb.2017.11.027

Publication III. Macey, J., Abarbanel, B., & Hamari, J. (2020). What predicts esports betting? A study on consumption of video games, esports, gambling and demographic factors. New Media & Society. 23(6), 1481-1505. https://doi.org/10.1177/1461444820908510

Publication IV. Macey, J., & Hamari, J. (2020). GamCog: A measurement instrument for miscognitions related to gamblification, gambling, and video gaming. Psychology of Addictive Behaviors, 34(1), 242-256. https://doi.org/10.1037/adb0000526

AUTHOR'S CONTRIBUTIONS

Publication I. The author planned the study in collaboration with the co-author, was the primary designer of the survey used to collect data, and was responsible for conducting the data collection. In addition, the author conducted the quantitative analysis. The author was responsible for writing approximately 80% of the manuscript, acted as the corresponding author during submission, and contributed approximately 50% of the revisions.

Publication II. The author planned the study in collaboration with the co-author, was the primary designer of the survey used to collect data, and was responsible for conducting the data collection. In addition, the author conducted the quantitative analysis and performed the relevant measures of validity and reliability. The author was responsible for writing approximately 80% of the manuscript acted as the corresponding author during submission, and contributed approximately 50% of the revisions.

Publication III. The author planned the study in collaboration with both co-authors, conducted the quantitative analysis and performed the relevant measures of validity and reliability. The author was responsible for writing approximately 60% of the manuscript acted as the corresponding author during submission, and contributed approximately 50% of the revisions.

Publication IV. The author planned the study in collaboration with the co-author, was the primary designer of the survey used to collect data, and was responsible for conducting the data collection. In addition, the author conducted the quantitative analysis and performed the relevant measures of validity and reliability. The author was responsible for writing approximately 80% of the manuscript, acted as the corresponding author during submission, and contributed approximately 75% of the revisions.

1 INTRODUCTION

"The subject of gambling is all encompassing… Fundamentally, it is nothing but an extension of the love of play which is so strong a force in man."

(Rosenthal, 1975): p.1.

Gambling is seen by some as an activity which affords social mobility and provides opportunities normally unavailable to all sections of society (Casey, 2020); it provides huge amounts of tax revenues to nation states and allows funding of charitable and cultural entities (Fong et al., 2011; Grinols & Mustard, 2001; McMullan & Miller, 2008). Furthermore, gambling is associated with events and activities which are cultural touchstones (Huggins, 2003; McMullan & Miller, 2008), offering enjoyment and excitement to large sections of society. Gambling is said to be present in every part of society since the dawn of civilization (Schwartz, 2013), an undeniable part of human nature which offers lessons for life (J. F. Smith & Abt, 1984) and the chance to release social tensions in a non-destructive manner (see Frey, 1984). Finally, it is presented as constituting the most egalitarian form of play, one which combines skill and luck, structure and spontaneity (J. F. Smith & Abt, 1984).

Gambling is, from an alternative perspective, a problematic and inherently negative activity; one which is "sterile, adding nothing to life or the mind" (Huizinga, 1955) p.48). Many associate gambling with criminal organisations and illegal operators, indeed it can often result in criminal behaviour and further undesirable activities (Grinols & Mustard, 2006). Rather than providing opportunities, gambling is seen by some as a means of exploiting the lower classes and maintaining existing social hierarchies (see Frey, 1984). It is thought to reward the lazy and the feckless (see Casey, 2020), it can be responsible for the breakdown of friendships and familial relations and can lead to financial ruin (Grinols & Mustard, 2001). Finally, gambling is thought to corrupt the innocence of pure play, introducing elements which focus attention of material outcomes rather than the experience itself (Huizinga, 1955).

The topic of gambling is one which is inherently problematic, not simply because it has the potential to lead to disordered consumption, for this is true of almost any

behaviour, but because, as outlined above, it embodies a range of contradictory social meanings (Cosgrave, 2008; Eadington, 1976). Consequently, given the need for researchers to negotiate these positions and the value judgements with which they are associated, the study of gambling is inherently political. As has been well-documented and discussed, research often reflects this duality whether explicitly or implicitly (Livingstone et al., 2018; M. Young & Markham, 2015). The reality, of course, is much more nuanced; gambling has characteristics and qualities which can be both positive and negative, it has the potential to benefit or harm, it effects individuals, families, and societies.

Whilst gambling has been a part of many, but not all, human societies beyond collective memory (Binde, 2005), the development of online and mobile technologies has amplified its reach and, consequently, both the harms and benefits it affords (S. M. Gainsbury & Blaszczynski, 2017; Peller et al., 2008). The same is true of video games; an activity which was once the preserve of adolescents, which was socially maligned, and which was viewed as being culturally bankrupt is now a significant cultural and economic force across the globe (Arbeau et al., 2020; Ruffino, 2018; Wulf et al., 2020). Video games are obviously a product of technology, and it is, therefore, unsurprising that they have benefitted from continued development. However, like gambling, video games are often demonised in mainstream media, they have been blamed for creating a lost generation, for inspiring acts of violence and mass killings despite a wealth of academic research failing to achieve consensus (Klecka et al., 2021; Krarup & Krarup, 2020; Weber et al., 2020). Video games have also benefitted from advocates, those who promote their ability to foster social and inter-generational connections, to afford outlets for expressions of identity and creativity, to motivate and engage users, to provide environments for learning and education (Arbeau et al., 2020; Choi et al., 2020; Johannes et al., 2021; Xu et al., 2020).

Both gambling and gaming are activities which are neither inherently good, nor inherently bad, however, that is not to say that these pursuits are free of risk or potential harm. Instead, they are reflective of the aims and intentions of those who promote them and who use them to gratify their own motivations. Studying these activities can offer insights into the wider realities of the societies and cultures in which they occur.

The process of media convergence is one in which traditional distinctions between forms and characteristics are becoming increasingly blurred, but more than this it is one which drives the development of new social relationships and behaviours (Jenkins, 2006). The convergence of gaming and gambling facilitated by

digital technologies has become the subject of growing academic attention in in recent years (Delfabbro & King, 2020), spurred by the rapidly growing social and economic impact of these digital media products. While the connections between gaming and gambling have been present for almost as long as video games themselves (Huff & Collinson, 1987; J. F. Smith & Abt, 1984), the relatively recent, and rapid, expansion of these connections can be linked to several associated developments: the emergence of new mobile platforms, the move to digital distribution and the development of freemium, or free-to-play (F2P) business models (Johnson & Brock, 2019).

The move to digital distribution of media content, primarily facilitated by the developments in digital streaming technologies, has increased ease of access while allowing for a profusion of available content. Consequently, content creators and platform operators have sought to develop means of increasing user engagement with their products and services in order to ensure market share and a stable user base. The interactive nature of video games, in contrast to more traditional media content such as films or television, combined with the prevalence of game-centred communities has allowed digital distributors of games to develop novel approaches and techniques of user engagement (Abarbanel & Johnson, 2020; Brock & Johnson, 2021; Zanescu et al., 2020).

In a similar manner, the emergence of the F2P business model in digital gaming is one which benefits from the increased accessibility afforded by mobile platforms, and which relies on a large and engaged user base, a community centred on the game (Britt & Britt, 2021; Davidovici-Nora, 2014). This is to ensure that although the proportion of users who actually make in-game purchases is relatively small, the absolute value of these transactions is enough to make the games profitable. Among the varied game mechanics that have been employed to increase user engagement, and profitability, are in-game currencies and loot boxes. Indeed, they have been so successful that they have become almost ubiquitous in contemporary games, whether F2P or those that follow the more traditional "premium" model where games require an up-front purchase, sometimes in excess of $70 (Avard, 2017).

Streaming technologies have also allowed the development of a new form of media consumption; watching others play games. Online video game streams are many faceted, and gratify a range of motivational drivers, from information-seeking to pure entertainment (Gros et al., 2017; Sjöblom et al., 2017). Indeed, watching others play has become so popular that it has enabled the development of competitive video game play, known as esports, from a locally-constrained activity into a global phenomenon (T. M. Scholz, 2021).

Esports (figure 1.) can be considered the epitome of media convergence, with the playing of video games being reimagined as a sporting endeavour (Hamari & Sjöblom, 2017; Heere, 2018; Lopez-Gonzalez & Griffiths, 2018) including all aspects of traditional sports: from local, grassroots clubs and associations, to internationally active franchises competing in tournaments where prize pools can reach into the tens of millions of dollars (Poulus et al., 2020). The game developers and publishers responsible for popular esports titles have, themselves, become both broadcasters, league organisers, and team managers (Jang et al., 2020; Peng et al., 2020). Successful esports athletes have migrated to traditional sporting organisations, becoming ambassadors for clubs or testers of the latest technological developments (Hewgill, 2020; T. Scholz et al., 2021). The spread of covid-19 across the world in 2020 has also seen movement in the opposite direction, with established leagues and sporting tournaments holding their own esports events while professional athletes have challenged esports athletes in the digital arena (Rose, 2020).

Figure 1. An esports tournament. © Roman Kosolapov, mexapixel.com

The increasing market for esports has attracted growing numbers of actors who seek to capitalise on its appeal to an audience which is increasingly hard to reach through traditional means, millennials (T. Scholz et al., 2021). This influx of money into the esports scene has driven the need for increased professionalization and regularisation at both national and international level, with the further consequence that it helped

establish esports as a viable offering for major players in the gambling industry (Lopez-Gonzalez & Griffiths, 2018; T. M. Scholz, 2019). Somewhat unsurprisingly, given the competitive nature of esports, a parallel betting scene has existed alongside the activity for some time. It is only relatively recently that esports betting has been picked up by mainstream operators, as such much of the early betting activity was either informal or facilitated by operators that emerged from within the community (S. M. Gainsbury et al., 2017a; Grove & Krejcik, 2015). Consequently, the bulk of esports betting has been conducted in an environment which has been self-regulating and free of outside involvement, indeed, until relatively recently it has been almost unknown in wider society. Finally, as with more traditional forms of gambling, esports betting has been made more easily accessible through mobile technologies, the use of virtual items as stakes, and the ability to use online payment methods (S. M. Gainsbury et al., 2017b).

Popular esports titles were never originally designed to be anything other than video games, and as such they include a range of features and characteristics which have been exploited by players in order to provide novel gambling activities. An example of this is the use of virtual cosmetic items known as "skins" as wagers in online gambling activities centred on specific games (see section 2.3.1.5, below). Such practices led to the term "esports gambling" as a rubric for all forms of gambling associated with video games (Grove, 2016), however, this is something of a misnomer as it does not accurately reflect the diverse forms of gambling, and gambling-like behaviours, associated with video games. These range from the translation of established practices to the context of video games, for example betting on esports (see section 2.4, below), to the provision of simulated gambling in games, for example mini-games or missions which include playing poker or similar (see section 2.3.1.1, below), to completely emergent forms of gambling which originate in the player base, and which are not anticipated by the game's developers (see section 2.3.1.2, below). Consequently, this dissertation, and the published articles which are included, use the term "esports gambling" to refer solely to fantasy sports competitions and sportsbook-style wagers on esports. The term "video game-related gambling" includes the previous activities, and all other types of gambling connected to both video games and virtual items used in games.

1.1 Research Problem and Questions

Recent decades have seen a general trend toward increased liberalisation of gambling practices internationally (Fong et al., 2011; Jensen, 2017; Kingma, 2006; Markham & Young, 2015). The same period has witnessed the gamification of everyday experiences (Hamari et al., 2015; Raessens, 2006), and the increasing significance of games as both entertainment media and cultural reference points. It is, perhaps, unsurprising therefore that there has been a rapid convergence between video game play and gambling, it is a process which has created not only new activities but also new relationships and consumption practices (Cassidy, 2013; S. M. Gainsbury et al., 2015; D. L. King & Delfabbro, 2018; Lopez-Gonzalez & Griffiths, 2018; Macey & Hamari, 2019; Wardle, 2019). Considering the concerns surrounding the practice of video game play, the potential effects of products which combine both video games and gambling is something which commentators have highlighted as requiring careful investigation.

The convergence of gaming and gambling has gained increasing academic attention since it was first brought to attention over a decade ago (D. King et al., 2010), yet it has only recently been acknowledged by mainstream media, legislators, and regulatory bodies. Much attention has been focused on the in-game items known as loot boxes, however, there are many more examples of gambling, and gambling-like mechanics, being used to drive player engagement and, consequently, monetisation. Notable examples include *Dota 2*'s Battle Pass, The Diamond Resort Casino update in *Grand Theft Auto Online*, and the platform tools provided to streamers by Twitch.tv. Concerns have been raised about such developments, with commentators arguing that they are inherently exploitative, that they normalise gambling and gambling-like interactions, and that they encourage problematic consumption (S. M. Gainsbury et al., 2015; S. M. Gainsbury, Russell, et al., 2016; D. L. King et al., 2012; D. L. King & Delfabbro, 2019). In addition, a particular area of concern is the fact that video games are predominantly played by children, adolescents and young adults (Kinnunen et al., 2018), a section of society particularly at risk of developing problematic behaviours as a result of early exposure to gambling (D. L. King et al., 2014; Shead et al., 2010; Winters et al., 2002). Esports is perhaps the most obvious example of the current trend of convergence between video gaming and gambling (M. Griffiths, 2017; D. L. King & Delfabbro, 2020). Not only are established industry operators offering esports markets, they are a significant and visible presence in the esports ecosystem, sponsoring teams and tournaments. Furthermore, a notable majority of online sites offering news and discussion forums

for esports fans display significant amounts of material advertising gambling operators and cross-promotion of other gambling activities (Abarbanel & Phung, 2019; Lopez-Gonzalez & Griffiths, 2018).

One of the most far-reaching of issues to emerge as a result of this process of convergence concerns the use of virtual, game-specific items and their use as de facto currencies to access gambling services. Contemporary legal and regulatory approaches rely on a definition of value which is centred upon the use and exchange of real-world currencies, with numerous authorities adopting the position that virtual items have no worth outside the game environment (Macey & Hamari, 2019).

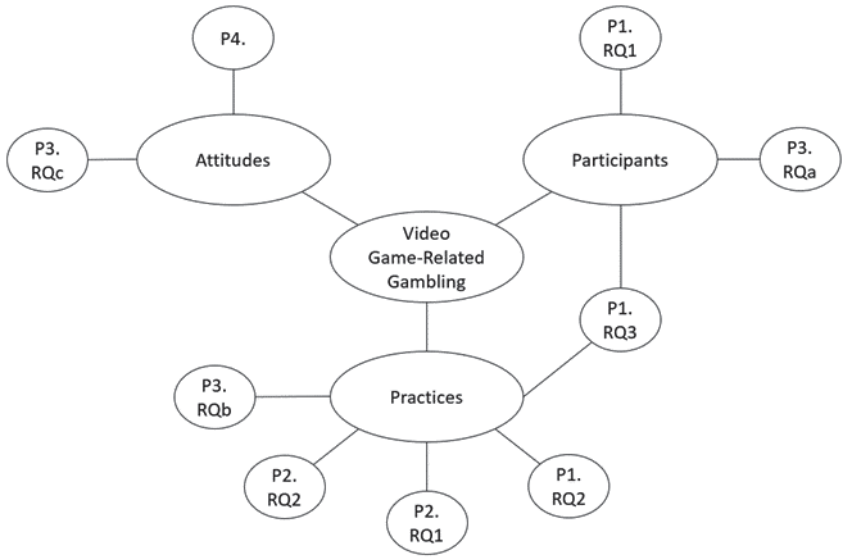
Finally, the process of convergence is one which, in addition to new activities and behaviours, also gives rise to new cognitive frameworks (Jenkins, 2006; Peters, 2020) which govern individual consumers' perceptions and attitudes toward these newly-emergent practices and products. In the case of gaming and gambling convergence, it has been theorised that the ideas and concepts associated with the play of digital games can be erroneously applied to, or significantly influence, participation in gambling activities. For example, the idea that a gambling game can be mastered through practice, in the same way that a video game can be mastered (D. L. King et al., 2012). This is another potentially significant area given the proven association between maladaptive cognitions and the development of problematic gambling (Goodie & Fortune, 2013).

The aim of this dissertation, therefore, is to investigate the emerging phenomenon of video game-related gambling (such as esports betting, virtual item lotteries, etc.), specifically the participants, practices, and attitudes with which it is associated. In particular, attention will be paid to: demographic characteristics of the population (participants); forms of video game-related gambling, the potential connections to video gaming habits, and associations with problematic consumption behaviours (practices); and both maladaptive cognitions related to gambling and motivations for consuming online services (attitudes). As such, this work is guided by the following research questions:

> RQ1: Who participates in video game-related gambling?
> RQ2: What are the relationships between participation in video game-related gambling, the consumption of video games, and measures of problematic consumption?
> RQ3: How is participation in video game-related gambling associated with: a) maladaptive cognitions; and b) motivations for consuming game-related content (such as esports)?

The work is divided into a series of complementary perspectives that, in unison, provide both depth and breadth to the investigation. The relationship of video game consumption to behaviours and attitudes towards online gambling requires a comprehensive overview, due to the relative nascency of the field at the time the research was conducted; with a significant lack of work relating to the phenomenon of gambling connected to esports games in particular. The following sections (1.1.1 – 1.1.4) outline the research questions which guide each individual article, with figure 2 (below) illustrating how each article contributes to the overall research aims of this work.

Figure 2. Research Outline



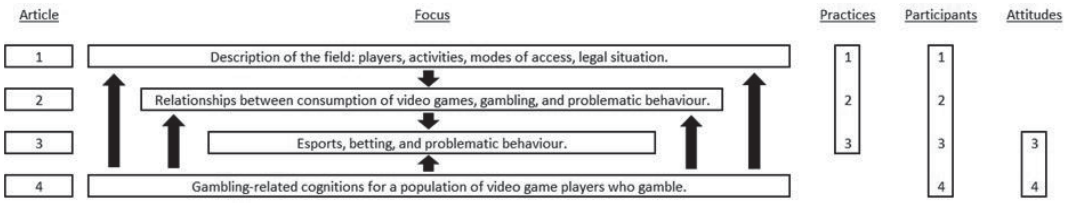
Note: P = Publication; RQ = Research Question

The work presented in this dissertation is structured in such a way as to introduce the reader to the phenomenon of video game-related gambling before focusing on specific analysis of certain behaviours; it concludes with an investigation of the cognitive frameworks underpinning attitudes to video game-related gambling. As such, article 1 provides an overview of the field, including descriptions of the varied forms of video game-related gambling, the ways in which these activities are accessed, and the contemporary legal situation. Article 2 narrows the scope of the research by using PLS-SEM to examine the associations between consuming media

connected to both video games and gambling, and measures of problematic consumption. The focus of the work is further refined in article 3 which employs PLS-SEM to investigate the practices associated with a specific form of video game-related gambling: esports betting. In addition, article 4 complements the previous works by addressing the issue from a new perspective, examining the cognitive frameworks of video game players who gamble. In addition, article 4 develops a new measure for identifying maladaptive cognitions related to gambling in this specific population.

Finally, the articles were planned in such a way as to address the three primary areas of interest identified in the research aims: articles 1 and 2 provided information about the players and participants of video game-related gambling; article 3 provided information about players, participants and attitudes; while article 4 provided information about participants and attitudes (see fig. 3, below).

Figure 3. Planned Structure of Articles



This research seeks to address a newly-emergent phenomenon in a comprehensive and systematic manner, bringing together aspects from Media Studies, Communication Studies, Human-Computer Interaction, Sociology, Behavioural Economics, Psychology, Social Policy Studies, Gambling Studies, and Game Studies.

1.1.1 Research aims, article 1

At the time of writing, there existed a significant and notable lack of research addressing esports and gambling, with what published works there were predominantly focusing on legal and regulatory issues (Owens, 2016; Schneider, 2015). The primary aim of this article was to provide an overview of a newly emergent behaviour in its relative infancy, thereby laying the groundwork for further studies. In order to achieve this, article 1 was composed of several parts: first, identifying the demographic characteristics of esports spectators who gamble;

second, describing the range of gambling, and gambling-like, activities available at the time of the research; and finally, to investigate potential associations between individual consumption behaviours and the development of problematic gambling. The work was both exploratory and atheoretical, with the intention being to provide descriptive information in regard to those who gamble related to both video games in general, and esports in particular. As such, the following research questions guided the research in this article:

> RQ1. What are the demographic characteristics of esports spectators who gamble?
> RQ2. To what degree are spectators of esports participating in gambling activities, either traditional (land-based or Internet-based) or related to video games, and which specific activities are favoured?
> RQ3. What are the rates of problematic gambling behaviour in the population of esports spectators, and how do these rates compare to those who participate in established forms of gambling?

1.1.2 Research aims, article 2

As with article 1, article 2 was conducted in an environment where both esports and video game-related gambling were in a phase of rapid expansion. Given the contemporary environment, one characterised by both rapid market growth and volatility, the need to record and to investigate the behaviours and experiences of those who participated in video game-related gambling was growing ever more urgent.

As such, the guiding aim of article 2 was to investigate associations between consuming: video games; esports; and different forms of gambling (offline, online, and that directly related to video games). The three categories of gambling distinguished between established forms of gambling, in online and offline contexts, and between the newly emergent practices of betting on esports matches, playing fantasy esports, paying to access randomly generated in-game items, using in-game items or currencies as wagers in third-party gambling sites, and social network gambling games. Although these newer forms of gambling are almost always, if not exclusively, conducted online they were distinguished from other forms of online gambling due to their very specific nature. The research was guided by the following research questions:

RQ1: Is increased consumption of video games and esports associated with increased levels of gambling?
RQ2: Are higher rates of problematic video gaming associated with higher rates of a) gambling activity, and b) problematic gambling?

1.1.3 Research aims, article 3

Gambling associated with esports is inextricably connected to video games across all levels, whether that be in regard to either play or spectating, gambling on games or through games. In addition, gambling is a significant presence in the esports ecosystem, including advertising and sponsorship of teams and tournaments, and of community sites and discussion forums. Indeed, the presence of mainstream gambling operators has led to increasing transparency and professionalism in the organisation of esports, while at the same time increasing the potential rewards for unscrupulous bettors, as with traditional sports (Abarbanel & Johnson, 2019; Fullerton et al., 2019). Accordingly, investigating the ways in which these consumption habits interact with one another provides evidence regarding the novelty, or otherwise, of the relationships between esports betting and media consumption practices. Therefore, this research is guided by the following question:

RQ: How are demographic characteristics and the consumption of video game-related media (video games, esports and gambling) associated with esports betting activity?

In order to aid conceptual clarity, this research question can be reformulated as follows:

RQ: How is the practice of esports betting associated with:

a) demographic characteristics.

b) consumption of video game-related media and gambling.

c) the motivations for consuming esports.

1.1.4 Research aims, article 4

The process of human cognition employs heuristic thinking in order to optimise decision-making, particularly in situations which are characterised by a deficit of information (Tversky & Kahneman, 1974). Heuristics are a form of cognitive short cuts, which, despite the benefits they offer, can lead to mistaken beliefs, or cognitive biases. Erroneous beliefs, in the form of cognitive biases, have been shown to contribute to the development of behavioural problems and addictive behaviour, including disordered gambling (Kouimtsidis et al., 2007).

Prior research has shown that individuals' cognitive frameworks, particularly those related to gambling, are strongly associated with socio-cultural background and personal experience (Okuda et al., 2009). As such, beliefs concerning gambling that have developed in consumers of both video games in general, and esports in particular, are likely to differ from those in more traditional populations of gamblers. While there are several existing measurement instruments which address gambling related cognitions, the newly emergent context and practices of video game-related gambling mean that a gap exists in this space. As such, the primary aim of article 4 was to examine the validity of an existing instrument, the Gambling Related Cognitions Scale (Raylu & Oei, 2004), in a population of video game players who also gamble. A secondary aim was to complement the measure with a series of items reflecting cognitions theorised as being likely to affect video game players in particular. The overarching intention, therefore, was to produce a refined version of the GRCS which could be utilised in the context of players of video games who are also gamblers.

1.2 Structure of the Dissertation

Having introduced both the context of article (section 1.), and the aims and questions which guided the research which together comprise this dissertation (section 1.1.), the remainder of the work is structured as follows. Section 2, *background*, provides an introduction to prior work contributing to the topics addressed in this dissertation: the societal and cultural relevance of gambling and of video games; the convergence of video games and gambling; esports; and gambling-related cognitions. Section 3, *method*, outlines the processes and procedures which governed participant recruitment, data collection, and data analysis for each of the four articles collected in this dissertation. Section 4, *results and discussion*, reports the findings of each

individual article and their relation to the research questions described in section 1.1. Finally, section 5, *conclusion*, addresses the theoretical and practical implications of the works, their limitations, and potential avenues for future research.

The articles presented in this dissertation were designed in such a way to begin with a description of the contemporary status of the phenomenon of video game-related gambling, before progressively narrowing the focus on specific areas of interest (see figure, 3). As such, after providing a background for the work, the dissertation presents information relating to the method (section 3), results and discussion points (section 4) on an article-by-article basis. Section 5 brings the work together, providing a summary before addressing both the limitations and the contributions of the body of work as a whole.

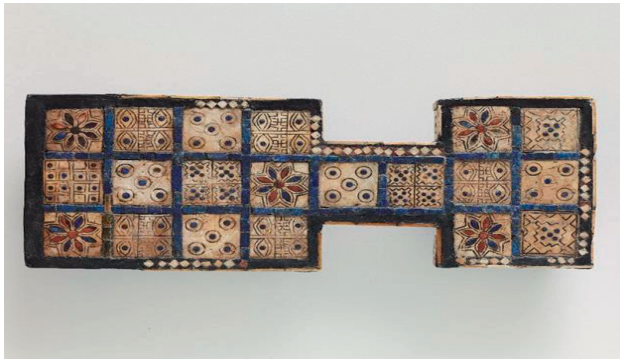
2 BACKGROUND

2.1 Homo Alea

Gambling is a fundamental component of human culture; indeed, it is, arguably, the form of play which most encapsulates the human condition, distinguishing the cultural from the pre-cultural, despite Huizinga's assertion that "Animals play just like men… all the essentials of human play are present in their merry gambols." (Huizinga, 1955)/1938. P.1). The play of animals can come in several forms including agon, mimicry, or ilinx; however, that which is absent from the repertoire of animal play is alea: games which are decided wholly, or in large part, by chance (Caillois, 2001)/1958).

That games of chance are particular to the human condition is asserted to be a product of the ability to think abstractly, to conceptualise inanimate forces to which we may be subordinate, and the ability to imagine a potential vision of the future, to speculate (Caillois, 2001)/1958). Indeed, games of chance are thought to have their origins in the methods by which humans have attempted to divine existential meaning and to predict the future (Abt et al., 1984; Bloch, 1951; Finkel, 2007). One of the oldest games of which we know, "The Royal Game of Ur" (figure 4.) is thought to have originated in Mesopotamia around 2,700BC and, in addition to being played as entertainment was also used to both tell fortunes and to gamble (Pfeiffer & Sedlecky, 2020).

Figure 4. Game Board for "The Royal Game of Ur". © The Trustees of the British Museum.



Throughout human societies, both temporally and geographically distant from one another, gambling has served as a means of resolving inter-group tensions, a proxy for physical conflict, a way of gaining social status, a pathway for social mobility, and a method for redistributing wealth (Binde, 2005; Geertz, 1973; Hill & Clark, 2001). Despite the many rich and varied socio-economic functions that gambling fulfils in human cultures, much of the discourse which surrounds the practice is framed in somewhat moralistic terms, with academic treatments not being exempt from this approach (Sutton-Smith, 1997). Indeed, in his seminal work in which the "play-element" is put forth as a driver of human culture, Huizinga allows no import to the practice of gambling, describing it as "sterile, adding nothing to life or the mind" (Huizinga, 1955)/1938, p.48). Similarly, games of chance are excluded, by design, from the work of Chateau and others when addressing the developmental qualities games afford children, despite their apparent qualities (Caillois, 2001)/1958). The play of children seems, to a certain degree, to have been lionised, to have been raised to a puritanical ideal, the "sacred play" of animals, primitives, and children.

It is undoubtedly true that games of chance feature less as part of children's play than of adult's play, and that the majority of children's gambling experiences occur as a result of familial practices, however, there are some games exclusive to children which can be characterised as games of chance. The most oft-cited example, at least in pre-digital forms of play, is that of marbles (figure 5.) where the combination of skill, chance, and "winner-takes-all" format has led some to categorise it as gambling (J. F. Smith & Abt, 1984). Caillois highlights a further point of note when he mentions that marbles are both objects for play and a medium of exchange, a context-specific currency (Caillois, 2001)/1958); something which is equally true of certain virtual items present in contemporary digital games (Wardle, 2019).

Figure 5. Parkvale Primary School, boys playing marbles. © The Hawke's Bay Digital Archives Trust

Caillois' approach to gambling was of a markedly different tone to much of the preceding work, in which the accrual of resources from non-productive means was seen to run counter to the prevailing social tenet which advocated such ideals as personal development through hard work, progress through attainment, and a reliance on rationality and logic. In such an environment, the supposed quick and easy financial gains of gambling, the reliance on luck and chance, were viewed as antithetical to the social order (Abt et al., 1984). The time in which Caillois was writing coincided with the beginning of a change in formalised attitudes toward gambling, with the 60's seeing the first wave of liberalised gambling laws in the West, e.g., the use of lotteries as a means of raining revenue for individual states in the US (Petry & Blanco, 2013). This period also saw the publication of fellow sociologist Erving Goffman's work investigating gambling as a means of self-determination, both in individual and social contexts, through risky activity. In addition, Goffman's research addressed the way in which gambling changed from being a "consequential" activity for individuals, to a "fateful" one; foreshadowing the later interest in problematic gambling behaviours which has come to dominate the field for decades (Shaffer et al., 2006). Although the consideration of gambling continued to be framed in predominantly negative terms, as seen by the concentration on the problems caused by disordered consumption, the work of Caillois and Goffman demonstrated that gambling offers a window into the processes and structures of society and that it is not, inherently, an immoral activity. Indeed, their work was vital for later generations of scholars:

> *"Goffman's essay on gambling … lifts gambling out of the moral abyss into which successive generations of commentators and reformers have consigned it and renders possible a consideration of its meaning which is freed from a priori associations of a negative kind."*
>
> *(Downes et al., 1976): p.17.*

Throughout the second half of the 20th century, and continuing into the early part of the 21st century, gambling became an increasingly visible aspect of western culture, with progressively liberal legislation providing increased opportunities for legitimate participation (Shaffer et al., 2006). Alongside this trend, academic research related to gambling similarly expanded; in the 100 years prior to 2003, the growth was exponential, with 97% of all work being published after 1963 (Shaffer et al.,

2006). This explosion of interest in gambling should not be surprising considering its cultural salience, indeed gambling has often been employed as a signifier of cultural values and aspirations throughout popular culture; from the novels of Austen to the James Bond franchise (Raento, 2013; Richard, 2011). Indeed, Abt et al. (1984) state:

> *"we are proposing that gambling is a culturally ritualized social form in which participants by following the rules of play reaffirm the basic values and norms of conduct characterizing their society."*
>
> *(Abt et al., 1984): p.208.*

Gambling, however, is seen to be more than the encoding of societal and cultural norms and values; it is proposed that gambling also serves as a model for life, one in which individuals ritually submit themselves to the forces of fate. It is an activity located at one end of a continuum encompassing many aspects of life in which elements of chance and risk are present; it is the way in which these risks are negotiated which allows individuals to assert and to create social identities. In modern, comparatively secure societies, gambling serves as a means by which individuals can test themselves against the capricious forces of nature (Goffman, 1967). Indeed, gambling is a means of sense-making, of giving structure to the unknown (Caillois, 2001)/1958) and, as with the Royal Game of Ur, the practice of gambling does not attempt to subjugate chance but, instead, to know it, and to benefit from that understanding. Finally, gambling is a democratising force, one which offers the chance of material advancement in societies in which the potential for upward social mobility is, otherwise, an ever-diminishing prospect (Abt et al., 1984).

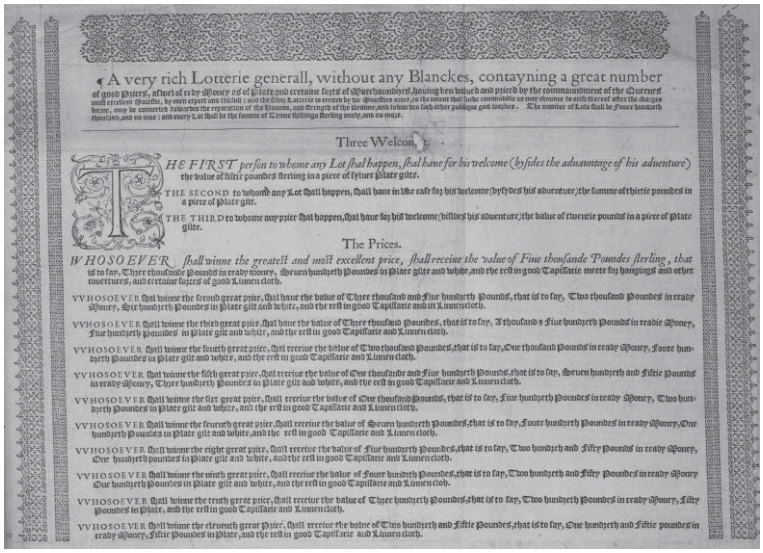
2.2 The contemporary influence of games and gambling

Whilst gambling has been a part of human culture stretching back thousands of years, the degree to which it has been considered a socially acceptable activity has varied wildly. Indeed, despite the association of gambling with spirituality and mysticism (Binde, 2013; Pfeiffer & Sedlecky, 2020) many religions actively prohibit gambling and view it as an immoral pastime. The acceptance, and incorporation of

gambling into religious practices is, predominantly, a feature of traditional and non-Western religions, whereas prohibitions on gambling are associated with modern Western religious practice and monotheistic religions (Binde, 2007). Although differences in attitudes toward gambling are present within distinct branches or denominations, for example Catholic Christianity is more accepting of gambling than Protestant Christianity (Adhikari & Agrawal, 2016; Binde, 2007). It is notable that, within Western societies at least, gambling has become more widespread as they have become more secular; indeed, gambling, alongside other forms of play such as attending festivals, has become both a substitute, and a rival, for religious experience (Sutton-Smith, 1997).

Yet changes in the social and cultural significance of gambling are not simply due to the waxing or waning of religious power and influence, they are also informed by the prevailing political elite. Although earlier legislation on gambling was enacted, for example the restriction of gambling to the period between Christmas Day and Epiphany in England (J. Ashton, 1898), the first government-sanctioned gambling events were lotteries in the time of Elizabeth the First, and were used as a means to raise revenue for commercial expansion (The British Museum, 2020), see figure 6., below. This practice was widespread, with lotteries being used to supplement income from taxation in a range of countries and territories (Ludwig et al., 2013; Petry & Blanco, 2013; Winslow et al., 2015).

Figure 6. An advertisement for England's first ever National Lottery in 1567. © The Trustees of the British Museum



A very rich Lotterie generall, without any Blanckes, contayning a great number of good Prizes, aswel of redy Money as of plate and certaine sorts of Marchaundyses, having ben viewed and prised by the commaundement of the Queenes most excellent Maiestie, by men expert and skilful: and the same Lotterie is ordeyned by her Maiesties order, to the entent that suche commodities as may chaunce to satisfie her of after the charges borne, may be conuerted towardes the reparation of the Hauens, and strength of the Realme, and towardes such other publique good woorkes. The number of Lots shall be Foure hundreth thousand, and no more: and every Lot shall be the summe of Tenne shillings sterling ready, and no more.

Three Welcom.

THE FIRST person to whome any Lot shall happen, shall haue for his welcome (beside the aduantage of his aduenture) the value of fiftie poundes sterling in a peece of fyne plate gilte.

THE SECOND to whome any Lot shall happen, shall haue in like sorte for his welcome (beside his aduenture) the summe of thirtie poundes in a peece of plate gilt.

THE THIRD to whome any price that happen, shall haue for his welcome (besides his aduenture) the value of twentie pounds in a peece of plate gilte.

The Prices.

WHOSOEVER shall winne the greatest and most excellent price, shall receiue the value of Fiue thousande Poundes sterling, that is to say, Three thousande Pounds in ready Money, Seuen hundreth Poundes in Plate gilte and white, and the rest in good Tapistarie meete for hangings and other couertures, and certaine sortes of good Linnen cloth.

WHOSOEVER shall winne the second great price, shall haue the value of Three thousand and Fiue hundreth Pounds, that is to say, Two thousand Poundes in ready Money, Six hundreth Poundes in Plate gilt and white, and the rest in good Tapistarie and in Linnen cloth.

WHOSOEVER shall winne the third great price, shall haue the value of Three thousand Poundes, that is to say, A thousand & Fiue hundreth Pounds in readie Money, Fiue hundreth Poundes in Plate gilt and white, and the rest in good Tapistarie and Linnen cloth.

WHOSOEVER shall winne the fourth great price, shall receiue the value of Two thousand Poundes, that is to say, One thousand Pounds in ready Money, Foure hundreth Poundes in Plate gilt and white, and the rest in good Tapistarie and Linnen cloth.

WHOSOEVER shall winne the fifth great price, shall receiue the value of One thousande and Fiue hundreth Pounds, that is to say, Seuen hundreth and Fiftie Pounds in ready Money, Three hundreth Poundes in Plate gilt and white, and the rest in good Tapistarie and Linnen cloth.

WHOSOEVER shall winne the sixt great price, shall receiue the value of One thousand Pounds, that is to say, Fiue hundreth Poundes in ready Money, Two hundreth Poundes in Plate gilt and white, and the rest in good Tapistarie and Linnen cloth.

WHOSOEVER shall winne the seuenth great price, shall receiue the value of Seuen hundreth Poundes, that is to say, Foure hundreth Poundes in ready Money, One hundreth Poundes in Plate gilt and white, and the rest in good Tapistarie and Linnen cloth.

WHOSOEVER shall winne the eight great price, shall receiue the value of Fiue hundreth Poundes, that is to say, Two hundreth and Fifty Pounds in ready Money, One hundreth poundes in Plate gilt and white, and the rest in good Tapistarie and Linnen cloth.

WHOSOEVER shall winne the ninth great price, shall receiue the value of Foure hundreth Poundes, that is to say, Two hundreth and Fifty Poundes in ready Money One hundreth Poundes in Plate gilt and white, and the rest in good Tapistarie and Linnen cloth.

WHOSOEVER shall winne the tenth great price, shall receiue the value of Three hundreth Poundes, that is to say, Two hundreth Poundes in ready Money, Fifty Poundes in Plate, and the rest in good Tapistarie and Linnen cloth.

WHOSOEVER shall winne the eleuenth great price, shall receiue the value of Two hundreth and Fiftie Poundes, that is to say, One hundreth and Fiftie poundes in ready Money, Fiftie Poundes in Plate, and the rest in good Tapistarie and Linnen cloth.

State-sanctioned gambling, however, has experienced a somewhat turbulent history with periods of acceptance alternating with periods of prohibition. It is in the mid-19th century that many Western societies introduced legislation which made gambling illegal, this was the result of a perspective in which gambling was seen as a dangerous and corrupting influence, particularly on those of the lower classes (Ashbury, 1969; Cosgrave, 2008; Ludwig et al., 2013). It is telling that although gambling was seen as a corrupting social influence, being perceived as negatively impacting upon the attitude and propensity for work and labour (Billieux et al., 2016), it was only those of lower social status who were at risk. The gambling legislation of Victorian England, for example, was directed specifically at the working classes, while the aristocracy remained exempt (Itzkowitz, 1988; McMillen & Doran, 2006).

The 20th Century saw attitudes toward gambling begin to soften, with events such as the Great Depression and the emergence of the Labour movement affecting change in the US and UK, respectively (Bedford, 2021; Laybourn, 2008; Sauer, 2001). However, it was not until the mid-part of the century that liberalisation of gambling laws began to become more widespread; the 60s saw increasing numbers of States permit gambling, while in 1960 the UK legalised off-course betting and bingo (Bedford, 2021; Petry & Blanco, 2013). It is perhaps unsurprising that Huizinga viewed gambling as a corruption of pure play, while later theorists such as Goffman and Caillois accommodated it into their writings, reflecting as they did the prevailing trends of the time. By the end of the century, the majority of the global North had introduced laws permitting regulated gambling of all types, whether it be in post-Franco era Spain (Jiménez-Murcia et al., 2014), reunified Germany (Ludwig et al., 2013), or as the result of national referenda (Billieux et al., 2016).

The increasing significance of gambling in the US since the Great Depression is thought to both reflect, and contribute to, the culturally dominant values of materialism and competition which run through American society (J. F. Smith & Abt, 1984). Indeed, the expansion of gambling as a leisure activity is emblematic of the wider commercialisation of play, the commodification of leisure (Habermas, 1989) and the rise of the experience economy (Pine & Gilmore, 2011), whether this be in regard to the sensationalisation of modern sports (Sewart, 1987; Walsh & Giulianotti, 2001), the fantasy worlds of Disneyland and the like (Borrie, 1999), or the realisation of Las Vegas as the epitome of the entertainment experience (Douglass & Raento, 2004), a globally-recognised centre of "action" (Goffman, 1967).

This realisation of play as a commodity is also, unsurprisingly, evident in the emergence of video games and their subsequent status as a cultural touchstone and the dominant entertainment media of the 21st century (Bowman, 2019; Muriel & Crawford, 2018). Indeed, the social history of video games bears a striking similarity to that of gambling, albeit contained within a significantly shorter period of time given that video games emerged only in the latter half of the twentieth century.

The initial commercial success of video games came from their positioning as children's toys before becoming an essential component of wider youth culture in the arcades of the early '80s (Borowy & Jin, 2013; Ivory, 2015). The play of video games, therefore, came to be viewed by the mainstream as an essentially childish or frivolous pursuit, an activity which was not one practised by adults or which made any meaningful contribution to society or culture (Deen, 2011; DeMaria, 2007). Such attitudes can be directly linked to beliefs dominant in society which maintain the distinctions between work and play, adulthood and childhood (Caillois, 2001; Huizinga, 1955; Westenholz, 2006). The perspective in which the play of video games is held to be an unproductive activity mirrors particular interpretations of gambling; gambling is seen by some to be a waste of resources, a meaningless distraction with no materials benefit to the majority of participants (see (Casey, 2003).

As with gambling, however, the play of video games has become increasingly accepted in many societies and has become the subject of less moral stricture; playing video games is no longer the preserve of children, or of niche sub-cultures. However, negative views associated with video games still persist in mainstream society; stereotypical images of video game players can still be observed, and video games are still portrayed as the source of many societal problems (Ferguson, 2018; Ferguson & Wang, 2021). It is undeniable that playing video games can lead to the development of problematic behaviours, as can many consumption behaviours, but recent years have seen the positive effects of games acknowledged more frequently. The motivational and engaging qualities of games have been used across a range of contexts to improve user experiences and outcomes, from education and training, health and medicine, etc. Harnessing the affordances of games in order to enhance non-game experiences is referred to as "gamification"; yet this is not a modern development, such practices have existed for many years, from the factories of Soviet Russia to the practices of American office managers (Nelson, 2012).

What is, however, an unarguably modern occurrence is the increasing cultural and economic importance of games, and of video games in particular. This has been referred to as both the gamification or "ludification" of culture (Raessens, 2006),

reflecting the growing acceptance and worth of games across a multitude of arenas. Video games are a notable influence in popular culture, with icons such as Mario or Pikachu being instantly recognisable across generations. Indeed, video games themselves range from small-scale independent productions, often seen as more artistic or experimental creations, to multi-million-dollar projects featuring dedicated teams of artists and writers, even featuring established actors (O'Donnell, 2012). The worth of the global video game market now eclipses that of the motion-picture industry, or almost any other artistic or cultural sector (Muriel & Crawford, 2018; Witkowski, 2021). Indeed, the video games industry is currently worth more than the global entertainment industry and North American sports markets combined (Hennings, 2021). Games and play have transitioned from childish, unproductive pursuits to businesses which together are worth many billions of dollars; they are no longer simply voluntary activities separated from real-life, instead playing video games can offer careers in streaming or esports to name but two examples. Where gamification refers to the encroachment of games into non-game contexts, "playbour" denotes the opposite trend: the increasing "workification" of play (Goggin, 2011; Törhönen et al., 2019). As with gambling, video games are no longer disconnected from adulthood, from work, from serious pursuits. Play has become integrated and ingrained within modern life, its presence is so pervasive that we can no longer say that a defining characteristic is its immateriality, its separation from real life.

2.3 Convergence

Media convergence is a socio-cultural force which generates new relationships, practices, and behaviours. It is concerned with the evolution in both the production and consumption of media, for example through the ways in which the digital environment affords enhanced opportunities for multimedia experiences, participatory culture, and collective intelligence (Jenkins, 2006). Media convergence incorporates many different aspects; indeed, such are the diverse applications of the term, it is most useful to approach media convergence through a four-part model into which the disparate uses of convergence are organised: technological, economic, regulatory, and cultural (Balbi, 2017).

It is important to note that convergence is not limited to the digital era, despite the fact that much contemporary discourse takes digitalisation as a pre-requisite for the process of convergence, particularly "convergence culture" (Jenkins, 2006).

Indeed, the term "convergence" was being used in pre-digital era, and we see many forms of convergence as far back as the Victorian era, for example the transmission of audio media via telephone (figure 7.). Variously dubbed "theatrephone", "pleasure telephone", and "electrophone", the use of the newly developed telephone network to provide live commercial services ranging from opera to sporting events preceded radio and has been referred to as the first "streaming" service (Curtin, 2013; Schulz, 2013).

As contemporary life is increasingly moving into the digital domain, we are seeing the ongoing and process of media convergence accelerating; media products are becoming increasingly difficult to distinguish from one another. An area in which this process is particularly evident is that of the convergence between digital gaming and gambling, with an increasing amount of academic work addressing a range of effects associated with this specific phenomenon: from technological and economic effects, to psychosocial and behavioural effects (Abarbanel & Rahman, 2015; Cassidy, 2013; S. M. Gainsbury et al., 2015; M. Griffiths, 2017; D. L. King & Delfabbro, 2019; Lopez-Gonzalez & Griffiths, 2018; Macey & Hamari, 2019; Wardle, 2019).

Figure 7. Electrophone listening salon in the London headquarters, Pelicon House on Gerrard Street (approximately 1903). © George R. Sims (1847-1922). Source: theconversation.com.

All this is happening in an environment in which gambling has become both increasingly liberalised (Fong et al., 2011; Jensen, 2017; Kingma, 2006; Markham & Young, 2015) and easier to access (S. Gainsbury et al., 2013). At the same time, normal life has seen the growing influence of gamification (Hamari et al., 2015; Raessens, 2006), and of games as both entertainment media and cultural touchstones. In addition, developments in virtual economies, the proliferation of the F2P model and of micro-transactions have furthered both the accessibility and appeal of video games and gambling. Recent years, therefore, have seen the rapid convergence between video game play and gambling, this process is one which has created not only new activities but also new relationships and consumption practices (Cassidy, 2013; S. M. Gainsbury et al., 2015; D. L. King & Delfabbro, 2019; Lopez-Gonzalez & Griffiths, 2018; Macey & Hamari, 2019; Wardle, 2019).

2.3.1 Convergence of video gaming and gambling

The initial period of convergence between video games and gambling began not long after video games were first developed; in this period gaming was initially an activity in which access was limited, although there were home gaming possibilities, for example Pong, the majority of people accessed video games in localised, public, spaces such as arcades (figure 8., below). As arcade gaming increased in popularity, the machines began to proliferate, spreading into other spaces such as youth clubs, pubs, even fast-food shops, also present in these spaces were slot machines (Griffiths, 1991; Haddon, 1999; Kocurek, 2012). Slot machines have been around for over 100 years and were originally mechanical, but by the mid-80s machines featuring microprocessors which could affect the odds of certain symbols appearing became commonplace (Turdean, 2012).

It is in the 80s that the first academic research into potential connections between gaming and gambling was conducted. One of the earliest investigations was conducted among youth offenders, examining how many played video games and how many had participated in gambling (Huff & Collinson, 1987). The co-location of video gaming machines and gambling machines in public spaces also lead to academic research in which the structural similarities between gaming and gambling were highlighted. In this way, a theoretical perspective was established in which games were considered as part of a developmental pathway which led to the problematic gambling behaviours (Fisher & Griffiths, 1995; Griffiths, 1991; Johansson & Götestam, 2004).

Figure 8. Mercer Island Video Arcade, February 10, 1982. © Natalie Fobes/Seattle Times.

As the play of video games moved away from public spaces, dominated by arcades, to the domestic context, the spaces in which gambling and gaming occurred began to be more discrete, however, digital versions of gambling games were available to play on home consoles and PCs, for example *Super Vegas Stakes*. This particular game was notable for not only including versions of casino games, but also interactions with other casino patrons (including pickpockets) which make it more "game-like" and not simply a reconstruction or simulation of gambling activities. Technological advances have not only changed the content of games, they have changed the way that games are played; venues for play have dispersed, no longer contained within the home, or within dedicated arcades, player-versus-machine is now player-versus-player via networked sessions and, subsequently, online multiplayer environments. The development of Internet Relay Chat (IRC) and multiplayer, networked gaming in the late 80s and early 90s enabled video gamers to practice emergent gambling, that is, gambling in games which was not part of the original design. While the internet has also facilitated the development of online, game-based communities which function both as centres of fan culture and as repositories of knowledge about games (Ho & Huang, 2009; Mora-Cantallops et al., 2021). These communities have also proved to be fertile grounds for the development of new, emergent gambling activities which utilise games (Macey & Hamari, 2019).

It is not only video games themselves which reflect, and at the same time drive, the convergence of gaming and gambling, the ways in which games are produced and distributed is evidence of this process. Business models such as F2P and "Games

as a Service" (GaaS; (Dubois & Weststar, 2021) have reintroduced gambling-like mechanics into video games, both overtly and covertly, primarily as a means of driving long-tail monetisation of players (Castillo, 2019; Davidovici-Nora, 2014). The most prominent examples of these developments can be found in Social Casino Games (SCGs; (S. M. Gainsbury, Russell, et al., 2016) and loot boxes (D. L. King & Delfabbro, 2019). In addition, the expansion of virtual economies and goods such as "skins" (Hardenstein, 2017) has served to occlude the use of real money in games; consequently, gambling-like mechanics are no longer obvious to players.

A third category in which the convergence of gaming and gambling can be observed is the consumption of games through a passive, rather than actional, relationship; that is, the growth of games as a medium which is not only played, but also spectated. The spectating of play can be divided into two main contexts: the phenomenon of esports, or competitive video game play (Hamari & Sjöblom, 2017); and online streaming of video game play (Törhönen et al., 2021).

Finally, the process of convergence is not one which is unidirectional; in addition to the myriad ways in which video games are becoming more "gamblified" (Brock & Johnson, 2021; Macey & Hamari, 2020), traditional gambling practices are bemoaning more gamified (S. Gainsbury et al., 2019; Mulligan, 2018). In recent years, Electronic Gambling Machines (EGMs) have become more overtly game-like, adopting aesthetics and narrative components which seek to emulate games as a means of enhancing player engagement and immersion (Kolandai-Matchett & Wenden Abbott, 2021). As discussed, different forms of convergence are not mutually-exclusive and as a consequence certain forms can be difficult to locate in discrete categories. This issue is most effectively illustrated by the fact that SCGs can be viewed both as F2P games which replicate gambling activities, and also as gambling activities which utilise the business models pioneered in the games industry. Furthermore, both game and gambling companies produce these games, further obscuring the relationship between the two activities. The gambling industry has also noted the mainstream appeal of video games and as a result of declining participation in traditional gambling among younger generations, the so-called "millennial problem" (Martinelli, 2017), has begun to invest in activities which explicitly utilise games. The development of "skill-based gambling", as it has been dubbed by the industry, is a process which has been underway for some time and is now beginning to emerge into mainstream gambling environments, typically casinos (R. Young, 2018).

In summary, the convergence of video games and gambling is evident across a range of interconnected practices which have been driven by technological

developments and which have been given further impetus as a result of digitisation and the myriad affordances of the internet. The process is one in which games and gambling influence one another, resulting in games which increasingly incorporate gambling, and gambling activities which increasingly resemble games. Convergence includes both the translation of established gambling activities and practices into new contexts, and the development of entirely new gambling activities which utilise games and game-based virtual items. A summary of the different activities which exemplify the ongoing convergence of video gaming and gambling is provided below, with one notable exception: esports. Given the centrality of esports to this research it will be addressed in a dedicated sub-chapter (section 2.4).

2.3.1.1 Simulated and In-Game Gambling

Perhaps the most established and easily-identified form of convergence between video gaming and gambling is the inclusion of simulated gambling in games. The earliest forms of which were simple remediated translations of gambling activities from the physical to the digital world, often limited to games such as poker. Indeed, many of the earliest poker games on home computers, despite the limited graphical capabilities, were strip poker, e.g. *Strip Poker: A Sizzling Game of Chance*, released on multiple formats in 1982. As the technical capabilities increased such games began to develop in complexity and interactional affordances, with *Super Vegas Stakes* on the Super Nintendo offering more game-like environments through interactions with computer-controlled characters in a casino. The inclusion of simulated gambling in video games is not limited to dedicated simulations, whether card games or casinos, but also includes recreated gambling as mini-games or as narrative elements. Such examples have become an established part of games as diverse as *Police Quest* (figure 9., below) to *Red Dead Redemption II* (figure 10., below).

In 2019, *GTA Online* released the Diamond Casino and Resort update in which simulated gambling was added to the game. As with the examples previously mentioned, gambling was confined to the game world and uses in-game "money" accrued by the player to buy casino chips, with no possibility to transfer any winnings into real-world currencies. Unlike these other games, however, if the player did not have enough in-game money to participate, they could purchase additional game funds, confusingly called "dollars" by using real-world currency (GTA Online, 2019). The update proved to be a huge financial success for the publishers, with year-on-year profitability increasing by approximately 23% (Strickland, 2020).

Figure 9. Gambling in PoliceQuest 1 © Sierra Online. Source: idonotlikepeas, lparchive.org

Figure 10. Gambling in Red Dead Redemption 2, © Rock Star Games. Source: u/bananashard, reddit.com

2.3.1.2 Game-based Emergent Gambling

The practice of emergent gambling is one in which players create their own gambling activities which exploit the characteristics and affordances of a video game which are not part of the designers' original intentions. Perhaps one of the most (in)famous

examples of emergent gambling is provided by the "flower game" in *RuneScape*, a Massively Multiplayer Online Role-Playing Game (MMORPG). While *RuneScape* offered several different in-game gambling activities, such as "Squeal of Fortune", as a means of earning in-game currency, players also devised their own activities leading to a rich sub-culture of emergent gambling. In *RuneScape* players can purchase seeds for their gardens which, when sown, grow into decorative flowers, the colour of these flowers is randomly generated and cannot be known in advance. In order to play the flower game players would congregate in a communal area and use the in-game chat window to wager in-game currency with winners and losers being decided as a result of the coloured flowers that grew out of the planted seeds. Rather than simply betting on individual colours, there were a range of different flower games, even one which replicated poker (tMoon, 2012). Similar games were developed based on the random generation of capes, Easter eggs, seals, and so on; the developers countered each of these games by introducing standard colours, patterns, etc in place of the originals which were randomly generated (Runescape Wiki, 2021).

The developers of the Massively Multiplayer Online Game (MMOG) *EVE Online* are known for taking a more hands-off approach to their game, allowing players an "unbounded" play experience in which transgressive play is common (M. Carter & Gibbs, 2013). A further notable characteristic of EVE Online is the highly developed in-game economic framework, including player-run banks and, until late 2016, casinos and bookmakers. Using the in-game currency, ISK, players could participate in all types of activities, including betting on diverse games and events, including real-life sports and esports. In 2016, the owners of these in-game casinos had accrued such a fortune that they were able to fund a massive conflict known as "World War Bee/The Casino War", which lasted several months and involved many tens, even hundreds, of thousands of players and caused the loss of in-game items valued at hundreds of thousands of dollars (Hall, 2016; Johnson & Mejia, 2018). After the conclusion of the conflict, the developed introduced new terms of services in their updated End User License Agreement which specifically banned games of chance and player-hosted casinos. Whether this was a reaction to the events of the Casino War, or related to the upcoming change to the F2P business model, from a subscription model, has not been made explicit. What is beyond doubt, however, is that the move from simulated gambling in games to actual gambling, both within a game and outside a game, but using game-specific currency, had direct and meaningful effects for players, both in terms of in-game and real-world consequences.

Figure 11. Crash betting, © roobet.com, 2021. Source: admin, silverhanna.com

In addition to emergent gambling within games, online game-centred communities have also created their own, entirely new forms of gambling. While many community-created gambling activities, for example skins lotteries or themed coin-flipping (see section 2.3.1.5 below), simply translate existing forms of gambling into a game-specific context, the practice of crash betting has no traditional analogue. In crash betting (see figure 11.), the player is presented with a simple, exponential, curve marked along x- and y-axes; the x axis shows the time passed, while the y axis is a multiplier. When the game starts, a point begins to move along the curve, as the time (x axis) increases, so does the value of the multiplier (y axis). The aim of the game is for players to wait as long as possible, in order to maximise the multiplier value, but to quit before the game "crashes". If a player ends their turn before the game crashes, their original stake is multiplied by the final y-value at the point they quit; if the game crashes before they choose to quit, then their stake is forfeit. Initially, crash betting sites could only be accessed using virtual in-game items known as skins and, therefore, were only available to players of certain video games (Macey & Hamari, 2019). However, they are now proliferating within the crypto-currency gambling scene (Menegus, 2021).

2.3.1.3 Social Casino Games

Social Casino Games (see figure 12., below) first emerged in the late 2000s and are distinguished from established online gambling in a number of ways. First and

foremost, SCGs are made available through online social network platforms, such as Facebook, rather than being provided by dedicated gambling services. Second, they employ the F2P business model meaning that although the games do not require any initial purchase in order to access content, they use microtransactions as a means to generate revenue (Alha et al., 2018). Third, they simulate a range of gambling activities, including card games such as poker, table games such as roulette, and slot machines. Fourth, despite the potential to make payments, for example buying additional chips, there is no opportunity to convert winnings into real world currencies.

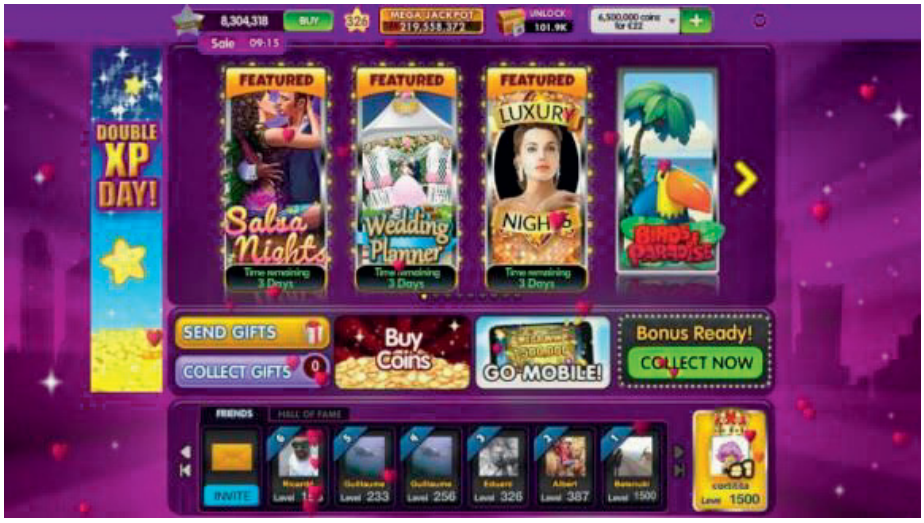
The rapid rise in popularity of SCGs was such that only several years after they were first made available, the active global user base was approximately triple that of online gambling, 173 million and 50 million, respectively (Parke et al., 2012). Although SCG players outnumbered online gamblers by a factor of three, revenues were significantly lower, $1.7bn compared to $38bn, respectively (Morgan Stanley, 2012). Increased growth, both in terms of total player numbers and market value has been driven by technological developments which have allowed SCGs to be accessed through mobile devices, largely via individual downloads from online app stores. Indeed, during the covid-19 pandemic all metrics showed notable growth, including number of users, number of daily active users, and daily average revenue per user (S. Carter, 2020).

The convergence of gaming and gambling evident in SCGs is not restricted to the F2P model; many of the first SCGs were published by companies which also produced non-gambling social games, such as Zynga (S. M. Gainsbury, Hing, et al., 2014). Similarly, those SCGs which are now available through online app stores are listed within the more general category of "games", with SCG poker games being listed alongside non-gambling games such as solitaire. As a result of the success of SCGs many established gambling operators moved into the market, either by developing and publishing their own games, or by acquiring existing SCG companies (S. M. Gainsbury, Russell, et al., 2016).

The fact that such large numbers of people participate in an activity which simulates gambling, but where there is no possibility to cash out, has prompted concerns that users of SCGs would migrate to real money online gambling (S. M. Gainsbury, Hing, et al., 2014; M. D. Griffiths, 2013). Such concerns were founded not solely as a result of the F2P model, but also on the fact that many SCGs were owned, wholly or in part, by established gambling operators. As such, many games featured prominent branding and advertising, while others were directly linked to online gambling sites where players were offered bonuses if they made the move

from SCGs to parent sites. Research has shown that, of the players sampled, between 19.4% (S. M. Gainsbury, Russell, et al., 2016) and 26.3% (Kim et al., 2014) migrated from SCGs to real-money online gambling, with the desire to win real money being the main predictor. There is, however, an increasing body of evidence suggesting that players also move in the opposite direction, with existing gamblers using SCGs as a proxy for real gambling, thereby limiting potential losses (Hollingshead et al., 2016; Macey & Kinnunen, 2020). Consequently, the effect of SCG on participation in real-money gambling is linked to motivations which drive individuals' use of SCGs (Wohl et al., 2017).

Figure 12. Social Casino Game menu. © Tangelo Games



2.3.1.4 Loot Boxes

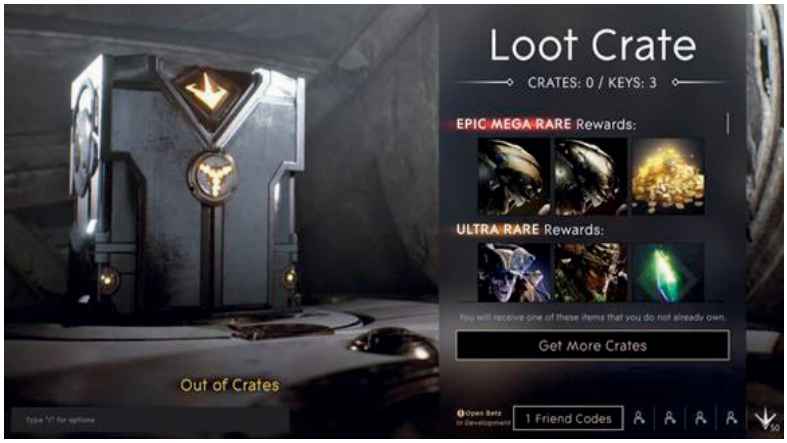
The issue of loot boxes in video games has gained increasing attention across a range of spheres in recent years, including the mainstream media, national governments and regulators, player communities, and academia (BBC, 2021; Garea et al., 2021; Lui et al., 2020; Perks, 2020). "Loot box" (figure 13., below) is an umbrella term for an in-game item which distributes rewards to players by means of random-number generation, that is, that when opened these boxes will grant players a random selection of items from a pre-defined pool of rewards of varying rarity (Larche et al., 2021).

There are many different types of loot boxes present in contemporary video games, and can be identified according to the following basic criteria: a) payment; b) drop rate; c) type of reward; d) transferable rewards. Payment refers to whether a loot box is provided to players free of charge, for example as a result of completing a specific in-game task, or if they are required to purchase a "key" before opening the loot box. "Drop rate" refers to whether there are any limits on the number of loot boxes provided to players within a certain timeframe. In addition, drop rate can also be used to categorise the distribution of tiered rewards, for example the likelihood of a player receiving rarer, and therefore more desirable, rewards. Anecdotal evidence has also revealed that some games utilise a "pity timer" which ensures players receive a minimum number of rare rewards within a certain number of loot box openings (Xiao et al., 2021). The type of reward refers to whether the rewards have a direct influence on the gameplay, or if they are simply cosmetic items (known as "skins", "sprays", "audio lines", "emotes", etc.). Cosmetic items may alter the appearance of a player's in-game character (or "avatar"), and include different costumes, decorated weapons, victory poses, character dialogue and so on. Those items which are purely decorative, altering the in-game appearance of avatar's clothing or weapons are collectively known as "skins" (Marder et al., 2019). Rewards which have a direct influence on the way the game is played include power-ups (enhanced weapons or skills), energy boosts, etc. In addition, some loot boxes also provide players with in-game currency which can be used to purchase both cosmetic items and in-game resources. Finally, the distinctions between transferable rewards are specific to individual games and refer to the fact that some rewards obtained via loot boxes can be transferred between players, or exchanged for real-world currencies (dollars, euros, etc.) via online marketplaces. Other rewards cannot be transferred and are tied to an individual player's account (Abarbanel, 2018). Loot boxes can combine different elements of each of these criteria in different ways, providing a multitude of potential formats, indeed different types of loot boxes are often available within an individual game.

Loot boxes are a relatively recent addition to video games, originating in the F2P business model first pioneered in Asia in the 2000s (Alha et al., 2014; Davidovici-Nora, 2013). In an attempt to remain profitable in the face of growing piracy of video games, a business model was developed whereby games were released with no up-front fees for purchase, instead players could make small payments (microtransactions) for a range of additional, in-game features. Consequently, games began to be designed in such a way that promoted the use of microtransactions, including the purchase of loot boxes (Castillo, 2019). The financial success of this

business model has been so significant that it has come to dominate the contemporary games market, indeed, many games which were already successful have adopted the F2P model in order to further increase profitability (Macey & Hamari, 2019). In addition, even those games which are not F2P, and which utilise a traditional up-front purchase model, have now incorporated loot boxes as a means of monetizing players. The most notable of such games is *Star Wars: Battlefront II*, in which the implementation of loot boxes so frustrated the playing community that it resulted in numerous protests and, arguably, brought the issue of loot boxes to the attention of mainstream media and national legislators (Xiao, 2018).

Figure 13. Loot Crate (aka Loot Box) from the game Paragon. © Epic Games



The exact amount of money raised by the sale of loot boxes in the contemporary games market is difficult to define, primarily due to the reluctance of the industry to make specific figures publicly available. However, market research organizations have provided estimates of the value of the loot box market. In 2018 Juniper Research estimated that players spent approximately $30bn on loot boxes, and forecast that the market would grow to $50bn by 2022 (S. Smith, 2018). While in 2019, published figures for the game *Overwatch* showed that over $1bn was generated via in-game microtransactions; although this figure is not limited solely to loot boxes, they are the primary focus of in-game purchases (Bailey, 2019). This information relates to the situation preceding the covid-19 pandemic which has been responsible for significant increases in the amount of both time and money spent on gaming (Ellis et al., 2020). Indeed, in 2020 the net revenue for the *FIFA Ultimate Team* platform was $1.49bn (Michael, 2020), as with *Overwatch*, this figure includes all forms

of spending, but the microtransactions within the game are primarily focused on the purchase of randomly allocated content in the form of "card packs". Unlike *Overwatch*, however, the basic FIFA game required in order to play *Ultimate Team* is not free and players must purchase a copy, approximately €60 at the time of release, before any further costs are incurred (Siuda, 2021).

The combination of financial outlay via micropayments and the random allocation of rewards has raised concern about the potential similarity between buying loot boxes and participating in gambling. Indeed, a number of regulatory bodies have issued guidance on the topic of loot boxes, while there are several ongoing investigations into the issue, with judgements being guided by local interpretations of what constitutes gambling. For example, while Belgian regulators have concluded that any loot box which players pay to open can be considered gambling (Naessens, 2018) those in The Netherlands ruled that only those loot boxes whose contents can be exchanged for real-world currencies can be considered as gambling (Kansspelautoriteit, 2021). Given that ongoing research in the field continues to highlight the potentially exploitative nature of these types of transactions (D. L. King et al., 2019) and the potential for responsible gambling initiatives to be applied to game-based transactions (D. L. King & Delfabbro, 2019), it is likely that there will be continued developments in regard to the regulation of loot boxes.

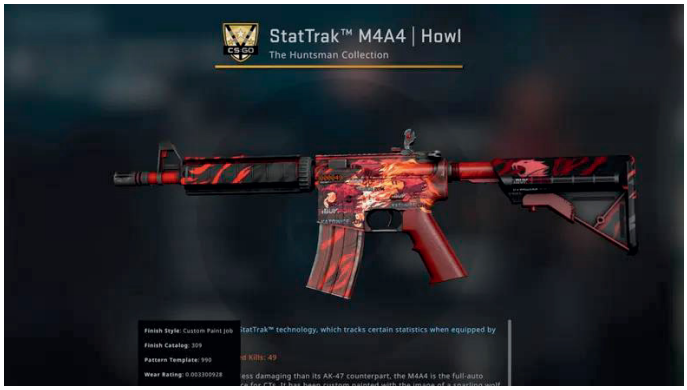
2.3.1.5 Skins Gambling

The virtual items known as "skins" are cosmetic items which allow users to personalise the appearance of their in-game avatars, or in the case of first-person shooter games (FPS) such as *CounterStrike: Global Offensive* (*CS:GO*), the appearance of players' weapons (see figure 14., below). Skins are predominantly obtained via loot boxes, whether paid or free opening, although some games allow peer-to-peer trading or one-off purchases via marketplaces. Given that some skins can be traded in online marketplaces they have a quantifiable value in terms of real-world currencies, this feature led to the emergence of skins gambling, i.e. the use of skins as stakes in a range of gambling activities.

Skins gambling has been subject to a number of notable changes in recent years; in early years, the dominant form of gambling related to skins was the skins lottery (Grove & Krejcik, 2015), however, due to a number of developments in the field, it has now been replaced by casino games and betting. The majority of these games are traditional activities, ranging from roulette to simulated coin-flipping, which have been adapted for gaming communities, for example through use of specific game

imagery (Macey & Hamari, 2019). However, the field has also seen the emergence of novel gambling activities created within the community, in particular the practice of "crash betting" (see section 2.3.1.2, above).

Figure 14. Decorative "skin" from CS:GO, reportedly sold for $130,000. © ohnePixel. Source: twitter.com



The majority, if not all, of those websites which provide skins gambling services are not directly linked to specific games or game publishers, although they require access to individuals' game accounts via an access protocol interface, or API (Holden & Ehrlich, 2017). No mainstream gambling operators currently allow users to access services using skins, as such the market is dominated by third-party providers who often operate in an environment which is predominantly unregulated, and which includes a number of questionable practices (Greer et al., 2019; Russell et al., 2020). As with loot boxes, the legal status of skins gambling is somewhat grey, largely due to the fact that traditional definitions of gambling are framed around the potential for financial loss or gain, the "consideration" and "prize" (D. L. King & Delfabbro, 2020). Consequently, in many legal jurisdictions virtual items have been argued to have no real-world value (Cloward & Abarbanel, 2020), a position supported by the majority of game companies who argue that the value afforded by skins is limited to in-game contexts and that they are an "ethical" and risk-free mechanic (BBC, 2019).

Whilst skins from a number of games can be used to access gambling, the practice is most strongly associated with CS:GO and, to a lesser extent, other games from the same publisher, Valve. The popularity of skins lotteries in particular declined dramatically in the wake of Valve's decision to image a 7-day trading hiatus for users of its online marketplace (Grove, 2016), including third-party websites who used APIs to take wagers and pay out winnings. This action, a response to a series of court cases (Holden et al., 2017), did not prevent gambling per se, but meant that players

and gambling sites had to wait a week in order to be able to access any skins which had been transferred to their accounts.

In order to counteract this move, an online trading and gambling site, OP Skins, implemented an express trading system which Valve ruled to be in breach of its own terms and conditions, as a consequence OP Skins was banned from using Valve's API to conduct business. OP Skins then developed their own virtual item, VGO skins, using blockchain technology to create one of the first widespread trading system using non-fungible tkens (Abarbanel & Macey, 2019). These NFTs were designed specifically to replicate the affordances provided by traditional skins, whether that be in regard to simple trading or use in gambling; they can be obtained in the same manner as traditional skins, via loot VGO loot boxes or online trading. The launch of VGO skins was accompanied by a press release which stated that VGO skins were independent of any specific title and could, therefore, be used in any game in which the developers chose to allow it (Oxendine, 2018). To date, they can only be used in the game *The Forge Arena*, they continue to be, however, a popular means of accessing gambling. Given that VGO skins were developed independently of any game, and were explicitly designed to afford the same uses of traditional skins, they can be considered a fiat currency. Furthermore, they question the assertion of game companies that skins, and other virtual items, only have in-game value.

2.4 Esports and Gambling

Esports is perhaps the most obvious example of the current trend of convergence between video gaming and gambling (M. Griffiths, 2017; D. L. King & Delfabbro, 2020). Not only are established industry operators offering esports markets, but they are also a significant and visible presence in the esports ecosystem, sponsoring teams and tournaments. Furthermore, a notable majority of online sites offering news and discussion forums for esports fans display significant amounts of material advertising gambling operators and cross-promotion of other gambling activities (Abarbanel & Phung, 2019; Lopez-Gonzalez & Griffiths, 2018).

Esports is an umbrella term for the competitive play of video games structured around leagues and tournaments (Hamari & Sjöblom, 2017; Jenny et al., 2017), it utilises popular titles from a range of genres including, but not limited to: FPS such as *CS:GO*; real-time strategy (RTS), such as *StarCraft II*; multi-player online battle areas (MOBAs), such as *Dota 2*; simulated racing games (Sim Racing), such as *iRacing*; fighting games, such as *Street Fighter V*; and sports simulation games such as *FIFA*.

Industry-facing organisations have found that esports are especially popular with the millennial generation, with over 30% of all internet users aged 16 to 24 watching esports (Fitch, 2020; Kemp, 2019). The popularity of esports among younger generations is also supported by a growing body of academic research (S. M. Gainsbury et al., 2017b; Macey & Hamari, 2018).

Although esports is a phenomenon which has come to widespread prominence within the last decade, the term itself was first used in the late 1990s (Gestalt, 1999). This fact highlights the fact that the history and development of esports can be, somewhat roughly, separated into two discrete periods. The point marking the distinction between these two phases is the development of online technologies which allowed mass participation in both peer-to-peer gaming outside of local area networks and the streaming of game play (T. Scholz, 2012).

Figure 15. Figure 15. LAN Party 1998. © ChristopherCollins. Source: imgur.com

The early period of esports is one in which competitive play of video games was one characterised by player versus computer, with performance being measured by the high score, rather than through direct competition between players (Borowy & Jin, 2013). At the same time, spectating play was limited to either live situations, such as in arcades or at staged events, or to the limited number of events broadcast on terrestrial or cable television. It is the adoption of local area network (LAN) technologies, and the development of games such as *Pathways into Darkness* and *Doom*

which facilitated real-time, multiplayer interactions (Wagner, 2006). It is at this point that the dynamic broadened in scope to allow player versus player competition, in addition to player versus computer (see figure 15., above).

In addition to the pre- and post-internet eras, the history of esports can also be viewed in terms of the differing developmental pathways which shaped it in the East and the West. The post-arcade rise of esports in the West can be traced to the growth of LAN parties and, consequently, was at first associated with the PC titles and first-person shooters which fully exploited the new affordances of the technology (Wagner, 2006). Despite the significance of Japan to the gaming industry, the country has been notably slower to embrace esports than many other nations, instead it is South Korea which first emerged as a major influence in esports, both regionally and internationally. In contrast to the more grassroots-led emergence of esports in Western nations, Korean esports can be directly tied to the massive governmental investment in the telecommunications infrastructure which occurred in the late '90s. This enhanced the appeal, and accessibility, of online games while also allowing a gaming culture to coalesce around the thriving internet-café, or PC Bang, scene. Furthermore, the Korean Esports Association was formed in the year 2000, in association with the Ministry of Culture, thereby formalising the government's commitment, legitimising esports as an activity and supporting esports players (Jin & Chee, 2008).

Esports has become a global phenomenon, with notable teams and players from almost every continent; its rapid expansion in popularity can be seen in the fact that prize pools have grown exponentially: The International, an annual tournament for the esports title *Dota 2*, has grown from $1.6m in 2012 to $34.3m in 2019 (Gough, 2021). The International is a noteworthy example not simply because its growth is illustrative of the wider trends in esports and that it has the largest prize pool of any tournament (Esports Earnings, 2020) but, in addition, due to the fact that it is funded through sales of the *Dota 2 Battle Pass*. The battle pass is a means by which the publisher, Blizzard, further monetises the game by making additional digital content available for purchase (Petrovskaya & Zendle, 2020), this content includes several examples of gamblifed activities and services (Zanescu et al., 2020).

As esports continues to grow in popularity, so does betting on esports; indeed, esports betting is an established market with the first betting company providing options as long ago as 2010 (Cooke, 2017). However, the relatively recent recognition of esports by mainstream culture has meant that for much of its existence the betting market has been served by sites which have been entirely unregulated (Greer et al., 2019). In 2019 the esports betting market was valued at

approximately $8bn (Wimer, 2019). This figure does not account for betting conducted on unregulated sites, of which there are a great many, neither does it include wagers made using tradable virtual items as a de facto currency. As such, the true scale of the current esports betting market is likely to be significantly in excess of $8bn (Macey, Abarbanel, et al., 2020; Macey & Hamari, 2019).

In addition to betting on esports, there are a number of other gambling activities associated with popular esports titles, but which are not directly associated with the concept of esports as competitive video game play. These practices often occur in the same environments as esports betting, or in closely connected environments and, as such, have been referred to as "esports gambling" (Grove, 2016). In order to ensure conceptual clarity and accuracy, the published articles that comprise this research use the term "video game-related gambling" in place of "esports gambling" to refer to wider practices of gambling which are associated with esports titles, but not with esports as a practice.

The recent influx of money into the esports ecosystem has resulted in increased professionalization and transparency, while the increased presence of established betting operators has provided more reliable opportunities for esports bettors to engage with the activity. The esports betting market has been established for some time and is currently undergoing significant realignment, with unregulated sites still a significant presence. The large number of unregulated gambling sites associated, both directly and indirectly with esports, mean that under-age gamblers can easily access a range of services and activities. These sites often accept digital in-game items in lieu of real-world currency (Macey & Hamari, 2019), further increasing ease of access for under-age bettors.

Esports betting is a practice which has only recently become visible to mainstream interests, with much activity taking place within communities and environments explicitly associated with video games (Lopez-Gonzalez & Griffiths, 2018; Macey & Hamari, 2019). However, the practice of esports betting has been steadily growing for years and is usually practiced by younger males, an established risk group. While many mainstream sites offer esports markets, there are many more unregulated sites which can be accessed without using real-world currency, instead making use of virtual, game-based items (Macey & Hamari, 2019), and explicitly locate betting as part of a game-based gambling sub-culture (S. M. Gainsbury et al., 2017b; Johnson & Brock, 2019).

Given the relatively recent emergence of video game-based gambling as a multibillion-dollar industry, alongside the presence of digital economies based around virtual items, little is known about the true extent of esports betting nor it's

potential for mainstream acceptance alongside traditional sports. However, the current pandemic is only likely to increase interest in esports and other computer-mediated sporting events, such as virtual sports. In an attempt to mitigate the spread of coronavirus virtually all professional sport was suspended for a period of several months from mid-March (Mather, 2020), however, esports did not suffer the same fate, with many leagues and tournaments moving to a purely online format (G. Ashton, 2020). In an effort to fill the space left by cancelled sporting events, sporting organisations sought to provide content which merged traditional sports and esports. For example, professional footballers competed in online tournaments using the game *FIFA 20* (Hern, 2020), see figure 16., while the NBA organised competitions between star players using *NBA 2K* (Dowsett, 2020), and professional Formula 1 drivers competed against established esports players in simulated racing events (L. Smith, 2020).

Figure 16. Figure 16. Marcus Rashford and Jadon Sancho playing FIFA as part of the #footballsstayinghome cup in April 2020. © The Football Association.

These conditions have potentially increased the appeal of video game-related gambling to a wider audience as sports bettors seek to find an alternative by wagering on esports and virtual sports. Indeed, the Las Vegas legislature recently opened up esports betting markets (Reames, 2020), while New Jersey has allowed wagers to be placed on simulated NASCAR races featuring professional drivers (Green, 2020). The migration of professional athletes to digital sports has also been observed in Formula 1 (Sim Racing), Football/Soccer (*FIFA 20*), and Basketball (Baldwin, 2020;

P. McInnes, 2020; Mills, 2020), serving to introduce a new range of sports fans and bettors to these digital activities. Other popular sport wagering events, such as horse racing, have turned to virtual simulations; the centrepiece of the UK calendar, The Grand National, was broadcast on free-to-air television, garnering 4.8 million viewers, approximately half the viewership of the previous year's real-life event. It raised over £2.5 million pounds for charity and, given that the average wager was £2, this shows significant betting activity on the virtual event (Scargill, 2020).

The growth in esports betting during the early stages of the pandemic was particularly significant; EveryMatrix, a company supplying betting software to companies across the globe, reported a 4,000% increase in esports betting in the first month of lockdown. The increased volume of bets was also matched by increased revenue, with esports making up the bulk of all bets by mid-April and average turnover per bettor increasing by 300%. The majority of this growth was driven by two esports, *NBA 2K* and *FIFA*, demonstrating the appeal for fans of traditional sports such as basketball and football (EveryMatrix, 2020). Indeed, an estimated 33% of traditional sports bettors migrated to esports within three weeks (Owen, 2020). The bright future for esports betting was highlighted by the fact that although esports betting increased across almost all age brackets, it is the most popular betting market for those under the age of 25, while the majority of esports bettors (79%) are aged 35 or under (EveryMatrix, 2020).

Given the established links between early exposure to gambling and the development of disordered gambling behaviours in later life (D. L. King, Delfabbro, et al., 2013; Shead et al., 2010; Winters et al., 2002), the gamblification of esports requires detailed investigation. At the same time, the ongoing pandemic is likely to lead to the continued suspension or cancellation of traditional sporting events, while encouraging increased consumption of digital media such as video games, esports, and online gambling. Add to this the fact that as both video game play and gambling are activities with the potential to develop into addictive behaviours, the combination of both video gaming and gambling has potentially serious implications. Consequently, the issue of esports betting in particular, is one which requires urgent attention as it is likely that it is an activity which will become truly embedded in digital cultures in the near future.

2.5 Cognitions and Gambling

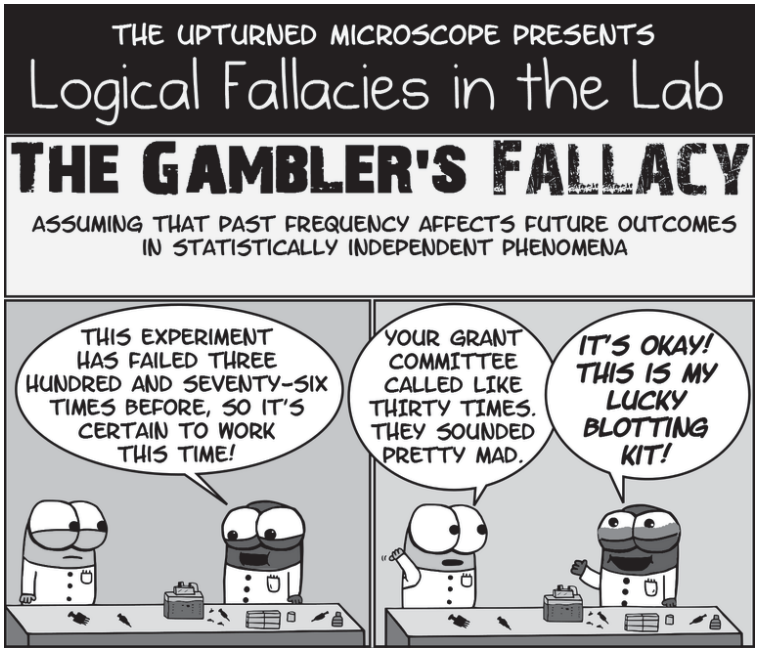
As a result of the ongoing convergence between video gaming and gambling in recent years, researchers in the field have theorised about the potential cognitive biases that may be associated with video game-related gambling (S. M. Gainsbury et al., 2015; S. M. Gainsbury, King, et al., 2016; D. L. King et al., 2012). It has been theorised that maladaptive cognitions from one context could be incorporated into the practices and behaviours associated with a previously distinct context. As a consequence, the cognitive frameworks employed by individuals in such situations have the potential to be even more damaging than would otherwise be the case.

Cognitive Behavioural Therapy (CBT) is an approach which aims to target such maladaptive beliefs in order to allow the subject to make more appropriate decisions, thereby reducing the potential to develop problematic gambling behaviour. Non-therapeutic approaches, such as gamification, paternalism, and choice architecture, have also been suggested as means of encouraging effective decision-making processes in economic situations, thereby combatting the effects of cognitive bias (Egan, 2017; Hamari et al., 2015; Thaler & Sunstein, 2003). This approach has been found to be effective in reducing monetary risk (Gaboury & Ladouceur, 1989), and the desire to gamble (Sylvain et al., 1997), as well as problems associated with gambling and excessive use of technology (Delfabbro & King, 2015).

Maladaptive cognitions are associated with heuristic thinking; heuristics are, in effect, mental shortcuts which are employed in order to lighten the cognitive load and are utilised in a range of situations, particularly those in which constraints exist, such as a deficit of information (Tversky & Kahneman, 1974). While they serve to optimise decision-making in risky situations and are developed as a result of prior knowledge or experience, they can lead to erroneous beliefs which become entrenched in an individual's mental framework. An area in which the reinforcement of erroneous or maladaptive cognitions can have particularly serious ramifications is that of problematic behavioural conditions, including disordered gambling (Dong & Potenza, 2014; Goodie et al., 2019), Internet use (Davis, 2001), video game play (Forrest et al., 2016a) and substance abuse (Verdejo-Garcia et al., 2018). The significance of maladaptive cognitions in the development of problematic gambling behaviours is evidenced by the fact that Cognitive Behaviour Therapy (CBT), and related techniques, have been found to be the most effective at treating disordered gambling, and consequently are the most widely implemented of treatments (Korn & Schaffer, 2004; Oei et al., 2010).

In the 1970s researchers began to move away from strictly normative theories of human decision-making and began to produce more descriptive theories to account for seemingly irrational behaviour, such as continued gambling in the face of losses. As a result, the role of heuristic thinking as part of the cognitive process was established and linked to the presence of erroneous cognitions. One of the most well-known cognitive biases is called the "gambler's fallacy" (figure 17.) , it refers to the belief that a series of results will soon be "corrected" by an alternative result or series (Tversky & Kahneman, 1974). The gambler's fallacy is based on a misunderstanding of the nature of probability in which a series of independent results are thought to be related (Cowan, 1969).

Figure 17. Logical Fallacies: The Gambler's Fallacy. © Nik Papageorgiou. Source: the upturnedmicroscope.com



Given the central role of risk, and the imbalance of information in the practice of gambling, it is unsurprising that it is an area in which cognitive biases influence a great deal of behaviour, whether disordered or healthy. In fact, research has identified numerous ways in which these cognitive biases impact upon individuals' perceptions concerning the nature of chance and probability (Tversky & Kahneman, 1974), for example: as a result of temporal and psychological distance (Kirby et al.,

1999; Sagristano et al., 2002); the effect of previous wins (Ludvig et al., 2015); misattributing the outcome of events (Gilovich, 1983); and superstitious beliefs and reframing of past events (Toneatto, 1999).

Since the turn of the century there have been a number of attempts to identify and collate cognitive biases associated specifically with gambling. Measures have been developed for use in both clinical and non-clinical environments, including: the Gambling Cognitions Inventory (GCI; A. McInnes et al., 2014); Information Biases Scale (IBS, Jefferson & Nicki, 2003); Gambling Beliefs Questionnaire (GBQ-S) Steenbergh et al., 2002); Gambling Belief Questionnaire (GBQ-J) Joukhador et al., 2003); Gambling Beliefs and Attitudes Survey (GABS) Breen & Zuckerman, 1999); the Video Gaming Device Inventory (VGDI; Pike, 2002); and the Gambling Related Cognitions Scale (GRCS; (Raylu & Oei, 2004).

When considering these measures several factors exist which limited their potential for use in this research. The first notable issue is that some of the measures were designed for use participants in a specific gambling activity, rather than gambling in general, for example EGMs (e.g. VGDI, IBS). Second, many measurements instruments utilise a single-, or two-factor model resulting in conceptually diverse items being grouped together and, consequently, violating assumptions of face validity (e.g. GBQ-S, GCI, IBS, GABS). Third, that some measures have been developed with specific, limited contexts of use, and are not suitable for use in general populations (e.g. GABS, GCI). Fourth, that when tested for convergent validity against problem gambling measures, some are unable to distinguish accurately between different categories, for example between problem gamblers and likely problem gamblers (e.g. GBQ-S, GBQ-J). Fifth, whilst the majority of measures are relatively short in length some contain a significant number of items, for example GBQ-J is made up of 65 items. As such, the GBQ-J is not suitable for use in survey research as part of a battery of measures. Finally, generalised criticisms levelled at extant instruments which have been designed to measure gambling-related cognitions include: lack of content validity, i.e. the and insufficient information relating to scale development (Goodie et al., 2019).

The GRCS can be subjected to the same general criticism offered by Goodie at al. (2019), in that it is not a comprehensive collection of gambling-related cognitions. However, it has been validated both in respect to different pathological measures and, unlike the other measures, across a range of distinct cultural contexts (Goodie & Fortune, 2013). Furthermore, it has been proven to be a useful measure in non-clinical settings and, at 23 items, has been designed as a self-report tool meaning it is suitable for use in survey research.

The importance of an evidence-based approach to clinical practice is well-established, offering the best possibilities for improved quality of care and recovery rates for those dealing with disordered gambling. The need for a strong evidence base is even more pressing in special populations of gamblers, where factors such as age, gender, or cultural influences shape attitudes, beliefs, and vulnerabilities in ways which differ from the mainstream cohort. In such populations dedicated research is needed in order to explore and uncover specific characteristics which significantly affect the success of clinical interventions (Korn & Schaffer, 2004).

Given the potential for growth in video game-related gambling, and the fact that it is an entirely mediated experience, there is a pressing need to understand how the psychological processes which inform betting behaviour, such as decision-making and risk assessment, function in these new environments. Indeed, research included as part of this dissertation has suggested that video game players who are also gamblers do indeed endorse different cognitive frameworks related to gambling from those endorsed by the general population. These differences are primarily concerned with the conceptualisation of luck and skill (Macey & Hamari, 2020).

3 METHOD

3.1 Data and Research Models/Design

The articles included in this dissertation make use of self-report data collected from four different surveys. The decision to employs surveys as the primary method of data collection was made for the following reasons: first, access to the target populations; and second, the need for data suitable for addressing the specific research questions. Online surveys are a relatively effective and cost-efficient means of accessing digitally-active populations and individuals, for example esports fans. Indeed, they have proven to be a more reliable approach than established techniques of probability sampling which often utilise more traditional technologies such as posting paper copies or contacting potential respondents via telephone (Forrest et al., 2016b; M. D. Griffiths, 2010). In addition, online methods of data collection have been found to increase the veracity of participant responses, primarily as a result of reduced social desirability bias, a consideration particularly relevant to gambling and other potentially sensitive topics (M. D. Griffiths, 2010).

3.1.1 Measurement Instruments

Articles 1, 2, and 4 used data gathered from a single survey, but which was utilised differently in each of these studies according to the aims of the research and the particular research questions specified therein. Consequently, an overview of this survey is provided below, with the specific characteristics of the datasets used in each article being described in the relevant sub-sections dedicated to each article. Article 4 used two further datasets; these will be described in full in section 3.1.6.

3.1.1.1 Articles 1,2, and 4

The survey used to collect data used in articles 1, 2, and 4 was publicised on a range of internet services and websites, including: social media, e.g. Facebook and Reddit; a range of discussion forums; and on the internet pages of a number of national

esports associations. The link was accessible for one month in late 2016, and was accompanied by a message which outlined the aims of the research and the eligibility criteria, if a potential participant chose to activate the link they were redirected to a landing page which, in addition to expanding upon the previous information, also informed the reader about the nature of the research, i.e. funding arrangements, the identities of the researchers and institutions associated with the research. Potential respondents were eligible to participate if they had played video games within the previous 12 months, and had watched esports, gambled or purchased loot boxes. Furthermore, participants were required to be a minimum of 18 years of age, or to have the permission of their parent(s) or other legal guardians. Although no restrictions were imposed on potential respondents based on their physical location, both the survey itself, and the accompanying information described above, were provided only in English. As an incentive to participate, eligible participants who provided fully completed responses had the opportunity to enter a prize draw with the chance to win one of five gift cards, each worth $50, and which could be redeemed on the digital distribution platform of their choice. The gift cards could only be used to purchase video games, they could neither be redeemed from real-world currency, in-game currency, or virtual items, furthermore, they could not be used to access any gambling services.

The survey included an extensive number of items which measured the following information: demographic characteristics; esports spectating habits; video game play habits; and gambling behaviour (online, offline, and related to video games). For all three forms of consumption (esports spectating, video game play, and gambling), individual items measured: frequency, average monthly spend (in US$), and average weekly hours spent on activity.

All items which related to specific forms of gambling (e.g. sports betting, online casino games, etc.) were accompanied by a full list of relevant examples. Respondents were instructed to consider all types of activity, whether formal (via a service provider), informal (with family or friends), legal, or illegal.

Also included in the survey were two extant measurement scales developed to assess problematic media consumption: the short form version of the Game Addiction Scale (GAS; (Lemmens et al., 2009); and the Problem Gambling Severity Index (PGSI; (Ferris & Wynne, 2001).

While several measures of problem gambling have been developed, including PGSI (Ferris & Wynne, 2001), SOGS (Lesieur & Blume, 1987), NODS (Gerstein et al., 1999), and PPGM (Williams & Volberg, 2010) among others, it is the former two measures which have been most extensively employed in research. In the latter years

of the 20th century, SOGS was the most widely used measure, a situation which persisted until 2002 until it was superseded by PGSI (Christensen et al., 2019). Indeed the PGSI has since become the "gold standard" in countries such as Canada and Australia, and it has been employed in numerous national contexts around the world (Miller et al., 2013). It was decided that either SOGS or PGSI would be used in this research in order to ensure comparability with a range of other studies; the PGSI was chosen in preference to SOGS for the following reasons. First, SOGS was initially developed for clinical use, while PGSI was specifically intended for use in the general population. Second, SOGS provides a binary, problem/non-problem, classification[1], while the PGSI was designed to distinguish between different types of problematic and potentially problematic behaviour, that is that it viewed problematic gambling as a continuum rather than as a simple yes/no distinction (Miller et al., 2013; Stevens & Young, 2008). Third, the dimensional structure of SOGS has been found to be questionable, with analysis revealing problems such as low internal consistency – suggesting items actually measure different constructs, while the same study showed PGSI to be robustly constructed. Other studies have also validated the unidimensional PGSI structure and found high test-retest reliability in comparison to SOGS (Christensen et al., 2019; Miller et al., 2013; Stevens & Young, 2008). Furthermore, the PGSI was found to be more highly correlated with known correlates of problem gambling than SOGS (Miller et al., 2013). Finally, SOGS has been criticised for overestimating the prevalence of problem gambling, particularly when used in non-clinical settings (Otto et al., 2020; Stevens & Young, 2008). As such, the PGSI was deemed to be the most suitable measure for use in this research.

The PGSI (Ferris & Wynne, 2001) is a well-established self-assessment measure which has been utilised and validated in numerous existing studies, (e.g. (Devlin & Walton, 2012; Loo et al., 2011; Orford et al., 2010). It consists of nine items and addresses a range of both problematic gambling behaviours, e.g. *"When you gambled, did you go back another day to try to win back the money you lost?"*, and potential consequences arising from those behaviours, e.g. *"Has your gambling caused any financial problems for you or your household?"*. Respondents are asked to consider the items in reference to the previous 12 months, and to score each item using the following scale: never = 0; sometimes = 1; most of the time = 2; almost always = 3. The scores for the nine items are summed and, according to the results, respondents are placed

[1] Cut points reflecting different categorisations were later introduced, but these were developed without relevant validation (Miller et al. 2013).

in one of the following four groups: score of 0 = *non-problem*; score of 1-2 = low risk; score of 3-7 = *moderate risk*; score of 8 + (up to a maximum of 27) = *problem gambler*.

There has been much debate concerning the most appropriate means of measuring problematic gaming, with some suggesting a focus on consequences of such behaviour, while others propose that specific criteria can be tied to differing degrees of consumption (D. L. King, Haagsma, et al., 2013). One such example is the Addiction-Engagement Questionnaire which distinguishes between core criteria, indicating problematic gaming behaviours, and peripheral criteria, indicating highly engaged consumption. The criteria which made up the Addiction-Engagement Questionnaire were derived from Brown's work on behavioural addiction (Charlton & Danforth, 2007). Indeed, numerous attempts to establish criteria for assessing problematic gaming behaviours have been made and have tended to draw upon the criteria for problem gambling presented in the DSM, or by adapting criteria for Internet Addiction (IA; (K. S. Young, 1999), itself derived from the DSM criteria on gambling. Others have used the WHOs ICD criteria for problem gambling as a basis for developing measures of problem gaming (Lemmens et al., 2009). The use of psychometric criteria to measure the condition is a more fruitful approach than the use of simple markers such as overall time spent playing, as was the case in early attempts to conceptualise problematic game consumption; such criteria are overly simplistic and do not distinguish highly engaged players from those who have more problematic consumption behaviours (D. L. King, Haagsma, et al., 2013).

Instruments such as the Video Game Addiction Test (van Rooij et al., 2012) and the Scale for the Assessment of Internet and Computer game Addiction (AICA-S; (Wölfling et al., 2012) are evidence of the conceptual confusion surrounding problematic gaming. The former is derived from the Compulsive Internet Use Scale (Meerkerk et al., 2009), while the latter assesses problematic use of the internet in general, with gaming viewed as a specific form of internet use alongside viewing pornography etc. (Wölfling et al., 2012). Viewing game play solely in terms of online play ignores a significant part of the gaming ecosystem and, as such, is not deemed to be a beneficial approach in the context of this research. The Game Addiction Scale (Lemmens et al., 2009) was chosen for inclusion as it is not limited to online gaming, has been found to possess high levels of internal consistency, and has been validated in a range of international contexts. Furthermore, the fact that the short-form version of GAS has been proven to be a robust measure means it is particularly suited for use in survey-based research unlike longer instruments.

The short-form version of GAS has been previously validated in a range of studies (Baysak et al., 2016; Gaetan et al., 2014; Mentzoni et al., 2011; C.-W. Wang

et al., 2014), and has been found to be as effective as the original, 21-item version. The short-form was chosen for this research in order to reduce the potential for fatigue on the part of respondents. The GAS uses seven items to measure: salience, tolerance, mood modification, relapse, withdrawal, conflict, and problems resulting from video game play. Each item is measured using a five-point Likert scale, with possible response options ranging from "never" (1) to "very often" (5), if a response to an item is "sometimes" (3) or higher, that item is considered to be endorsed by the respondent. Two possible approaches to categorisation are proposed by the authors: the monothetic, wherein all seven items are endorsed, and the polythetic, in which four of the seven items must be endorsed (Lemmens et al., 2009). However, Forrest et al. (2016b) proposed a third approach to scoring, one in which all the scores are summed in order to provide a continuous scale of problematic gaming behaviour. It was the latter approach which was adopted by this research as it was felt that it provided greater scope to capture the nuances of problematic behaviours associated with video game play which would be lost if a binary yes/no classification were applied.

The final measure included in the survey was the Gambling Related Cognitions Scale (GRCS; (Raylu & Oei, 2004), an extant, previously-validated measure developed for use in non-clinical contexts. The merits of the GRCS and its suitability for inclusion in this research, in reference to other extant measures, have been discussed previously, in section 2.5. The GRCS consists of 23 items which together make up five sub-scales, three of which directly address gambling-related behaviours proposed by Toneatto et al., (1997): *Illusion of Control* (IC), *Predictive Control* (PC), and *Interpretive Bias* (IB). The remaining two sub-scales are somewhat wider in scope, and were developed to reflect aspects of individual control and motivations to gamble: *Gambling Expectations* (GE); and *Inability to Stop Gambling* (IS). Each item is rated on a seven-point Likert scale, with options ranging from "*strongly disagree*" (1) to "*strongly agree*" (7). Following a literature review (see article 4) a number of additional items were developed and included in the survey in order to supplement the GRCS. This approach was deemed necessary as the literature review revealed several issues hypothesised as influencing regular video gamer's cognitive framing of gambling and, as such, were not part of the original measure. These potential influences were grouped into the following four themes: *Reduced Desire to Gamble*; *Normalisation of Gambling*; *Structural Characteristics of Gaming and Gambling*; and *Locus of Control*. The full list of supplementary items, and their sources from which they were developed, can be found in appendix A of article 4.

As stated previously, eligible participants were those that had played video games within the previous 12-month period, and had either watched esports or gambled. In total, 2397 responses were received of which 891 were fully complete. The survey included a filter question and of the 891 complete responses, 241 were removed for failing to answer the filter question correctly. Subsequently, 34 responses were removed during data cleaning as they had either provided inconsistent responses or there were observable patterns in the responses to items using Likert scales, e.g. straight-lining or other patterns. Finally, 3 responses were removed from the data as they had indicated that they had not played video games within the previous 12 months. As such, the final dataset consisted of 613 records, 25.57% of total responses.

3.1.2 Data: Article 1

In addition to the data cleaning described above, those who did not pay to open loot boxes were excluded from the analysis. Furthermore, those who reported neither watching esports nor participating in any form of gambling in the preceding 12 months were deemed ineligible and were also removed from the data sample. The final sample used in article 1, therefore, consisted of 582 responses, 24.28% of total responses received.

Respondents constituting the dataset employed in article 1 were characteristically young and male; 525 respondents reporting their gender as male (91.9%), in addition 157 (27%) were under 18 years of age with a further 182 (31.3%) ranging from 18–21 years of age. In respect to nationality, the five most represented countries were: USA, 207 (35.6%); UK, 46 (7.9%), Finland, 41 (7%); Canada, 39 (6.7%); and Germany, 27 (4.6%). In total, responses were received from 61 different countries, although the survey was only available in English, see table 4, article 1 for full descriptive statistics.

As described previously, potential participants were required to have played video games within the previous 12 months and to have either watched esports or gambled within the same period. Over half of respondents (51%) reported both gambling and watching esports during the preceding year, with the figure rising to 67.2% when purchasing loot boxes is included alongside established forms of gambling. Those who reported participating in any form of gambling but not spectating esports constituted 7.4% of the sample, including the paid loot box opening this figure rose

to 8.25%. The final 24.57% of the sample reported watching esports but did not participate in any form of gambling in the year prior to completing the survey.

In regard to individual gambling activities, the most popular were found to be: video game–related betting (19.8%); online betting (26.8%); offline lottery (22.9%); and offline betting (17.9%). However, when considering loot box purchases alongside established gambling activities, it becomes the single most popular activity by a considerable margin, constituting 42.6% of participation in gambling or gambling-like experiences (see table 5, article 1). It is noteworthy that of the 177 respondents who reported paying to open loot boxes, 121 also reported using skins obtained from loot boxes to gamble, for example in skins lotteries.

Categorising respondents according to the PGSI reveals that 4.5% can be considered problematic gamblers, 18% were at moderate risk of developing problematic behaviours, and 27.8% were at low risk.

3.1.3 Data: Article 2

The eligibility criteria for article 2 were that participants must have played video games within the preceding 12-month period and must have either watched esports or gambled at any time prior to participating in the survey. As such, no further responses were removed from the core dataset, described above, meaning that the dataset employed in article 2 consisted of 613 respondents, 25.57% of total responses.

Considering that the dataset utilised in article 2 included an additional 31 respondents to that which was used in article 1, the demographic characteristics are understandably similar with 58.1% being aged 21 or under (table 1, article 2), and 91.4% reporting their gender as male (table 4, article 2).

The sample was dominated by regular video game players, with 98.2% of respondents reporting that they played video games once a week or more, while just over half the sample (50.1%) watched esports once a week or more (table 2, article 2). In regard to specific forms of gambling it is unsurprising that the most popular format was that of video game-related gambling, with 47.5% reporting participation, 34.4% of the sample had gambled online not related to video games, while 32.8% had gambled offline within the previous year (table 3, article 2).

3.1.4 Data: Article 3

Article 3 utilised data gathered from an online survey between April 11th and April 19th, 2018, with participants being recruited via Qulatrics, a market research company. In order to be eligible, respondents were required to be of legal age to gamble (18 or older) and to have either played video games or watched esports at least once in the previous 12-month period.

Potential participants were provided with an informed consent document which provided information about the nature of the study, its aims, and sources of funding. Furthermore, it outlined the principles of informed consent, advising that participation was voluntary, and that it could be withdrawn at any time without consequence. In addition, potential participants were required to read and sign a consent form before being granted access to the online survey. No incentive for participation was provided to respondents. The survey was conducted entirely within the United States of America and ethical approval for this study was granted by the Institutional Review Board at University of Nevada, Las Vegas.

In total, 2035 responses were received, of which 400 were removed due to the fact that they were incomplete, with a further 230 being deleted as a consequence of failing to meet the relevant inclusion criteria. During data cleaning, a total of 37 outliers were removed, providing a final dataset of 1368 records.

The survey included items demographic items measuring: Age, Gender, Marital Status, Annual Household Income and Educational Attainment. Participants were asked to provide actual age to the closest complete year, with both Gender and Marital Status being nominal, categorical variables.

In addition to demographic information, the survey included items which measured the consumption of video games, esports and gambling activities in the preceding 12-month period. The consumption of video games was measured via items measuring: frequency of play, average hours spent per play session, and the context of play. As with any traditional sport, the consumption of esports can take the form of either spectating or participating, as the research was concerned solely with spectating, the survey included the following items: frequency of spectating, average hours spent per spectating session, the context of spectating, and the type of broadcast (live or pre-recorded). Information regarding the consumption of gambling was collected using items which measuring overall participation in gambling activities, with no distinction being made between different forms of gambling, for example offline versus online versus offline gambling. As such, the

survey included items which measured the frequency of play, average hours spent per session, and average spend per session (in US$).

Respondents' esports betting behaviours were measured via two distinct items, the first was a categorical item asking if participants had bet on an esports event in the previous year, with the following response options provided: "yes", "no" and "I cannot remember". In addition, those that had wagered on esports were asked to indicate whether they had used dedicated esports betting sites, for example Unikrn, general sportsbook providers, e.g. William Hill, or both.

Finally, motivations for consuming esports were assessed using the Motivation Scale for Sports Consumption (MSSC; (Trail & James, 2001), adapted for use in the context of esports. The article utilised the updated version of the MSSC (Trail, 2012), with "esports" being inserted into all relevant fields indicated in the MSSC manual., as per the following example: *'An individual player's "sex appeal" is a big reason why I watch esports'*. The MSSC is an extant measurement scale, previously validated in a range of different sports and sporting environments, including: wrestling (Schaeperkoetter et al., 2016); disability sports (Cottingham et al., 2014); South African soccer (Stander & van Zyl, 2016); and esports (Hamari & Sjöblom, 2017). The adapted MSSC consists of 31 items which together constitute 8 constructs, a full list of the constructs and a description of each is provided below in table 1. Respondents are asked to rate each item using a five-point Likert scale, with response options ranging from '*strongly disagree*' (1) to '*strongly agree*' (5).

Table 1. Constructs of the updated MSSC

Motive	**Description:** Motivated by …
Acquisition of Knowledge	The need to learn about the team or players through interaction and media consumption
Aesthetics	The artistic appreciation of the sport due to its inherent beauty
Drama/eustress	The need to experience pleasurable stress or stimulation gained from the drama of the event.
Escape	The need to find a diversion from work and the normal, unexciting activity of everyday life.
Physical attractiveness of the athletes	Watching sports because of the physical attractiveness or "sex appeal" of an individual athlete or group of athletes
Physical Skills of the participants	The appreciation of the physical skill of the athletes or the well-executed performance of the team
Social Interaction	The need to interact and socialize with others of like interests to achieve feelings that one is part of a group
Vicarious Achievement	The need for social prestige, self-esteem and sense of empowerment that an individual can receive from their association with a successful team

The finalised dataset contained responses from those ranging from 18 to 80 years old, the mean age being 37.83 (M = 37.83), and the majority of participants reported their gender as male (58.4%). A more detailed summary of descriptive statistics, including marital status, average household income, and educational attainment are provided in the supplementary materials for article 3, appendices A to F. As described above, the survey was conducted entirely within the US, as such it is unsurprising that respondents were overwhelmingly of American nationality (N = 1,152, 97.9% of those who provided their nationality). The sample included responses from an additional 21 nationalities, however, none of these constituted more than 0.2%.

Most participants played video games once a week or more (78.2%), with play sessions of up to two hours being the most frequently reported at 57%. Nearly half (47.5%) of participants reported spectating esports, of these 57.5% indicated that they watched at least once a week; esports spectating replicated video game consumption, in that the most commonly reported length of viewing session was two hours. Full details are available in tables 1 and 2, article 3.

Over half (52.1%) of respondents reported participating in some form of gambling at least once in the preceding 12-month period, however, a significant minority (13.5%) gambled at least once a week. Of those who gambled, the majority reported gambling sessions lasting up to two hours (55.3%, median: two hours), while expenditure per session ranged from $0 to $5,000 (mean spend: $108.27). Full details are available in table 3, article 3.

3.1.5 Data and Measures: Article 4

The nature of the research question resulted in the following eligibility criteria: respondents must have both played video games and gambled at least once within the previous 12 months. As described above, article 4 utilised 3 separate datasets, the first dataset (dataset A[2]) was culled from online survey 1. In addition to the data cleaning described previously, those that had neither played video games nor gambled within the previous 12 months were excluded. After deleting ineligible responses, the final sample consisted of 391 respondents, 16.31% of total responses.

[2] Please note that for the purpose of clarity, in this dissertation datasets have been labelled A, B and C, reflecting the order in which they were collected. However, in publication 4, the datasets were labelled differently, reflecting the order in which they were used in the analysis. As such, the datasets labelled A, B, and C in this dissertation correspond to datasets 2, 1, and 3, respectively, in the published article.

This dataset displayed somewhat differing demographic characteristics than those employed in articles 1 and 2 due to the fact that the eligibility requirements resulted in the removal of over 200 respondents from the core data set. However, it still demonstrated an obvious skew towards young males, with 85.7% of respondents aged under 30, and 93.4% being male. Of these, 98.2% can be considered regular video game players (played at least once a week), 21% participated in gambling directly connected to video games at least once a week, 18.7% participated in other forms of online gambling at least once a week, and 13.1% gambled offline at least once a week.

3.1.6 Article 4: Additional Data

As described previously, article 4 used three datasets, each randomly assigned to an individual stage of the research. Dataset A was culled from a larger set collected between November and December 2016 and is fully described above (section 3.1.5). Datasets B and C were gathered via an online survey, data collection was conducted at two different times in August 2019; participants were recruited via the online service *Pollfish*, and had to have both gambled and played video games within the previous 12 months in order to be eligible. Ineligible respondents were disqualified before being allowed to complete the survey, in addition, those who failed the filter question were also disqualified in real-time, meaning that they were not permitted to complete the survey. In total, datasets B and C comprised 442 and 335 responses, respectively. As with dataset A, the link to the survey took potential participants to a landing page which was populated with text detailing the aims of the study, funding, and eligibility criteria. The material, both survey and accompanying information, was only made available in English, however, there were no geographical restrictions which were imposed upon potential participants.

The survey was an abridged version of that described above, and contained items measuring: video game playing habits, esports spectating habits, gambling habits, demographic information, GRCS and supplementary items. All items are as described previously.

Dataset B was constituted of 63.6% male respondents, while 33.5% of the total dataset was under 30 years of age. In total, 78.1% of respondents reported played video games once a week or more, while weekly (or more) participation in offline gambling, online gambling, and video game-related gambling was reported to be 50%, 47.5%, and 35.1%, respectively.

Finally, dataset C displayed the least imbalanced gender split with 57.8% reporting being male; 36.7% were aged 30 or under. The rate of video game play was very similar to dataset B, with 80.9% being categorised as regular gamers, once a week or more, however, the rates of participation in gambling were more varied: 43.3%, 48.1%, and 19.6% participated in offline gambling, online gambling, and video game-related gambling once a week or more, respectively.

3.2 Analysis Methods.

3.2.1 Crosstabulation (Article 1)

The research questions driving article 1 concerned the identification of different characteristics and consumption habits which were associated with certain types of gambling, specifically with the newly emergent forms of video game-related gambling and loot box purchasing. Given that the survey data was predominantly categorical, and that any continuous data could be grouped into mutually exclusive categories, it was decided that cross-tabulation would be the most effective and robust means of identifying patterns and associations.

Considering that single measures of consumption do not provide a holistic picture of behaviour, the research used a combined measure to assess consumption habits related to the spectating of esports, playing of video games, and participation in gambling. This single construct, measuring overall engagement, was constructed by combining the following indicators: frequency, average weekly hours and average monthly spend.

The following two-stage method was used to create each of the engagement constructs. First, values for each of the three measures listed previously were converted into numeric scales, ranging from 1 to 6, where 1 represented the lowest level of involvement and 6 the highest level. Second, the three individual scores were summed, with the mean representing the overall level of engagement. However, in regard to esports, the prevalence of free online content, predominantly via streaming services, means that the significance of expenditure is not as meaningful as either frequency of consumption or the number of hours spent watching esports content. As such, during the second stage of building the esports engagement construct, average monthly spend on esports was weighted at 50%.

During the process of analysis, in which consumption constructs were cross-tabulated with esports engagement, several cells in each of the tables yielded low counts, as such Fisher's exact test was used in place of Pearson's chi-squared test. In order to determine predictive power and direction of association, Somers' delta (Δ) and Kendall's tau (τ) were performed, respectively; Somers' delta is an asymmetric test, requiring that an independent variable be specified, in this case esports engagement. Finally, all tables were square (6 x 6), meaning that Kendall's tau-b was reported, rather than tau-c; the standard interpretation was followed, meaning that $\tau < 0.1$ shows a weak relationship, $0.1 < \tau < 0.2$ a moderate relationship, $0.2 < \tau < 0.3$ a moderately strong relationship and $0.3 < \tau < 1$ a strong relationship (Pollock III, 2011).

3.2.2 Structural Equation Modelling (Articles 2 and 3)

The articles conducted as part of this research utilised several methods of analysis, with Structural Equation Modelling being the most prevalent, featuring in both articles 2 and 3. This research questions addressed in these studies were concerned with the relationships between the consumption of contemporary digital media, in the form of both video games and esports, the motivations driving consumption behaviours, gambling behaviour, and demographic factors. Accordingly, two distinct involvement models (Binde, 2013) were developed in order to answer the respective research questions driving each study.

Structural Equating Modelling was chosen as the statistical technique most suitable for investigating these models as it combines both confirmatory factor analysis and multiple linear regression. Accordingly, it is suited to analysing models which include latent variables, observed variables, whether categorical, continuous, or ordinal. Specifically, Partial Least Squares-Structural Equation Modelling (PLS-SEM) was employed for the following reasons: the combination of factor analysis and linear regression efficiently addresses the potential issue of multi-collinearity in regression problems (Fornell & Bookstein, 1982; Wold et al., 1984); it is the preferred method in situations where the model includes a combination of both formative and reflective latent variables (Hair Jr et al., 2016); and it is the method best-suited where the focus is on prediction, rather than preferring the most optimally-fitting model (Chin et al., 2003). Finally, it is the recommended analytical approach when employing multiple linear regression with a self-selected data sample (Heckman, 1979).

3.2.2.1 Article 2

The model (fig. 1, article 2) measures consumption habits (video games, esports spectating, online gambling, offline gambling, and video game-related gambling) using formative constructs, as such, common methods of assessing construct validity are not applicable as they have been developed for use with reflective constructs (Diamantopoulos & Winklhofer, 2001; Wang et al., 2015). In order to assess construct validity, the outer VIF values were examined; construct validity was met as 11 of 15 outer VIF values were below 3.3, while the remaining four were below 5 (Diamantopoulos & Siguaw, 2006; Hair Jr et al., 2016). In addition, bootstrapping revealed that all t-values for outer weights were in excess of 2.57, thereby providing evidence that the outer loadings were significant at the level of 0.01 (Hair Jr et al., 2010).

3.2.2.2 Article 3

As in article 2, the constructs measuring consumption habits were formative. Construct validity was established as all VIF values except one, were under 3, with the single exception remaining under 5 (Diamantopoulos & Siguaw, 2006; Hair Jr et al., 2016). Furthermore, in order to minimise paths within the structural model, the MSSC variable was used as a single latent variable; 27 of the 30 items had outer VIF values under 3, with all remaining items being under 5. In regard to internal consistency, Cronbach's Alpha for the MSSC was found to be .956, demonstrating its robustness.

3.2.3 Confirmatory Factor Analysis and Exploratory Factor Analysis (Article 4)

The original aims of article 4 were twofold: first, in stage 1, to examine the validity of the GRCS for use in a newly emergent cohort of gamblers using Confirmatory Factor Analysis (hereafter, CFA); and second, using Exploratory Factor Analysis (EFA) to investigate the viability of supplementary items derived from a literature search (stage 2a). The study intended to produce a consolidated scale which would be assessed also using CFA, as well as for validity and reliability (stage 3a). However, during the course of the initial stage, a number of problems were found with the GRCS, typified by a large degree of inter-factor correlation, indeed, none of the five

constructs of the GRCS passed all validity and reliability tests. Consequently, the initial research plan was abandoned and a new one devised wherein all original GRCS items were pooled with those which were originally intended to supplement the GRCS. An EFA was conducted on the pool of items (stage 2b), with the finalised measure then being subjected to CFA (stage 3b). In order to ensure a viable measure was developed, different datasets were utilised in each stage of analysis (see sections 3.1.5 and 3.1.6).

CFA is a technique devised in order to test whether data fits a pre-determined measurement model, this is in contrast to EFA where the process reveals factors present within the data and for which no prior model is hypothesised (Suhr, 2006). Given that stage 1 utilised an extant model, and that stage 3b tested a model developed in the previous stage, CFA was the most appropriate analytic method. In contrast, EFA was used in stage 2b as the intention was to identify factors without applying a priori hypotheses.

CFA is comprised of two distinct parts: Goodness-of-Fit analysis (GoF), and validity and reliability testing. In regard to GoF a number of approaches have been proposed, article 4 adopted that recommended by Kline (Kline, 2011) which proposed reporting $\chi 2$, p-value, degrees of freedom, RMSEA, SRMR, and CFI. Given that this approach is the most robust, it was applied to this research. In addition, to ensure greater robustness PCLOSE, the p-value associated with RMSEA, and the parsimony-adjusted CFI value (PCFI) were also be reported. Finally, $\chi 2$ has been proven to be sensitive to sample size, particularly in situations where the sample is in excess of 200, as such the normed $\chi 2$ ($\chi 2/df$; (Wheaton et al., 1977) was reported in preference to $\chi 2$.

Following analysis of goodness-of-fit, the model structure is examined for reliability and validity: Convergent validity is determined where Average Variance Explained (AVE) of a factor is greater than .5; Discriminant Validity is established if both the Maximum Shared Variance (MSV) is less than the AVE, and the square root of the AVE is greater than the inter-factor correlations; Composite Reliability (CR) requires a value greater than .7 (Hair et al., 2006). Finally, in order to assess internal consistency, Cronbach's alpha is calculated for both the overall scale and any sub-scales, the following standard cut-off values were applied: $\alpha < .5$ = unacceptable; $.5 \leq \alpha < .6$ = poor; $.6 \leq \alpha < .7$ = questionable; $.7 \leq \alpha < .8$ =acceptable; $.8 \leq \alpha < .9$ = good; $.9 \leq \alpha$ = excellent (DeVellis, 2012).

As indicated above, the GRCS did not pass the GoF, validity, or reliability tests performed during stage 1 using dataset B, as such the GRCS was pooled with additional items and an EFA was conducted using a new data set (A). Several

different methods can be used in order to determine the number of factors identified in Exploratory Factor Analysis: Eigen values, scree plots, and Parallel Analysis (PA). Perhaps the most common method of identifying discrete factors is to examine Eigen values, with any factor scoring 1 or more being considered a viable construct, an approach known as the K1 test (Kaiser, 1960). However, this approach has been criticised as being overly simplistic and, often, providing an over-estimate of the number of factors (Fabrigar et al., 1999). An alternative is the scree-test, wherein Eigen values are plotted on a graph in order of size, the graph is then examined visually in order to identify a point at which the values no longer display significant difference from one another, the so-called "scree" at the bottom of a cliff (Cattell, 1966). Finally, Parallel Analysis is a method which compares Eigen values generated from the sample data to those generated from a monte-carlo simulation in order to determine the appropriate factor solution (Horn, 1965). The K1 test identified six discrete factors, the scree-test identified two possible solutions, four and seven factors, and PA identified six factors. However, the six-factor solution included many low-loading and cross-loading items. When developing a measurement scale, it is recommended that it be both parsimonious, in regard to the number of factors, and representative of underlying (Fabrigar et al., 1999; Hayton et al., 2004). As such, the potential four-factor model suggested by the scree-test was investigated, this solution was found to produce more coherent factors (face validity) while minimising cross-loading and low-loading items.

The finalised factor structure was then subjected to CFA using a third, distinct dataset (C), at this point it passed the GoF test, and displayed good Cronbach's alpha values, both at the overall scale level and for the four sub-scales. However, there were some issues regarding validity and reliability, leading to the deletion of a further seven individual items. The finalised measurement scale was named GamCog and consisted of 18 individual items divided among four discrete constructs: "Benefits of Gambling"; "Inability to Stop"; "Illusion of Control"; and "Perceived Gambling Skill".

4 RESULTS AND DISCUSSION

4.1 Article 1

The research conducted in article 1 was intended to provide an overview of behaviours which were only recently coming to prominence, and which have since become increasingly established in mainstream culture. The primary rationale underlying the study was to conduct one of the first academic investigations of both participation rates in gambling related to video games, and of the prevalence of problematic gambling behaviours among those who participate in such activities. Three main research questions underpinned the research, focusing on: the demographic characteristics of esports spectators who gamble; the degree participation in gambling activities, and types of activities; and the rates of problematic and potentially problematic gambling behaviour in the cohort.

Investigating the correlations between online spectating of esports and gambling products showed that engagement with esports is positively associated with both the number of gambling activities accessed and the number of channels used to access gambling services. In addition, the degree of problematic and potentially problematic gambling behaviour found in the sample was significant (50.34%). Of the four stated hypotheses, two were supported and two were partially supported, see table 2 below.

It is worthwhile to note that the sample features a high number of adolescent and young adult males which, while in part supporting H1, results in the fact that other aspects of the hypothesis (annual income and employment status) could not be realised. Although this hypothesis was developed from existing research, previous work has largely excluded those under 18 as they are legally restricted from gambling. This study imposed no such restriction and as such it highlights the fact that many individuals participate in video game-related gambling activities, despite being legally under-age. Furthermore, the fact that the hypothesised characteristics related to employment status and income were not observed can be explained by the fact that a large percentage of the sample reported still being in full-time education, therefore they had not yet been able to pursue a career.

Table 2. Article 1, hypotheses.

Hypothesis	Description	Result
H1	Those who both watch esports, and participate in different forms of gambling or purchase loot boxes, will predominantly be: young males, in full-time employment, and to report higher than average levels of income.	Partially supported.
H2a	Esports spectators who participate in gambling, and gambling-like, activities are likely to participate in a range of activities, accessed via mixed channels	Supported.
H2b	Betting, purchasing loot boxes, participating in skins lotteries, and using virtual items to play casino games expected to be the most popular individual activities.	Partially supported.
H3	For esports spectators who gamble, or participate in gambling-like experiences, rates of problematic gambling are expected to be higher in this population than other populations.	Supported.

In addition to highlighting the prevalence of under-age gambling related to video games, this study also reinforced the results of previous works which suggest that individuals use a range of channels to access gambling (Wardle & Griffiths, 2011) and, therefore, that participation in gambling should be considered holistically. Indeed, the discussion of online gamblers, offline gamblers and video game-related gamblers is, to some extent, an artificial construction as they are not mutually-exclusive categories. That said, the findings of this article show that traditional, land-based gambling, is the least popular channel for accessing gambling for esports spectators, clearly demonstrating the associations between video game-related gambling, loot box purchasing, and online gambling.

This research further highlighted the complex inter-relation between loot box opening and video game-related gambling as findings show that of those who purchased loot boxes, 68.4% went on to use the rewards (skins) as stakes in third-party gambling services. As such, the article provides clear evidence of a strong relationship between paid loot box opening and gambling, making clear the need to further investigate the use of virtual items as a means of accessing gambling services.

Despite the fact that paid loot box opening was the most popular individual activity reported by respondents (46.2%), it is noteworthy that esports engagement was negatively associated with both average weekly hours and average monthly spend on loot box opening. This is potentially explained by the fact that at the time the data was collected, those individuals who are heavily engaged with esports viewed the opening of loot boxes negatively as it was associated with several contemporary

scandals and negative publicity. This may also explain why using skins and other virtual items to access casino games was not found to be an especially popular activity, despite the stated hypothesis (Holden & Ehrlich, 2017; Lewis, 2017).

Finally, this article builds upon previous research in which both those who gamble online and those who engage in sports betting are more likely to exhibit problematic gambling behaviours (S. M. Gainsbury, Russell, et al., 2014; Hing et al., 2016; R. T. Wood & Williams, 2011). However, the rate of problematic gambling found in this sample was higher than anticipated, with the combined rate of "problematic" and "at-risk" gamblers being in excess of 50% using the PGSI. As such, further investigation of this issue is required in order to establish whether the results are specific to the collected data sample; it is recommended that a range of other measures are utilised, such as the SOGS or PPGM, so as to ensure that findings are not the result of particular measurement instruments.

4.2 Article 2

The ongoing convergence of contemporary media products, typified by video gaming, esports and gambling has emerged as an area of notable interest in recent years. Article 2 was one of the first empirical investigations of this topic and, as such, developed an involvement model (Binde, 2013) in order to examine potential relationships between the consumption of these different media formats, and the potentially problematic behaviours with which they may be associated.

The underlying research questions driving the study were articulated as follows: RQ1 - Is increased consumption of video games and esports associated with increased levels of gambling?; and RQ2 - Are higher rates of problematic video gaming associated with higher rates of a) gambling activity, and b) problematic gambling?

The primary findings of article 2 were that no strong associations were observed in relation to the consumption of video games, esports, and gambling activities, although esports spectating was moderately associated with gambling in relation to video games. Indeed, the amount of variance of established gambling, online and offline, was very small at $r^2 = .058$ and $r^2 = .022$, respectively. However, the model explained a significant portion of variance of video game-related gambling, $r^2 = .44$. The second notable finding was that problematic video gaming, measured using GAS, displayed a statistically significant negative association with participation in gambling generally, and with problematic gambling score in particular.

Table 3. Article 2, hypotheses

Hypothesis	Description	Result
H1	Video gaming habits will be positively associated with Offline Gambling Habits.	Not supported, no association observed.
H2	Video gaming habits will be positively associated with Online Gambling Habits.	Not supported, no association observed.
H3	Video gaming habits will be positively associated with Video Game-Related Gambling Habits.	Supported.
H4	Video gaming habits will be positively associated with Esports Viewing Habits.	Supported.
H5	Esports Viewing Habits will be positively associated with Offline Gambling Habits.	Not supported, no association observed.
H6	Esports Viewing Habits will be positively associated with Online Gambling Habits.	Supported.
H7	Esports Viewing Habits will be positively associated with Video Game-Related Gambling Habits.	Supported.
H8	Video gaming habits will be positively associated with Game Addiction Score.	Supported.
H9	Esports Viewing Habits will be positively associated with Game Addiction Score.	Not supported, no association observed.
H10	Game Addiction Score be positively associated with Offline Gambling Habits.	Not supported, negative association observed.
H11	Game Addiction Score will be positively associated with Online Gambling Habits.	Not supported, negative association observed.
H12	Game Addiction Score will be positively associated with Video Game-Related Gambling Habits.	Not supported, no association observed.
H13	Offline Gambling Habits will be positively associated with Video Game-Related Gambling Habits.	Not supported, no association observed.
H14	Online Gambling Habits will be positively associated with Video Game-Related Gambling Habits.	Supported.
H15	Offline Gambling Habits will be positively associated with Problem Gambling Score.	Not supported, no association observed.
H16	Online Gambling Habits will be positively associated with Problem Gambling Score.	Supported.
H17	Video Game-Related Gambling Habits will be positively associated with Problem Gambling Score.	Supported.

Best practice when developing a structural equation model requires hypotheses to be developed for each specified path. A summary of the hypotheses is provided above, in table 3.

The findings of this research highlight the fact that relationships between differing forms of media consumption are complex constructions, even in the case of those which seem to be an extension of connected media. For example, the model employed in article 2 theorised that the spectating of esports is predicted by the pre-existing consumption of video games, although this hypothesis was found to be supported the actual amount of variance explained was very small (less than 9%). This finding was also replicated in the relationship between video game consumption and game addiction score, in this case the variance explained was less than 8% despite using a holistic measure of consumption. This latter finding is of particular significance as many existing studies utilise individual measures of video game consumption, primarily frequency or time spent gaming, as a shorthand for addictive behaviour.

A further area in which the findings of article 2 contradict established orthodoxy in the field is in regard to the connections between video game play and participation in established gambling activities, i.e. those not associated with video games. The model explained very small amounts of variance for online and offline gambling and, furthermore, no statistically significant relationships were observed between video game consumption and either of the two established forms of gambling. As such, this article contributes to a growing body of research which questions the view that the structural characteristics of video gaming are similar to those of gambling and that, as a result, regular video game players are likely to consume gambling products as they gratify the same core motivations. This view was further supported by the fact that while video game consumption was found to have a statistically significant and positive correlation with video game-related gambling, the relationship was relatively small and was the weakest of all observed relationships. Instead, of all game-related measures, it was the consumption of esports which was the found to correlate with the consumption of gambling activities most strongly; both those related to video games and established forms of online gambling. Indeed, a strong association was observed between video-game related gambling and online gambling, however, given that this study was correlational the direction causality cannot be determined.

In regard to problematic gambling behaviours, both video game-related gambling and online gambling were found to have similar overall effects. This is likely explained by the fact that video game-related gambling is conducted almost

exclusively via the internet, meaning that they share the same characteristics which have been theorised as encouraging problematic consumption: increased ease of access, use of digital/virtual currencies, anonymity, etc. (Derevensky & Gupta, 2007; S. M. Gainsbury, Hing, et al., 2014; Lopez-Gonzalez & Griffiths, 2018).

Finally, the amount of variance of problematic gambling score, 25%, explained solely by measures of gambling consumption is notably larger than the amount of variance of problematic gaming score explained by measures of video game consumption, 7.8%. This finding suggests that although problematic gaming is a behavioural condition in the same way as problematic gambling, there is something which sets it apart from other behavioural conditions. Consequently, the article supports existing calls to develop behaviour-specific measurement instruments, ones which do not, necessarily, utilise concepts derived from substance-based disorders (Demetrovics & Király, 2016; Kardefelt-Winther, 2015; D. L. King & Delfabbro, 2016; Petry, 2013).

4.3 Article 3

The research conducted in article 3 integrated the approaches of article 1 and 2, employing a purposely gathered dataset in order to investigate the relationships between demographic factors, the consumption of video games and esports, and gambling behaviour. However, in contrast to previous research the research model used in this article focused specifically on the practice of esports betting, rather than on a range of gambling behaviours related to video games in general. In addition, as the motivational drivers for sports consumption can been shown to influence betting behaviour (Karg, A., & McDonald, 2009; Lopez-Gonzalez et al., 2018), the model also included the MSSC adapted for esports.

The most notable findings of this study are in respect to the nature of the relationship between gaming and gambling for, while there is a positive correlation between spectating esports and participation in esports betting, no such association was evident between esports betting and the consumption of video games per se. As such, the results suggest that although games are increasingly being used as a vehicle for gambling content, there does not appear to be any specific characteristics or elements which directly promote or encourage gambling. In addition, a positive relationship between participation in gambling generally and betting on esports, echoing the findings of previous studies (S. Gainsbury et al., 2012; Macey & Hamari,

2018), thereby providing further evidence of the ongoing convergence of gaming and gambling.

As with article 2, hypotheses were developed for each of the paths present in the model, a summary of the hypotheses is provided in table 4, below.

Table 4. Article 3, hypotheses

Hypothesis	Description	Result
H1	The esports-adapted MSSC will be positively associated with the consumption of esports.	Supported.
H2	The esports-adapted MSSC will be positively associated with participation in esports betting.	Supported.
H3	The esports adapted MSSC will be positively associated with the use of dedicated esports betting sites.	Supported.
H4	The consumption of esports will be positively correlated with esports betting.	Supported.
H5	The consumption of esports will be positively correlated with the use of dedicated esports betting sites.	Supported.
H6	The consumption of esports will be negatively correlated with age, but positively associated with: males, higher levels of education, and higher levels of household income.	Partially supported.
H7	The consumption of video games will be associated with younger males.	Supported.
H8	Participation in gambling will be associated with the following demographic characteristics: younger males, higher levels of education, and household income.	Not supported.
H9	Esports betting will be associated with the following demographic characteristics: younger males, higher levels of education, and household income.	Partially supported.
H10	The use of dedicated esports betting sites will be associated with the following demographic characteristics: younger males, higher levels of education, and household income.	Supported.
H11	Increased consumption of video games will be positively associated with increased betting on esports.	Not supported, no association observed.
H12	Increased participation in gambling will be positively associated with increased betting on esports.	Supported.

Despite the fact that the esports-adapted MSSC, employed as an independent variable in the research model, was found to be positively associated with both the

consumption of esports in general, and betting on esports specifically, these relationships were found to be weak. The poor predictive power of the MSSC in the context of esports was somewhat surprising as previous works in traditional sports have found it to be a good predictor of both consumption and participation in betting activities (Karg, A., & McDonald, 2009; Lopez-Gonzalez et al., 2018; Trail & James, 2001).

The active and engaged nature of esports consumers is likely to explain not only the positive association with esports betting, mirroring traditional sports, but also the preference for using services dedicated to esports rather than those offered by mainstream betting companies. The communities based around both esports in general, and specific esports titles, are often extremely dynamic and committed, indeed, they are characterised by a certain degree of tribalism (Hayday et al., 2021). Consequently, it is likely that esports fans are drawn to services which have either been developed from within the community, or to those which are specifically targeted at them, for example by employing video game aesthetics or those that allow the use of in-game items.

Esports betting is almost entirely facilitated online, as such it is no surprise that existing works have found that the demographic makeup of esports bettors is similar to early adopters of online betting (S. M. Gainsbury et al., 2017b). This, however, was not reflected in the results of article 4, with only age and gender being associated with participation in esports betting. Indeed, age and gender were also the only two demographic items associated with spectating esports and the consumption of video games, both supporting the results of other academic research while questioning the picture being painted by market research organisations.

4.4 Article 4

The previous three articles which form the bulk of this dissertation were primarily descriptive in that they were attempts to assess both the demographic characteristics and consumption behaviours of those who participate in a range of gambling activities related to video games and esports. The approach of article 4, however, was dictated by the need to understand the cognitive frameworks which influence the conceptualisation of gambling by participants. Prior work had theorised that the convergence or chance-based gambling and skill-based video game play may engender cognitions which are distinct from those identified in studies of traditional gambling populations (S. M. Gainsbury et al., 2015; S. M. Gainsbury, King, et al.,

2016; S. M. Gainsbury, Russell, et al., 2016; D. L. King et al., 2012; Toprak, 2013). Consequently, there were two principal aims for article 4: first, to validate an existing instrument (GRCS) in the context of video game-based gambling; and second, to investigate cognitions theorised in previous works. This would allow the existing GRCS to be supplemented with a new set of cognitions specifically related to video game players who gamble.

The most significant finding was that the GRCS was not found to be a robust measure in the context of video game players who gamble; there were numerous areas of concern in relation to model fit indices, convergent validity, discriminant validity, composite reliability, and inter-factor correlation. As a consequence, those items that had been extracted from prior literature, and which were originally planned to supplement the GRCS, were instead pooled together with the GRCS items and subjected to exploratory factor analysis using dataset A. This produced a four-factor model which was validated via confirmatory factor analysis using a third dataset (C), for full information regarding validity and reliability please see article 4 (tables 3 and 6, GRCS and GamCog, respectively). The final outcome of the research was a scale suitable for use in a population of video gamers who gamble, accordingly it was named: GamCog – A Scale for Video Game-Related Gambling Cognitions.

While conducting the EFA, five individual items were deleted for reasons of either poor loading (i.e. had loadings under .32), or cross-loading (Costello & Osborne, 2005). It is notable that the majority of these deleted items shared a common theme in that they were concerned misunderstanding the nature of probability.

Additionally, in order to improve validity and reliability of extracted factors, an additional seven items were deleted, thereby ensuring the finalised measures consisted of robust factors. These deletions were also justified based on the fact that they were inconsistent with the overarching themes of the parent factors, meaning that they failed face validity, or that they were specific examples or more general concepts already captured by other items.

The original GRCS contained five separate constructs: "Gambling Expectancies" (GE): "Interpretive Bias" (IB); "Illusion of Control" (IC); "Inability to Stop Gambling" (IS); and "Predictive Control" (PB). Of these, only one (Inability to Stop Gambling) was retained in the finalised GamCog measure in its original form, thereby indicating that the construct is particularly strong. Gambling expectancies also proved to be fairly robust with only a single item of the original four being deleted, however, in the finalised GamCog measure, GE was renamed "Benefits of Gambling" (BOG) as it was felt that such a title more accurately reflected the

meaning of the individual items from which it was constituted. The Illusion of Control construct underwent more significant revision as a result of the EFA and CFA, as one of the original items was removed, while a further two were added, raising the total number of items from four to five. The GRCS construct Predictive Control was subject to more drastic revision, with five of the six original items being removed, while three new items were added. In addition, an item originally part of the Interpretive Bias construct was also incorporated into the new construct, which was titled "Perceived Gambling Skill" (PGS) in order to both accurately reflect the meaning of the items contained therein and to more effectively communicate meaning to users of the finalised measure. Finally, aside from the individual item which was retained in the PGS construct, the original Interpretive Bias construct disappeared, with three of four items being deleted. The changes to the original GRCS measure, and the resultant GamCog measure, are detailed below in table 5.

Table 5. Detail of changes to GRCS constructs.

GRCS Construct	# of items	# of items deleted during EFA and CFA	Equivalent GamCog Construct	# of new items	Total # of items
GE	4	1	BOG	0	3
IB	4	3* (1 item moved to PGS)	n/a	n/a	n/a
IC	4	1	IC	2	5
IS	5	0	IS	0	5
PC	6	5	PGS	3	5

While both IS and GE were found to be relatively robust constructs, with only minor amendments being made to GE and none to IS, the remainder of the GRCS underwent notable revision. The significant amendments to PC, and the complete removal of IB, is perhaps unsurprising as the initial stage of the work found high levels of inter-factor correlation present for both. Indeed, the inter-factor correlation between PC and IB was especially high, with a value of over 1. The revision of PC resulted in a change of focus from the construct originally included in the GRCS; items reflecting concepts such as instinct and fate disappeared, while those that referenced a concept of personal agency which was explicitly connected to skill were included. Accordingly, the construct was renamed to more accurately reflect this new perspective.

The original IC construct emphasised the attempts of gamblers to influence the outcomes of gambling events outside of the game itself. The changes to IC, described above, are consistent with the original meaning of the construct as they

reflect conscious efforts to acquire, and control, luck through direct action on the part of the individual. As such, the construct did not require renaming as face validity was clearly observed.

After revising the components of the GRCS, it was evident that several core concepts were present in the finalised GamCog measure. First of these is that, for some individuals, gambling is not an activity which is characterised by addictive, or compulsive tendencies; considering the nature of the activity it is unsurprising that the construct reflecting such beliefs (IS) remained unchanged. Second, gambling is an affective activity which can produce positive changes in mood or perspective. And, finally, that individuals adopt various behaviours in an attempt to influence the results of gambling outside of the field of play. This final concept was somewhat muddied in the original GRCS, with Predictive Control composed of items which reflected ideas of luck, skill, and misunderstandings of probability. In the finalised GamCog scale, attempts to influence results were re-framed in terms of active attempts to influence events based on either rational or irrational terms, i.e. skill and knowledge versus luck and fate. Items from the original GRCS reflecting a more passive approach by individuals, i.e. those to whom luck "happened", were removed during the course of the analysis.

The primary aim of article 4 was to validate the GRCS in a population of video game players who also gamble, while a secondary aim was to supplement the measure with further items which had been derived from a review of relevant literature. However, the results of the initial evaluation required a change of approach given that a number of significant problems were found in relation to validity and reliability indicators. Accordingly, article 4 produced an amended measurement tool intended for use in populations of video gamers who gamble: GamCog – A Scale for Video Game-Related Gambling Cognitions.

5 CONCLUSION

The principal aim of this dissertation was to investigate the emergent phenomenon of video game-related gambling, with particular attention being paid to the relationships between the consumption of video games, esports, and traditional forms of gambling. Each individual article was guided by its own research questions and aims; considered together they offer a holistic perspective of the phenomenon, addressing: the individual activities, demographic characteristics and consumption habits of participants, the cognitive frameworks of participants, the importance of virtual items to the ecosystem, and the shifting legal context.

Considering the nature of the topic and the lack of empirical studies into video game-related gambling, the work in this dissertation was planned to first provide an overview of activities and behaviours, before focusing on specific groups, activities and issues. As such, article 1 investigated and described the contemporary environment and legal status of the multiple practices associated with video game-related gambling. Article 2 then focused on examining the inter-relations between video game play, esports spectating, and participation in all types of gambling in a sample of regular video game players, while article 3 concentrated on the specific activity of esports betting. Finally, article 4 examined the presence of maladaptive cognitions related to gambling in players of video games. In this way this dissertation provides a solid, empirical foundation for the study of gambling related to video games.

Article 1 was primarily concerned with those who participated in video game-related gambling, or more accurately, those who spectate esports and who participate in video game-related gambling. It provided valuable contextual information by providing detailed descriptions of the activities themselves, the use of virtual items in the video game-related gambling ecosystem, and the contemporary legal situation. Furthermore, article 1 revealed that engagement with esports was positively associated with engagement in gambling, both in terms of the range of individual activities and the range of channels used to access gambling.

This work laid the foundation for further research into the ongoing convergence between gaming and gambling by providing the first qualitative, empirical study of the individual characteristics and practices of esports fans who gamble.

Building upon the previous work, article 2 investigated the relationships between the consumption of video games, esports, and varied forms of gambling activity. It found that increased levels of video game play were associated with increases in both game addiction score (GAS) and general participation in video game-related gambling. Whilst this simple, positive correlation seemed to suggest that video game play was positively associated with gambling, the overall picture was somewhat muddled. In addition to the relationships described above, game addiction score was also found to be negatively correlated with both video game-related gambling, and overall problem gambling score (PGSI). The associations between the consumption of esports and gambling, however, appear to be simpler: spectating esports was shown to be positively, and strongly, correlated with participation in both online gambling and gambling related to video games, while it was also found to be moderately, and positively, correlated with increased problem gambling score.

These findings suggest that, contrary to previous work, modern video games are not, in themselves, a precursor to the development of problematic gambling behaviours. Furthermore, the findings of article 2 question the assertions that problem gaming and problem gambling are directly and meaningfully linked to one another. Rather, it is the cultural contexts which surround the consumption of games which seem to influence gambling behaviour more significantly than the consumption of games per se, as can be seen in the example of esports. Indeed, it seems that it is the more general process of digital media convergence which is holds the key to understanding the phenomenon of video game-related gambling.

Following the approach described above, article 3 continued the process of focusing attention on specific aspects of video game-related gambling by investigating the activity of esports betting. Once again, the findings revealed a discrepancy between the consumption of video games and spectating esports and their associations with gambling, in this case esports betting specifically. Confirming the findings of previous research, no direct associations between playing games and gambling were observed, whereas a statistically significant, positive association was observed between spectating esports and betting on esports.

Consequently, it appears as though video games do not have any inherent qualities which promote gambling for users, however, they function as a mediator given that esports cannot exist without video games. This article, therefore, contributes to an existing body of work which questions the previously held view that video games act as a pathway to gambling. Instead, it serves to highlight the importance of contextual factors of gamblified media consumption in promoting gambling.

Finally, this article used a version of the MSSC adapted for use with esports, however, the weak predictive power displayed by this measure adds to the growing body of evidence suggesting the need for a measure to be developed which is specifically targeted at the motivations for consuming esports.

Article 4 employed the GRCS to investigate gambling related cognitions in regular video game players, finding that it does not constitute a reliable measure for this population. Considering that the GRCS has a wider scope than other measures concerned with gambling related cognitions, and had been developed for use in non-clinical contexts, it is probable that similar issues exist with other, extant measures. The most marked problems with the GRCS were observed in relation to concepts concerning skill and luck, supporting the perspective that regular video game play is associated with the development of cognitive frameworks which are distinct from the general population. The scale of these differences necessitated the development of a scale targeted at video game players, despite the fact that such work was not an original aim of the article.

The work included in this thesis was conducted over the course of several years, at the time it was initiated there was little which addressed the growing prevalence of gambling, and gambling-like activities, within video games. What work that did exist addressed specific practices, e.g. SCGs or esports betting (S. M. Gainsbury, Russell, et al., 2016; Owens, 2016), or specific issues such as the structural similarities between gaming and gambling (Johansson & Götestam, 2004; R. T. A. Wood et al., 2004), the prevalence of gambling-like activities in F2P games (Alha et al., 2014; Koeder & Tanaka, 2017), or the degree to which such activities conformed to legal definitions of gambling (Holden et al., 2017; Holden & Ehrlich, 2017). Since article 1 was published there has been a rapid growth in literature addressing video game-related gambling, with loot boxes in particular receiving a significant amount of attention (Yokomitsu et al., 2021). Indeed, several works have found associations between the purchase of loot boxes and problematic behaviour (see (Garea et al., 2021), while others have investigated issues such as audio-visual presentation of loot boxes (Kao, 2020) and associated design features which promote problematic consumption behaviours (Zendle et al., 2020). In addition, a growing body of work has recently begun to address the wider phenomenon of gambling within the gaming ecosystem, for example as a means of monetising game streams (Abarbanel & Johnson, 2020) or of furthering engagement as part of game-centred platforms (Zanescu et al., 2019, 2021). As such, the articles which form this body of work can be considered to have been among those which moved beyond the concepts of

gaming and gambling as discrete activities, thereby laying the groundwork for the in-depth study of gambling as part of the gaming ecosystem.

5.1 Contributions

The work presented in this dissertation makes a number of concrete contributions to the field of study, many of which are derived from the fact that this work is the first empirical study dedicated to video game-related gambling as a whole, rather than in regard to individual activities, for example SCG or esports betting (S. M. Gainsbury, Russell, et al., 2016; Owens, 2016). Consequently, it constitutes the first attempt to describe a population who participate in video game-related gambling specifically. This is in contrast to previous works which have addressed video game players, both in general terms and in respect to specific sub-populations, esports fans, or those who participate in more traditional forms of gambling, whether online or offline. Instead, this work is concerned with a population who reside at the intersection of these groups. As a consequence of this approach, this dissertation serves to document video game-related gambling at a key period during its development, the point at which it broke through into mainstream awareness, ceasing to be the preserve of dedicated communities which are part of larger game cultures. Finally, this dissertation contains one of the first empirical investigations of gambling-related cognitions in a population of video gamers who gamble. As a consequence of this approach it produced the first and, to date, only measure dedicated to identifying such cognitions in the target population while also offering insight into the potential to further improve established measures used in traditional gambling populations.

Together, the theoretical and practical knowledge provided by this dissertation serves to make a significant contribution to understanding the role played by video games in the development of problematic gambling. Indeed, perhaps the most significant contribution of this work is that it provides a body of empirical evidence questioning the orthodoxy that video game play is a pathway to increased participation in gambling and that the two activities fulfil the same needs in participants. While article 2 shows a clear association between increased video game play and increased consumption of gambling activities, article 3 highlights that this is not due to any fundamental qualities of games. Indeed, the relationship is likely due to the increasing convergence of gaming and gambling, games are being used as a vehicle for gambling content, and to promote gambling, in the same way as other

mainstream social and cultural activities, such as sports (Lopez-Gonzalez & Griffiths, 2018; McMullan & Miller, 2008). This dissertation, therefore, contributes to a growing body of work which contradicts the traditional position whereby the play of video games is a positive predictor for involvement in gambling, and the development of problematic gambling behaviours (e.g. (Delfabbro et al., 2009; Delfabbro & King, 2020; Forrest et al., 2016b).

Approaching problem gaming via problem gambling, therefore, is a practice which is likely to be misleading and ineffective; assessment criteria for problematic gaming derived from problematic gambling, and from substance abuse measures, require re-assessment and potential revision. This need is further supported by the results of article 4 in which an extant measure for assessing maladaptive cognitions related to gambling was found not to be a viable tool for use in a population of video game players.

Considering the increasing convergence of video games and gambling, this dissertation highlights that it is the context in which video games are consumed which is more influential in regard to gambling behaviours than the consumption of games per se. Articles 1-3 all demonstrate that engagement with esports is a strong and consistent predictor of participation in gambling, while article 2 also shows that it is a moderately strong predictor of problematic gambling using the PGSI scale. In addition, article 2 also shows that the use of individual items, such as frequency or time spent playing, as a shorthand for addiction is a problematic approach in the specific context of video games. As such, any conclusions based on single-item measures are likely to be questionable. It is recommended, therefore, that any measures of engagement with video gaming should consist of a number of items, each reflecting a specific facet of consumption behaviour.

Indeed, it is not only those items used to measure addiction which require attention; article 1, in particular, highlights how the process of convergence has given rise to a need to revisit the legal definition of gambling in light of new practices. The use of virtual items as both mechanisms for delivering game-related content to users via random number generation, e.g. loot boxes, and as stakes in digital gambling environments, e.g. skins, is particularly problematic for regulators. The main areas of concern centre upon the utility of these virtual items outside the game environment, the value placed upon them, and upon the potential for them to be exchanged for real-world currencies (Cloward & Abarbanel, 2020; M. D. Griffiths, 2018; Holden & Ehrlich, 2017). Since the beginning of this research, several regulators have classified loot boxes as gambling products, while many others are conducting ongoing investigations (Derrington et al., 2021). The findings of article

1 show the role virtual items have in facilitating online gambling; two-thirds of those who paid to open loot boxes then used the skins they received as stakes in other gambling activities. Many jurisdictions quantify the stakes and prizes in gambling in terms of "money or money's worth", as such virtual items are often excluded from this definition. Given the importance of virtual items to the unregulated gambling services provided online, the legal definition requires review.

Following the practice of previous research, article 3 utilised the Motivation Scale for Sports Consumption, adapted for use with esports, in order to investigate motivations for consuming esports. However, the weak predictive power of the scale observed in the work implies that the MSSC is not an optimal measure for use in the context of esports. Allied with a growing body of work which also report concerns with the use of adapted measures (Macey, Tyrväinen, et al., 2020; Qian et al., 2020), article 3 provides evidence that a dedicated measure for assessing motivations for consuming esports be developed.

The benefits of developing measures specifically targeting the newly-emergent practices of gambling related to video games in general, and esports in particular, is illustrated in article 4, with the development of the GamCog measure. In addition to raising important theoretical issues concerning the conceptualisation of luck and skill in both games and gambling, the work has significant practical implications for the assessment and treatment of problematic gambling in regular video game players. This is especially significant considering the emergence of problematic gamblers whose first experiences of gambling were directly associated with video games. Although no academic studies of such individuals have yet been published, the author has been provided with anecdotal evidence from clinical professionals in several countries in Northern Europe describing this situation.

Article 4 also has direct implications regarding the form of the Gambling Related Cognitions Scale, as it appears that the internal validity of the measure, and its efficacy, could be improved with the inclusion of additional items which address cognitions around luck and skill. During the initial development and validation of the GRCS, the authors found that only one of the five sub-scales, Predictive Control; was not an accurate predictor of problem gambling score. Predictive Control includes items which reflect attempts to control outcomes through a range of techniques, among them different manifestations of luck and skill. Article 4, however, shows that attempts to influence outcomes via skill differ markedly from those centred upon luck. Given the fundamental importance of luck and skill to gambling, it appears as though the effectiveness of the GRCS would be improved through distinguishing these two concepts from one another.

Finally, considering that this work constitutes one of the first empirical investigations of video game-related gambling, it provides valuable information regarding not only the practices and behaviours, but also the participants. Articles 1 and 3 demonstrate that both video game-related gambling in general, and esports betting in particular, are associated with younger males, supporting previous research in similar areas, e.g. engaged esports fans (Freitas et al., 2020; Sjöblom et al., 2017; Wardle et al., 2020; Weiss & Schiele, 2013), gambling (S. Gainsbury et al., 2012; Gupta & Derevensky, 1998; Hing & Breen, 2001; Welte et al., 2002). It is important that investigation into this area continue as, to date, the majority of information regarding consumption of esports and of video game-related gambling is provided by market research companies (see (Cranmer et al., 2021; Gawrysiak et al., 2020). Relying on such sources is problematic given both the varying degrees of clarity in the methods employed by such companies and the commercial agenda which underpins such publications. For example, few, if any, market research publications include under-18s in their analysis, however, in article 1 27% of respondents were under the age of 18, while approximately 65% were under the age of 26. Of these participants, 60% of under -18s reported having gambled within the previous 12 months, rising to 64% for all those aged 25 or under. These figures demonstrate the importance of including adolescents and young adults in research addressing gambling, despite the fact that they are not yet old enough to participate legally. Given the lack of clarity regarding the legality of many gambling activities associated with video games, alongside both the growing influence of games in mainstream popular culture and the increasing convergence of gaming and gambling, the significant presence of gambling amongst youth is an area of obvious concern.

5.2 Limitations

The most obvious limitation of this research is that the data was gathered exclusively via surveys, meaning that it is subject to the standard criticisms: that the sample is self-selected, that surveys increase the potential for Common Method Bias in responses, that specific behaviours or practices may be either over- or under-represented, that responses may be guided by a desire for social acceptance, that self-reported data can be inaccurate, and that findings are not generalisable to wider society. Furthermore, in the case of the survey that was distributed directly to the public, rather than those that were distributed via market research companies (articles 3 and 4), the data may potentially be influenced by the platforms upon which

the survey was publicised. These problems are, however, mitigated by a number of factors, the most significant of which is that many of these issues are not limited to online survey research, indeed the potential for social acceptance bias to influence results is stronger in one-to-one methods such as interviews, focus groups, etc. Second, the surveys were designed to minimise the presence of common method bias through such practices as item randomisation in order to ensure proximal separation. Third, the surveys included numerous, separate, items which were used to double-check consistency of responses. Fourth, the size of the samples collected are not small: article 1 = 582; article 2 = 613; article 3 = 1368; and article 4 = 1168 (dataset A = 391; dataset B = 442; dataset C = 335). As such, the effects of any intentionally misleading responses are eliminated. Finally, the link to the survey used in articles 1, 2, and 4 was distributed across a range of social media platforms, dedicated gaming and esports discussion forums; every effort was made to promote the survey on sites dedicated to marginalised members of the gaming community (e.g., gender, sexuality, race, geographical location). Participants in articles 3 and 4 were recruited via market research companies according to a strict set of eligibility criteria.

It is important to consider the fact that employing surveys to gather data also has a number of characteristics which mean that it is the most suitable method of data collection for addressing the questions that guided this research. The most significant of these advantages is that of access: the population of interest in this research is one which is characterised by high levels of digital engagement and is notably difficult to reach through traditional probability sampling methods which, for example, utilise telephone landlines. Esports is a global phenomenon, although more well-developed in some regions than in others; online surveys have global reach, unrestricted by either physical or temporal boundaries. Second, unlike face-to-face methods of data gathering, online surveys provide participants with increased levels of anonymity. This situation is one which provides participants with an environment in which they are more likely to be comfortable providing information about sensitive or embarrassing topics, or those with a degree of social stigma attached such as gambling, problematic gaming, or addictive consumption. As such, the responses provided via surveys are less likely to be affected by social acceptance bias than other forms of data gathering (M. D. Griffiths, 2010). Third, recruiting participants from social media platforms has been found to be as reliable a practice as popular alternative methods, such as recruiting university students or using paid recruitment (Jamnick & Lane, 2017).

Finally, the use of third-party organisations to recruit participants, in addition to reducing potential for self-selection bias, produced samples which were more reflective of the general population than that obtained by distributing the survey online. It is notable that the more representative samples echoed the findings of the non-representative sample; article 3 found correlations between both esports betting and young males, as with article 1, and between esports engagement and participation in gambling, as with article 2. Article 4, on the other hand, used more representative samples in the initial assessment of the GRCS and in the CFA of the finalised GamCog structure. Although the clinical validity of the GamCog measure is compromised by the use of self-selected samples, to varying degrees, the aim was to produce a measure for use with regular video game players and esports fans, the nature of the sample ensured that this intention was realised.

A further limitation, one directly connected to the method by which data was gathered, is the lack of diversity in respondents. For example, the data used in articles 1, 2, and dataset A, from article 4, was overwhelmingly male, with approximately 6% of participants reporting their gender at female. This figure rose to 35%, 36%, and 41%, for article 3 and datasets C and B from article 4, respectively. Although these latter figures reflect contemporary estimates of female participation in both video gaming, 41% (ESA, 2018), and casual esports spectating, 36% (EEDAR, 2015), the first figure is significantly below those levels. Considering the nature of the research topic, the number of male respondents echoes that of previous work, both in regard to engaged esports fans (Sjöblom et al., 2017) and participation in activities predominantly associated with video game-related gambling: sports betting, casino games and internet gambling (S. Gainsbury et al., 2012; Gupta & Derevensky, 1998; Hing & Breen, 2001; McDaniel & Zuckerman, 2003; Welte et al., 2002). Given the lack of empirical research prior to these studies, there is, as yet no reliable means of ascertaining whether or not the data gathered is truly reflective of the target population. The combination of engaged esports spectators, gambling, and the relatively recent emergence of the phenomenon do, however, indicate that the demographic characteristics of the population are likely to be skewed towards young males.

During the collection of data, participants were asked to consider items in light of their gambling activities over the previous 12-month period. Consequently, a limitation exists whereby no conclusions can be reached as to whether the sample reflects either those who are new to gambling, or those who are existing gamblers that have adopted esports and video game-related gambling. The large number of adolescents and young adults in the data suggest that it is unlikely that they are

existing gamblers who have taken up these new forms, although this does not discount the possibility, which has been advanced in other works (S. M. Gainsbury et al., 2017a). Furthermore, this research utilised "esports" as an umbrella term, one defined as competitive video game play, individual genres or categories were not considered. This approach was one which was deemed to be necessary given the attempt to establish a knowledge base in this new field of study, however, it is possible that fans of a certain esports title or genre may be over-represented in the data.

The final limitation regarding the use of surveys as a means of collecting data is associated with the use of one survey as the source of data for use in three different articles. While it can be argued that the design of the research could have benefitted from a more iterative approach, this was a decision made in order to maximise the use of available resources. Furthermore, the dataset was filtered in such a way as to address the different research questions of each article, while article 4 also made use of two additional datasets as part of the research.

In addition to limitations regarding the data and the method by which it was collected, the use of the modified MSSC in article 3 may also be considered a potential limitation. Although a Cronbach's Alpha value of .956 shows that the MSSC had good levels of internal consistency, it was found to have weak predictive power in the sample of esports bettors. This is in contrast to previous studies examining the consumption of both traditional sports and sports betting, where the MSSC was found to display strong predictive power (Karg, A., & McDonald, 2009; Lopez-Gonzalez et al., 2018; Trail & James, 2001). Allied to the fact that a number of studies utilising the MSSC in the context of esports have also displayed mixed results (Hamari & Sjöblom, 2017; Macey, Tyrväinen, et al., 2020), it may be that it is not the most suitable measure for use in this context.

5.3 Future Research

At the time this research began, there were few empirical studies of gambling related to video games and esports; what work that did exist was largely confined to specific practices arising from the convergence of gaming and gambling, such as social casino gaming and esports betting, or of the resulting legal issues. The last few years, however, have seen continued growth in the field, with increasing diversity in both topics of interest and of methodological approaches.

Despite the increasing academic attention being paid to video game-related gambling, and the wider phenomenon of gaming-gambling convergence, many of the issues raised by this research have only begun to be tacked, while many others remain unaddressed. With this in mind, a series of potential avenues for future research are presented below which address the three main themes which have guided the work presented in this dissertation: participants, practices, and attitudes. It is worth noting, however, that due to the relative novelty of video game-related gambling, the scope for future work remains enormous and will require a range of approaches in order to address the many questions that are likely to emerge as the phenomenon becomes ever more significant, both in socio-cultural and economic terms.

5.3.1 Participants

Perhaps the most pressing issue, as implied in the previous section, is the need to accurately identify, and quantify, the demographic profiles of those who participate in specific gambling activities connected to video games. It is only once these sub-populations have been identified that indisputably representative samples can be gathered, thereby allowing more accurate picture to emerge of, for example, participation rates and the prevalence of problematic consumption behaviours, alongside other important issues. As discussed previously, this is a somewhat problematic issue due to both the potentially sensitive nature of the issue, particularly in relation to possible under-age gambling, and the shortcomings of traditional probability sampling methods when it comes to contacting younger generations. In order to successfully tackle this problem, it may require closer collaboration with the game industry itself and access to company data, although this too can be difficult.

A parallel avenue for future work, to that identified above, would be the qualitative investigation of the communities which have coalesced around video game-related gambling, thereby complementing the large number of quantitative works which currently exist in the area. Such an approach would also build upon an existing body of work which uses qualitative methods to investigate other gaming communities, offering new and detailed insights into the experiences of individuals in this particular sub-population. For example, qualitative content analysis of the online services and communities oriented toward video game-related gambling would increase understanding of both the social practices of, and attitudes towards video game-related gambling. Alternatively, semi-structured interviews could be used

to obtain detailed, and in-depth accounts of the individual experiences of varied sub-populations participating in video game-related gambling, producing knowledge that informs wider debates regarding the conceptualisation of gambling activities, their relationships to video gaming (D. King et al., 2010). These potential approaches would also serve to bring the voice of players into the debate, thereby giving a platform to a previously disregarded stakeholder and enhancing the likelihood of reaching a consensual approach to the consumption of gambling in the specific context of video game environments. Indeed, they would be particularly well-suited to examining the experiences of marginalised or under-represented groups of gamers, thereby addressing one of the main limitations of the existing body of work.

5.3.2 Practices

In order to address the limitations inherent in studying the diverse range of behaviours under the umbrella term of esports, a productive approach would, instead, be the investigation of distinct esports genres, e.g. MOBA, FPS, RTS, etc. The structural characteristics of particular formats or titles may give rise to distinct practices and behaviours, for example the shorter and quicker rounds of FPS games such as *CS:GO* are likely to result in different betting practices than those associated with MOBA games such as *Dota 2* or *League of Legends*. It would be beneficial if future research were to focus on observed behaviours, rather than rely on self-reported data. With this in mind, there is scope to develop both laboratory and field experiments which address specific behaviours or contexts.

An additional area for future work, originally suggested by this research, the review of gambling as a legally-defined activity in light of convergent practices in general, and virtual items in particular, has already commenced, with a number of authorities having conducted investigations in the area. However, the majority of work has been focused on the specific issue of loot boxes and understanding how they fit into existing legal definitions of gambling. This work proposes that an alternative approach be taken: to adapt existing definitions and concepts in order to account for the practices afforded by convergent media.

Awareness of the ways in which convergence has promoted the gamblification of games would produce knowledge that can be applied to consumer interactions across a range of digital media. For example, future research into the traditional definitions of value in respect to the utility and affordances of virtual items offer the potential to inform not only regulatory approaches to gambling, but also to consumer

protection and other such frameworks. Indeed, little regulatory attention has been paid to the use of gambling as a mechanism for increasing user engagement with games, such as *Dota 2*'s "Battle Pass" (Zanescu et al., 2020), or the tools provided to streamers on Twitch.tv. The latter example, in particular, raises a number of issues related to the conflation of gaming and gambling and the potential impact upon consumers (Abarbanel & Johnson, 2020; Kim & King, 2020).

The ways in which gambling has been used to further user engagement may also impact upon individual behaviours within digital environments; laboratory experiments could be designed which expose participants to a series of different interfaces, each employing a pre-determined set of gamblified options or features in order to see in what way the features influence their decision-making. Similarly, the exploration of the potential for virtual reality environments to offer immersive sport experiences, both traditional and esports, has already commenced (Baker, 2021; Jarvis, 2019; Myers, 2017; Rogers, 2019); experiments investigating the potential ways in which virtual reality experiences affect decision-making for in-play betting markets would offer valuable knowledge.

5.3.3 Attitudes

In the limitations section above, several issues were outlined which relate to the measurement tools employed in this research, consequently, there are a number of directions future work could take in order to address these concerns. First is the dedicated study of motivations for consuming esports; given the mixed findings from studies which utilise an adapted version of the MSSC, the reliability of other extant measures requires detailed and systematic investigation. Indeed, given the status of esports as a computer-mediated form of competition it may be that a dedicated measure warrants development rather than simply adapting existing measures. Second, it is recommended that the Gambling Related Cognitions Scale be adapted to reflect a distinction between the use of luck and skill as means to influence the outcome of gambling events. Such work would be a means to address some of the failings of the original measure, such at the high levels of inter-factor correlation, thereby improving its value as a tool both in assessment and treatment of maladaptive cognitions.

In addition to utilising extant measures, this research also developed a new measure: GamCog – A Scale for Video Game-Related Gambling Cognitions. GamCog naturally requires further validation, both in different populations of

gamblers in general, and in specific sub-populations of video game players who gamble. Such work would provide valuable knowledge regarding the ways in which concepts of luck and skill influence gambling behaviours. Given the nature of the items excluded from the finalised version of the measure, it is recommended that any future work validating of GamCog also includes all deleted items, as detailed in article 4 (Appendix D).

Finally, current work into both the motivations driving consumption of video game-related media, and the cognitive frameworks related to gambling in video gamers, have been derived from existing work in associated areas of interest. Using qualitative interviews, for example, to explore the experiences, motivations and attitudinal drivers of video game players who gamble would facilitate the development of items and measures which are specific to the population in question. Furthermore, unlike traditional gambling activities, video game-related gambling can involve virtual items which have no direct monetary equivalent, or which cannot be exchanged for real-world currencies. Understanding the ways in which the value of virtual items are conceptualised by different groups of players, and the varied affordances of virtual items to different groups, would provide valuable knowledge that may explain behaviours or relationships that cannot be understood using existing theories or models.

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The Forge Arena. Minacov, 2018 (PC).

8 ERRATA

Unfortunately, a small number of errors were noticed in 2 of the already published studies. The author apologises for any inconvenience or misunderstanding caused by these errors. The errors, and their corrections, are highlighted below:

8.1 Publication III

When describing the ethical review process, the finalised manuscript includes the following text "blinded for review", this should read: University of Nevada, Las Vegas.

8.2 Publication IV

In appendix F (instructions for administering GamCog) the summary of the scale notes that sub-scales BOG and PGS have 4 and 6 items, respectively. These figures should read 3 and 5, respectively.

In Addition, the following work was cited in the finalized manuscript, but was not included in the list of references:

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*. https://doi.org/10.1126/science.185.4157.1124

PUBLICATIONS

Publication I. Macey, J., & Hamari, J. (2019). eSports, skins and loot boxes: Participants, practices and problematic behaviour associated with emergent forms of gambling. New Media & Society, 21(1), 20-41. https://doi.org/10.1177/1461444818786216. © 2018 The Author(s). Reprinted with permission.

Publication II. Macey, J., & Hamari, J. (2018). Investigating relationships between video gaming, spectating esports, and gambling. Computers in Human Behavior, 80, 344-353. https://doi.org/10.1016/j.chb.2017.11.027. © 2017 Elsevier Ltd. Reprinted with permission.

Publication III. Macey, J., Abarbanel, B., & Hamari, J. (2020). What predicts esports betting? A study on consumption of video games, esports, gambling and demographic factors. New Media & Society. 23(6), 1481-1505. https://doi.org/10.1177/1461444820908510. © 2020 The Author(s). Reprinted with permission.

Publication IV. Macey, J., & Hamari, J. (2020). GamCog: A measurement instrument for miscognitions related to gamblification, gambling, and video gaming. Psychology of Addictive Behaviors, 34(1), 242. https://doi.org/10.1037/adb0000526. © 2019 American Psychological Association. Reprinted with permission.

PUBLICATION 1

eSports, skins and loot boxes: Participants, practices and problematic behaviour associated with emergent forms of gambling

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eSports, skins and loot boxes: Participants, practices and problematic behaviour associated with emergent forms of gambling

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Abstract

Twenty years since the Internet transformed gambling products and services, the convergence of online games and gambling has initiated a new means of consuming Internet-based media. Gambling specifically connected to eSports is a significant development, not only offering a new avenue for existing gambling products to be inserted into gaming media but also affording several novel experiences (e.g. skins and loot boxes). This study assesses participation rates and demographic characteristics of eSports spectators who gamble via an international online survey ($N = 582$). The sample highlighted the prevalence of young, often under-age, males in eSports-related gambling activities. Participation in gambling, and gambling-like activities, was found to be 67%, with rates of problematic and potentially problematic gambling in the sample being 50.34%. Finally, increased gambling is associated with increased spectating of eSports. Although the results are not generalisable to the wider population, they suggest a need for increased attention, from academia and regulators, regarding newly emergent gambling behaviours in contemporary digital culture.

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Keywords
eSports, free-to-play, gambling, gamification, loot boxes, problem gambling, skins gambling, video games

Introduction

The preceding decades have seen substantial growth in research addressing gambling, especially in regard to Internet-based activities and new media contexts (Armstrong et al., 2016; Lopez-Gonzalez and Griffiths, 2016). In addition to the realm of web-based electronic commerce, new media have brought gambling into many other areas of online life, including social media networks and electronic sports (King et al., 2014; Lopez-Gonzalez and Griffiths, 2016; Macey and Hamari, 2018). Nowhere is this more evident than in the convergence of online gaming and gambling made possible by the Internet, mobile communications and networked online communities (Gainsbury et al., 2016; King et al., 2010). This rapidly evolving environment offers consumers novel opportunities to participate in an ever-increasing range of gambling, and 'gambling-like' (King et al., 2010), experiences on the Internet.

With the emergence of advanced, mobile communications, the practices of both video gaming and gambling have been revolutionised by increased ease of access and sophisticated audio-visual environments (Abarbanel, 2013; Deans et al., 2016). In addition, novel points of convergence between gambling and new media have appeared, such as electronic sports (eSports), free-to-play games, social network games, online practice sites and virtual economies consisting of online possessions of players. As a result, entirely new consumption practices are being created.

This process is not limited to games and gambling, but is part of a wider trend of media convergence (Jenkins, 2006), and has been studied in reference to other, more established, gambling activities such as sports betting (Lopez-Gonzalez and Griffiths, 2016). The blurring of boundaries between video games and gambling activities has led to a range of problems regarding regulation and legislative issues (Teichert et al., 2017). Although the consequences of this trend are yet to be fully assessed, current concerns include the targeting of vulnerable populations through gambling-like experiences and increased penetration of gambling using socially accepted vehicles such as sports and video games (Lopez-Gonzalez and Griffiths, 2016). Allied to these specific concerns are those aspects of Internet gambling which may potentially facilitate problematic behaviour, such as increased ease of access and the continuous availability of formerly discontinuous gambling activities (Cotte and Latour, 2009; Deans et al., 2016; Gainsbury et al., 2012).

eSports and gambling

One of the most notable areas of media convergence today is eSports, that is, competitive video gaming (Hamari and Sjöblom, 2017) (Table 1). eSports are rooted in the Local Area Network (LAN) culture (Jansz and Martens, 2005; Taylor, 2012); however, it is only with the advent of Internet Protocol Television (IPTV) and streaming technologies

Table 1. Points of convergence between gaming and gambling.

Point of convergence	Description	References
Free-to-play (F2P) games	Game mechanics which blur boundaries between gameplay and gambling	Hamari and Järvinen (2011) and Hamari and Lehondivirta (2010)
Social network games	Gambling is integrated into social media platforms	Paavilainen et al. (2013)
Online practice sites	Gambling-like experiences are offered, but with no chance to withdraw 'winnings'	Gainsbury et al. (2016)
Virtual economy	Use of virtual items linked to player's game accounts as stakes in gambling activities	Hamari and Keronen (2017), Holden et al. (2016) and Lehdonvirta and Castronova (2014)
eSports	The 'sportification' of video games facilitates increased social penetration of gambling	Lopez-Gonzalez and Griffiths (2016) and Macey and Hamari (2018)

that they have begun to make the transition from niche culture to international phenomenon (Hamari and Sjöblom, 2017; Scholz, 2011). As eSports has grown, a range of related gambling activities has emerged, facilitated by the use of real currencies, virtual currencies and a range of virtual items. These issues are discussed below and summarised in Tables 2 and 3.

Betting. There are many forms of betting associated with eSports, the majority of which are direct analogues of pre-existing practices, for example, sportsbook betting (Gainsbury et al., 2017a) and fantasy eSports (Tsai, 2015). Similarly, there is evidence of informal betting such as between friends and eSports players, with the latter having implications for the integrity of the eSports scene as a whole in regard to player conduct and potential match-fixing (Brickell, 2017; Holden and Ehrlich, 2017). However, the digital nature of eSports has allowed the development of formalised Player-versus-Player (PvP) betting, where players can bet on their own performance when playing a video game (Grove, 2016; Holden et al., 2016).

Casino games/themed games. Almost all forms of casino games (roulette, blackjack, etc.) and simulated slots are available and are often themed according to popular eSports games, most notably 'Counter Strike: Global Offensive' (*CS:GO*). In addition, themed versions of simulated coin-flipping and 'rock, paper, scissors', among others, are also available (Gainsbury et al., 2017a; Martinelli, 2017).

Loot boxes. In many contemporary games, players can choose to make small payments in order to open loot boxes (also called crates, cases, chests and other similar terms), which are received either as random drops or as rewards for in-game achievements. These payments are primarily facilitated using real-world currency, but some games also provide 'free' loot boxes which can be opened using in-game currency or as rewards for in-game

Table 2. Forms of currency used to access gambling activities associated with eSports.

Type	Sub-type	Description	Example
Real-world currency (RWC)	–	Standard payment options made using credit cards or services such as PayPal	US$, GBP, EUR, etc.
Digital/Crypto-currency (DCC)	–	Payments made using client's digital 'wallet'	Bitcoin
Site-specific currency (SSC)	Transferable	Payments are converted into currencies which can only be used on the specific site, can be cashed out (exchanged for RWC/DCC, etc.)	HEROcoin (Herosphere.gg/ Firstblood.io)
	Non-transferable	Payments are converted into currencies which can only be used on the specific site, cannot be cashed out (exchanged for RWC/DCC, etc.)	Unikoins (Unikrn.com)
In-game currency (IGC)	Soft	Earned through gameplay, non-transferable	'Blue Essence', from 'League of Legends'
	Hard/Premium, transferable	Purchased using RWC, can be exchanged for RWC via marketplace or third-party sites	'FIFA Coins', from 'FIFA Ultimate Team'
	Hard/Premium, non-transferable	Purchased using RWC, exchange for RWC is prohibited by EULA	'Riot Points', from 'League of Legends'
Virtual items (VI)	Transferable	Earned or purchased (RWC, DCC, IGC), can be exchanged for RWC via marketplace or third-party sites	Skins from 'Counter-Strike: Global Offensive'
	Non-transferable	Earned or purchased (RWC, DCC, IGC), exchange for RWC is prohibited by EULA	Skins from 'Overwatch'

EULA: end-user licence agreement; GBP: British Pounds (£); EUR: Euros (€).

efforts. Those games that do provide payment-free loot boxes also provide the opportunity for players to purchase further loot boxes with real-world currency. Loot boxes contain virtual items which may affect gameplay or may be entirely decorative. The contents of loot boxes are randomly determined (Baglin, 2017) and the total value of the items may, or may not, exceed the price paid to open the case; a real-world analogue are lottery scratch cards. In addition, some loot boxes constitute part of a closed in-game economy, where there is no direct means of exchanging loot boxes, or associated virtual items, for real-world currency. Other games, however, do allow loot boxes and associated virtual items to be directly exchanged for real-world currency, through in-game marketplaces, third-party services or a combination of both.

Table 3. Gambling activities associated with eSports.

Activity		Activity providers	Non–video game analogue	Stakes accepted (see Table 2)
Primary descriptor	Secondary descriptor			
Betting	Sportsbook	Reg., unreg.	Traditional sportsbook	RWC, DCC, IGC, SSC, VI
	Fantasy sports	Reg., unreg.	Traditional fantasy sports	
	PvP	Unreg.	Informal betting	
Casino/Themed games	Roulette, blackjack, etc.	Unreg., in-game	Traditional casino games	RWC, DCC, IGC, SSC, VI
	Dice, coin-flipping	Unreg., in-game	Traditional dice games or tossing of a coin	
	'Rock, Paper, Scissors', 'Minesweeper'	Unreg.	Traditional forms of both digital and non-digital games	
Loot boxes	In-game	In-game	Lottery scratch card	RWC, DCC, IGC
	Third-party case opening sites	Unreg.	Lottery scratch card	RWC, DCC, VI
Skins and other VI	As stakes in established activities (e.g. betting, casino games.)	Unreg.	Use of money/casino chips	VI
	Skins lotteries	Unreg.	Sweepstake/Jackpot lottery	
	Crash betting	Unreg.	n/a	

Unreg.: unregulated third-party operators; Reg.: regulated third-party operators; RWC: real-world currency; DCC: digital/crypto currency; SSC: site-specific currency; IGC: in-game currency; VI: virtual items.

The use of loot boxes began with free-to-play games, but has since been adopted by the majority of genres and business models, from independent productions to those produced by major studios. In the final weeks of 2017, the implementation of loot boxes in the game Battlefront 2 initiated a player backlash and community-driven campaign for loot boxes to be categorised as gambling, drawing the attention of both media and regulators (Macey, 2017).

Skins and virtual items. The use of virtual items in gambling related to video games includes both those which can be exchanged for real-world currencies and those that cannot (Table 2). Although there are numerous possibilities to gamble with virtual items, the practice is most closely associated with a specific item: the 'skin' (Holden et al., 2016). Skins are in-game items, often with a real-world monetary value, that can be either purchased directly from an online market place or earned in-game by players. Skins are obtained by opening loot boxes, and they often have no direct effect on gameplay, being decorative items. The use of virtual goods such as skins in gambling is primarily

associated with *CS:GO*, but is also connected to others (Holden and Ehrlich, 2017; Martinelli, 2017).

Skins, and other virtual items, are used in gambling in two ways. The first is by replacing real-world currency as stakes in established gambling activities, ranging from simulated coin-flipping to playing poker (Gainsbury et al., 2014; Martinelli, 2017; Woodford, 2013). The second way skins are used is to access newly emergent forms of gambling, most of which cannot be directly accessed with any other form of currency. Skins gambling, in its many varied forms, has led to a series of legal disputes which have been well documented (Holden and Ehrlich, 2017; Martinelli, 2017).

Skins lotteries. Skins are used as stakes in 'lotteries' where the higher a player's stake (as a percentage of the pot), the higher their chance of winning the total pot, essentially a form of 'jackpot'-style lottery (Grove, 2016).

Loot box/crate openings. Emerging after the events which affected skins gambling, third-party sites offer players the chance to open unlimited numbers of crates for a reduced fee. As with the skins gambling websites, these sites are unregulated and have been accused of dishonest practices (Lewis, 2017).

Crash betting. In crash betting, players deposit skins into an account which are then converted into a site-specific currency. Crash betting is essentially a game of nerve: a marker progresses along an exponential curve where the *x*-axis shows time and the *y*-axis is the multiplier. The aim is to achieve the highest multiplier before the game crashes; if the player quits before the crash, their stake is multiplied by the value reached on the *y*-axis; however, if the game crashes before the player quits, they lose their stake (eSports Betting Ninja, 2017).

In addition to using real-world currencies or virtual items as stakes in gambling activities, participants can also choose between the following alternative options, depending on the individual activity and the host site/game: digital/crypto-currencies, site-specific currencies and in-game currencies which can be either earned in-game (soft currency) or purchased (hard/premium currency). See Table 2 for a full summary.

To date, the majority of research into eSports spectators has been conducted by market research organisations, with academia only recently beginning to publish in the area. Current figures presented by market researchers claim total global eSports viewers to be in the region of 385 million, with an approximate 50-50 split between 'occasional viewers' and 'enthusiasts' (Newzoo, 2017).

According to existing figures, eSports spectators have been found to be predominantly young males, more likely to be in full-time employment and to earn more than non-eSports spectators (Gainsbury et al., 2017a). A large section, 40%, of eSports spectators do not regularly play the games which they watch, thereby mirroring traditional sports consumption practices (Gainsbury et al., 2017a).

Due to the prevalence of unregulated gambling sites and the continued state of flux, gambling with skins and other virtual items is hard to quantify. However, in 2016, a total of 6.5 million consumers were estimated to have wagered in excess of US$5.5bn on

eSports-related gambling, of which US$649m was on sportsbook, PvP and fantasy sports betting (Grove, 2016).

Similar to eSports spectators, a previous study found that the majority of eSports bettors were young males with high levels of educational achievement; furthermore, they were likely to be more highly engaged with gambling than traditional sports bettors (Gainsbury et al., 2017a).

Legal context

The practice of gambling is governed by local laws and regulations which can vary widely between, and sometimes even within, countries. For example, in the United States, online sports betting remains illegal in the majority of states, but is, however, legal in Nevada, New Jersey and Delaware. Gambling related to video games has been subject to increased scrutiny in recent times, most notably in relation to the use of virtual items such as skins and the use of loot boxes. In the latter part of 2016 Valve, the publisher of *CS:GO* was the subject of legal proceedings in the United States which related to the use of skins in third-party gambling websites (Holden and Ehrlich, 2017; Martinelli, 2017). The outcomes of these cases are notable as the rulings have (a) begun to normalise the activities associated with eSports gambling (Canfield, 2017) and (b) established that US law does not recognise virtual items as constituting items of value, in contrast to other countries such as the United Kingdom (Holden and Ehrlich, 2017).

Regulatory interpretations in the West are centred around a definition of gambling in which virtual items are deemed not to possess value outside of the game from which they originate. As such, activities which utilise virtual items are not considered gambling in law.[1] This position is one which has been questioned, both in relation to loot boxes (Baglin, 2017; Griffiths, 2018) and other gambling-like experiences associated with games (Gainsbury et al., 2014, 2016; King et al., 2014).

The UK Gambling Act 2005 defines ‘gambling’ as (a) gaming, (b) betting or (c) playing a lottery; in turn, ‘gaming’ is defined as ‘playing a game of chance for a prize’, where ‘prize’ ‘means money or money’s worth’. The prize does not require the return of the original stake when applied to gaming machines (Gambling Act, 2005). By this definition, any purchase of a key to open loot boxes constitutes gambling in the same way as playing an electronic gaming machine. Griffiths (2018) highlights the fact that this is acknowledged by the Gambling Commission in a recent position paper, yet the Gambling Commission maintains that loot boxes are not gambling as they cannot be exchanged outside the game. This is, however, incorrect as numerous services exist that allow players to exchange virtual game items for real-world currency, services provided by both game developers such as Valve or third parties.[2] Games such as *Overwatch*, which do not facilitate player to player transfers, reimburse players with in-game currency which can be used to purchase items from the game store. Furthermore, online auction sites exist where players can sell their game accounts, and the accrued virtual items, for real-world currency. As such, ‘skin-farming’ is facilitated in the same way as the more established practice of ‘gold-farming’ (Heeks, 2009).

A final point which adds a further layer of complexity to the debate is that many contemporary video games require users to accept an end-user license agreement (EULA)

which defines in-game items as not having real-world monetary value. However, recent legal judgements by the Netherlands Gaming Authority (see Note 2) and the Washington State Gambling Commission (Songer, 2018) have declared that using virtual, in-game, items for gambling is equivalent to using a real-world currency. This is just one example of the larger debate surrounding ownership of digital content and intellectual property rights associated with video games (Giddings and Harvey, 2018; Joseph, 2018; Prax, 2012).

The authors contend that the gambling-like activity of paying to open loot boxes merits its inclusion in this research, alongside other forms of gambling facilitated by virtual items, notwithstanding the legal grey area which currently exists. Due to the lack of consensus surrounding the categorisation of paid loot box opening, this work will refer to it as a 'gambling-like experience' and to participants as 'loot box purchasers'.

The present study

The rapid rise of eSports and video game–related gambling, allied with concerns around the nature of Internet gambling and the practices evident in media convergence, means that urgent study is required. This study aims to provide an overview of a newly emergent behaviour in its relative infancy, thereby laying the groundwork for further studies. Furthermore, it is intended to form one of the first assessments of participation rates and the prevalence of problematic gambling behaviours from an academic perspective.

With these issues in mind, the following research questions guided this study:

- *RQ1*. What are the demographic characteristics of eSports spectators who gamble?
- *RQ2*. To what degree are spectators of eSports participating in gambling activities, either traditional (land-based or Internet-based) or related to video games, and which specific activities are favoured?
- *RQ3*. What are the rates of problematic gambling behaviour in the population of eSports spectators, and how do these rates compare to those who participate in established forms of gambling?

Existing research has highlighted that both video gaming and gambling, at a high level of involvement, are activities dominated by males (Forrest et al., 2016; McCormack et al., 2014). Compared to land-based gamblers, online gamblers have been found to be younger, more often male, more frequent gamblers, to spend more money gambling, to be involved in more forms of gambling and more likely to meet criteria for problem gambling behaviour (Blaszczynski et al., 2016; Edgren et al., 2017; Goldstein et al., 2016). Online gamblers have also been found to have attained higher levels of educational achievement, to be employed in full-time work and to have a higher average income than offline gamblers (Blaszczynski et al., 2016).

Given that eSports and video game–related gambling are almost exclusively facilitated online, video game–related gamblers are likely to share much of the same characteristics as online gamblers. Therefore, it is hypothesised that those who both watch eSports, and participate in different forms of gambling or purchase loot boxes, will

predominantly be young males, in full-time employment and to report higher than average levels of income (H_1).

Loot boxes are a mechanic prevalent in all types and genres of contemporary video games, and the virtual items obtained from opening loot boxes are used as stakes in a huge range of gambling activities (Gainsbury et al., 2017a; Martinelli, 2017). Therefore, it is hypothesised that eSports spectators who participate in gambling, and gambling-like, activities are likely to participate in a range of activities, accessed via mixed channels (H_{2a}), with betting, purchasing loot boxes, participating in skins lotteries and using virtual items to play casino games expected to be the most popular individual activities (H_{2b}).

For eSports spectators who gamble, or participate in gambling-like experiences, rates of problematic gambling are expected to mirror those found in online gamblers (Gainsbury et al., 2017b) and, therefore, will be higher in this population than other populations (H_3).

It is expected that the results of this work will contribute to identifying and understanding the profile of eSports spectators who gamble or participate in gambling-like experiences, a pressing issue in light of the rapid growth of this population. In addition, by examining the interactions between watching video games, eSports and gambling services, this research hopes to shed light on behaviours which are associated with the development of problematic gambling. The approach of the research is exploratory and atheoretical; the aim is to provide descriptive information regarding those who participate in gambling related to eSports and video games.

Methods

Procedure

A link to an online survey was posted on social media sites, such as Facebook and Reddit, on eSports discussion forums and on the social media pages of various national eSports associations. The link was introduced with text explaining the aims of the research, who was conducting and funding the research, and eligibility criteria. Potential respondents were eligible to participate if they had played video games and had watched eSports, gambled or purchased loot boxes within the preceding 12 months. Those respondents who reported opening loot boxes, but not purchasing them, were not categorised as loot box purchasers and, as such, were excluded from the analysis.

The survey was only available in English, as was the accompanying text, and was published on English-language sites. As an incentive to participate, respondents had the chance to enter a raffle to win a US$50 gift card.

The decision to collect data via an online survey was made having examined the characteristics of both the target population and the topic. Online surveys have the benefit of being a far more effective and cost-efficient method for reaching digitally engaged individuals, such as eSports fans, than the established techniques of probability sampling – an issue acknowledged by established researchers in the field (Forrest et al., 2016; Griffiths, 2010). Furthermore, the anonymising effect of online methodologies has been shown to increase veracity of responses, particularly in regard to sensitive issues such as gambling (Griffiths, 2010).

A total of 2397 responses were recorded, of which 891 were fully completed. The number of people viewing the link but not participating cannot be ascertained. The survey included a filter question; those who failed the filter were removed from the sample, as were those who reported neither watching eSports nor participating in any form of gambling in the preceding 12 months. The final sample consisted of 582 responses, 24.28% of total responses received.

The survey included items which recorded demographic characteristics of respondents, viewing habits for eSports and gambling behaviour, both in established contexts (online and offline) and those related to eSports, including the gambling-like activity of purchasing loot boxes. For all items relating to individual gambling behaviours, a full list of activities accompanied the item. Respondents were asked to include all types of gambling or gambling-like activity, whether formal (with a licensed company), informal (between friends), legal or illicit (with unlicensed or unregulated third parties).

In an attempt to mitigate potential fatigue for respondents, while ensuring all types of gambling were represented, gambling activities were grouped according to structural characteristics. A full list of items is shown in Supplementary Appendix A. For all activities, items recorded frequency of participation, average weekly hours spent on activity and average monthly spend.

Analysis was conducted using SPSS version 24; all tests are two-tailed.

Measurement

Consumption habits. Since the advent of Internet-based gambling, it has been common practice to distinguish between traditional offline activities and online ones (Deans et al., 2016; Gainsbury et al., 2012). Gambling related to video games is a particular focus of this study, despite the fact that it is facilitated almost exclusively via the Internet; it was decided that it would constitute a separate category due to the specific context and activities of which it is comprised.

For each individual activity, participants were asked to indicate how often (daily, weekly, monthly, etc.) they participated, their average weekly hours and average monthly spend, in US$. For all questions concerning finances, a link was included which allowed respondents to enter information in their currency of choice and obtain an accurate conversion to US$. The same information was collected regarding their consumption of eSports (viewing habits only); participants were not asked how often they played eSports.

For each of the five activities (gambling in three contexts, purchasing loot boxes and watching eSports), a construct relating to overall engagement was formulated by combining the three main indicators: frequency of participation, average weekly hours and average monthly spend. It was decided that a combined measure would prove most effective as using a single measure, for example, frequency of participation, does not provide a holistic picture (Macey and Hamari, 2018). Therefore, values for each of the three measures were converted into scales, from 1 to 6, with 1 showing the lowest involvement and 6 the highest. An average of the three scales was calculated, thereby indicating overall engagement. For eSports engagement, the ready availability of free content means expenditure is not as significant an indicator as either frequency or

average weekly hours. Therefore, when calculating engagement, average monthly spend was allocated a 50% weighting.

Problem gambling. The Problem Gambling Severity Index (PGSI) is a widely used self-assessment tool derived from the Canadian Problem Gambling Index (CPGI; Ferris and Wynne, 2001), consisting of nine items. Possible responses to the items are 'never', 'sometimes', 'most of the time' and 'almost always' and are scored as follows: 'never' = 0, 'sometimes' = 1, 'most of the time' = 2 and 'almost always' = 3. Respondents with total scores of 0, 1–2, 3–7 or 8 or more are categorised as 'non-problem gamblers', 'low-risk gamblers', 'moderate-risk gamblers' and 'problematic gamblers', respectively. Cronbach's alpha for the present study was $\alpha = .823$.

Analysis

Consumption habits, relating to both the context of gambling and specific activities, were cross-tabulated with eSports engagement in order to investigate potential relationships. Due to low counts in several cells in each of the tables, Fisher's exact test was used in place of Pearson's chi-squared test; in addition, Somers' delta (Δ) and Kendall's tau (τ) were performed to ascertain predictive power (Δ) and direction of association (τ). Somers' delta is an asymmetric test; as such, eSports engagement was used as the independent variable. All tables were square; as such, Kendall's tau-b was reported, with $\tau < 0.1$ showing a weak relationship, $0.1 < \tau < 0.2$ a moderate relationship, $0.2 < \tau < 0.3$ a moderately strong relationship and $0.3 < \tau < 1$ a strong relationship (Pollock, 2011).

Results

Demographics

As shown in Table 4, the final sample skews male (91.9%) and young, with 27% being under 18 years of age, and a further 31.3% being in the age range 18–21. The youthful nature of the sample is also reflected in the educational level and current employment status of respondents. The most common nationality recorded was American, 35.6%, followed by British, 7.9%, Finnish, 7%, and Canadian, 6.7%; in total, responses were provided by 61 different nationalities.

Gambling habits

A total of 51% of respondents reported both spectating eSports and gambling within the preceding 12 months; this figure rises to 67.18% when including the gambling-like experience of purchasing loot boxes. A further 7.4% reported gambling but not watching any eSports, rising to 8.25%, including the purchase of loot boxes. The remaining 24.57% reported watching eSports, but not gambling in the previous 12 months. Among those who had gambled, there was a clear preference for using multiple channels to access gambling content, with 57.6% using two or more channels compared to 42.4% using only a single channel (i.e. offline only, online only or video game–related only). With the

Table 4. Descriptive statistics of sample.

Descriptive statistics		
	n	%
Information not provided	11	1.9
Age		
14 or under	11	1.9
15–17	146	25.1
18–21	182	31.3
22–25	96	16.5
26–29	69	11.9
30–33	31	5.3
34–37	12	2.1
38–41	11	1.9
42–45	10	1.7
46–49	2	0.3
50 or over	1	0.2
Gender		
Male	535	91.9
Female	32	5.5
Other/Non-binary	4	0.7
Employment status		
Employed part-time	51	8.8
Employed full-time	147	25.3
Student	324	55.7
Unemployed	49	8.4
Nationality		
American	207	35.57
Australian	18	3.09
British	46	7.9
Canadian	39	6.7
Finnish	41	7.04
German	27	4.64
Others	193	33.16

inclusion of loot box purchases, the divide is even more pronounced: 61.6% using multiple channels to access gambling and gambling-like experiences, in comparison with 38.4% accessing gambling or gambling-like content via a single channel.

The most popular of all individual gambling activities was video game–related betting, with 19.8% of respondents having reported participating within the preceding 12 months (Table 5). This was followed by: *online betting* (26.8%), *offline lottery* (22.9%) and *offline betting* (17.9%). When considering loot box purchases alongside established gambling activities, a similar picture emerges, with the exception that the most popular activity is now *loot box purchasing*, with 42.6% of those who participate in gambling or gambling-like experiences having reported paying to open loot boxes (Table 5).

Table 5. Frequency of gambling activities in the preceding 12 months.

Participation in individual gambling activities[a]		*n*	% (gamblers *n* = 340)	% (gamblers + loot box purchasers *n* = 383)
Offline	Lottery	78	22.9	20.4
	Betting	61	17.9	15.9
	Casino games	13	3.8	3.4
	Electronic gaming machines	17	5	4.4
	Card games (not poker)	38	11.2	9.9
	Poker	50	14.7	13.1
	Dice	12	3.5	3.1
Online	Lottery	20	5.9	5.2
	Betting	91	26.8	23.8
	Casino games	26	7.6	6.8
	Electronic gaming machines	5	1.5	1.3
	Card games (not poker)	17	5	4.4
	Poker	27	7.9	7
	Dice	7	2.1	1.8
Video game–related	Skins lottery	47	13.8	12.3
	Betting	115	33.8	30
	Fantasy eSports	14	4.1	3.7
	PvP betting	9	2.6	2.3
	Casino games using skins	23	6.8	6
	Card games using skins (not poker)	4	1.2	1
	Poker using skins	4	1.2	1
	Loot box purchasing[b]	177	–	46.2

[a]Activities are not mutually exclusive; percentages have been calculated using the total number of gamblers.
[b]Purchasing loot boxes has been separated from established forms of gambling due to its debated status.

Investigating levels of engagement with gambling, and purchasing loot boxes, in respect to level of engagement with eSports (Supplementary Appendix B) shows clear evidence of strong associations across all four contexts, *offline* ($p < .001$), *online* ($p = .007$), *video game–related* ($p < .001$) and loot box purchasing ($p = .039$). However, only *online* ($\Delta = .077$, $\tau = .073$, $p = .049$) and *video game–related* ($\Delta = .240$, $\tau = .219$, $p < .001$) show clear monotonic relationships, which are moderate and moderately strong, respectively. We can see, therefore, that increased spectating of eSports is associated with increased levels of gambling both online and directly related to video games.

Considering individual gambling activities related to eSports engagement reveals a number of statistically significant relationships. In the offline context, average weekly hours spent betting, playing Electronic Gambling Machines (EGMs) and playing lotteries are associated with eSports engagement ($p = .037$, $p = .004$ and $p = .004$, respectively). However, it is only the first two which show clear relationships of moderate strength.

Offline betting has a positive correlation ($\Delta = .181$, $\tau = .136$, $p = .003$), while playing the lottery has a negative correlation ($\Delta = -.393$, $\tau = -.088$, $p = .004$). Average monthly spend on offline EGMs also shows a clear association with eSports engagement ($p = .010$), but once again the exact nature of this relationship is unclear from the data.

Examining online gambling activities shows that average weekly hours spent playing dice games has a statistically significant relationship to eSports engagement, with a p value of .030 although, potentially as a result of the small number of cases, the exact relationship is unclear. In addition, average weekly hours spent in online betting shows a clear, positive relationship of moderate strength, with eSports engagement ($p = .014$; $\Delta = .225$, $\tau = .183$, $p = .001$).

Unsurprisingly, it is in the context of video games where the strongest associations between gambling/gambling-like experiences and eSports engagement exist. The most notable relationships are in respect to video game–related betting, with both average weekly hours and average monthly spend displaying strong positive associations ($p < .001$; $\Delta = .399$, $\tau = 0.3$, $p < .001$) and ($p < .001$; $\Delta = .343$, $\tau = .245$, $p < .001$), respectively. An unexpected finding was that both average weekly hours and average monthly spend for purchasing loot boxes have significant, negative relationships of moderate strength, with eSports engagement ($p < .001$; $\Delta = -.180$, $\tau = -.131$, $p = .002$) and ($p < .001$; $\Delta = -.149$, $\tau = -.148$, $p = .002$), respectively.

Examining the specific channels used to access gambling, and gambling-like experiences, provides few meaningful results as, due to the number of contexts examined in this work, many categories are small. For example, 15 respondents reported gambling online only. In total, there were 15 specific categories ranging in size from $n = 8$ to $n = 68$ (see Supplementary Appendix C).

We can, however, infer certain patterns from the breakdown of channels used to access gambling. Online and VG gambling are usually accessed alongside other gambling channels. We can see this by comparing online only ($n = 15$) and VG gambling only ($n = 21$) to online and others ($n = 118$) and VG and others ($n = 107$), an eightfold and fivefold increase, respectively.

Loot box purchasers

Of the total respondents, 13 reported opening loot boxes but not paying to do so; as such, they were excluded from analysis. However, of these 13, 3 reported using the skins obtained via loot box opening in other gambling activities such as skins lotteries and stakes for playing poker. Similarly, 121 (of 177) respondents who reported opening crates also reported using skins to gamble.

Problem gambling assessment

Rates of problematic gambling behaviour in the sample appear substantial, with those classified as either being problematic gamblers or at moderate or low risk of developing problematic behaviour totalling 50.3% of the sample, with rates of 4.5%, 18% and 27.8%, respectively (Supplementary Appendix C).

As above, the ability to examine problematic gambling in regard to specific channels used to access gambling, and gambling-like, content is restricted due to small group sizes. However, we can see that rates of problematic and potentially problematic gambling correlate with the number of channels used to access gambling content: for those who use a single channel to access gambling content, rates of problematic and potentially problematic gambling total 44.2%, compared to rates of 81.7% and 83% for users of two and three channels, respectively (Supplementary Appendix E). As can be expected, the majority of respondents fall into 'low-risk' and 'moderate-risk' categories, with 2.9% of single-channel users and 2.4% of two-channel users being rated as 'problem gamblers'. For those who use all three channels (*offline, online and video game–related*) to access gambling, the number of 'problem gamblers' rises to 17%.

Assessing PGSI in respect to the level of engagement with different channels used to participate in gambling, or gambling-like experiences (Supplementary Appendix D), reveals statistically significant associations across all contexts, whether *offline, online, video game–related gambling* or *purchasing loot boxes* with p values of $<.001$ for all. All relationships are positive, with both *online* and *video game–related gambling* being significantly stronger than *offline gambling and loot box purchasing* ($\Delta = .437$, $\tau = .402$, $p < .001$), ($\Delta = .479$, $\tau = .424$, $p < .001$), ($\Delta = .208$, $\tau = .188$, $p < .001$) and ($\Delta = .213$, $\tau = .172$, $p < .001$), respectively.

Discussion

Investigating relationships between the online spectating of eSports and gambling products reveals that as engagement with eSports grows, so too does engagement in both the range of gambling activities and the range of channels through which gambling services are accessed. Furthermore, the rates of problematic and potentially problematic gambling behaviour observed in the sample were high (50.34%).

The predominance of males in the sample (Table 4) supports H_1; at first sight, this seems to be a heavily skewed distribution. However, it echoes results from several other studies who report rates of 85% for engaged eSports fans in the United States (Statista, 2017), attendees at LAN events (Jansz and Martens, 2005) and for video game stream consumers (Sjöblom et al., 2017). Furthermore, rates of around 93% for Internet gamblers have been reported (Gainsbury et al., 2012, 2015), although characteristics can vary according to country and gambling activity (Wood and Williams, 2011).

Similarly, the fact that the sample features a high number of adolescents and young adults (Table 4) further supports H_1, although the skew is stronger than anticipated, and highlights the consumption of video game–related gambling by those who are legally under-age. However, the skew towards youth means that specific elements of H_1 (employment status and income) were not realised. This can be explained by the fact that the high numbers of respondents still in full-time education have not yet had the opportunity to establish a career for themselves.

eSports spectators were found to access gambling services in a number of different ways, with higher rates of eSports engagement correlating with increased number of channels used to access gambling (Supplementary Appendix F). Furthermore, video game–related gambling and online gambling were relatively unpopular means to access

gambling in isolation, but significant numbers of respondents combined them with other channels. Together, these findings support H_{2a}. This is in line with previous research which highlights the need for caution when talking of gambling channels as being mutually exclusive (Wardle and Griffiths, 2011).

A further point of interest is that the three least popular contexts were found to be *online only, offline and online*, and *offline and video game–related*. These results demonstrate that traditional, land-based gambling is not as popular a means of accessing gambling activities for viewers of eSports as new media channels. Taken together, these findings are a clear demonstration of the connections between video game–related gambling, the purchase of loot boxes and online gambling.

Finally, those spectators who are highly engaged in eSports participate in gambling, and gambling-like, activities at a higher rate (74.6%) than those who have either low (64.3%) or moderate (59.8%) levels of engagement. This lends weight to the findings of previous research which note correlations between eSports consumption and increased gambling activity (Macey and Hamari, 2018).

In respect to individual activities, purchasing loot boxes and video game–related betting were the two most popular, with participation rates of 46.2% and 30%, respectively (Table 5). As such, H_{2b} is partially supported.

Considering the popularity of loot box opening, it is interesting that both *average weekly hours* and *average monthly spend* for this activity show negative associations, of moderate strength, with eSports engagement. It is possible that those who are heavily engaged with eSports view the opening of cases negatively, due to their associations with less desirable aspects of the eSports community (Lewis, 2017).

Although the number of respondents who reported not paying to open loot boxes was small, a significant percentage (30.8%) were found to use the skins to facilitate gambling activities. For those who did pay to open loot boxes, the percentage who then used skins as wagers for gambling more than doubled (68.4%). Loot boxes are the primary source by which skins are obtained, and this is evidence of a strong relationship between loot box opening (paid and unpaid) and gambling, thereby highlighting the complicated nature of gambling related to video games and the need to establish clear terms of reference in regard to the use of virtual items.

Betting accounts for three of the top five most popular gambling/gambling-like activities (Table 5), providing evidence that it is a significant activity for spectators of eSports. These findings support previous work which has found associations between the consumption of video games and a preference for games of skill (Forrest et al., 2016).

Finally, the expectation that using skins and other virtual items would be a popular way to access casino games (H_{2b}) was not realised. The low levels of participation in skins lotteries, and in the use of skins to access online casino games (Table 5), may be accounted for by the fact that the data were collected shortly after the events of late 2016 which questioned common practices in the skins-betting ecosystem (Holden and Ehrlich, 2017).

Analysis of gambling engagement in respect to eSports engagement (Supplementary Appendix B) shows clear and meaningful evidence that increased eSports spectating is associated with increased participation in gambling activities related to video games.

The findings of this research support H_3 as rates of problematic and potentially problematic gambling were found to be substantial, with a combined rate of over 50% (Supplementary Appendix C). These results echo previous research, which has found higher rates of problematic gambling in Internet gamblers when compared to offline gamblers (Gainsbury et al., 2014; Wood and Williams, 2011) and for those who participate in sports betting (Hing et al., 2016). However, the degree of problematic gambling evident in this sample was unanticipated and as such requires additional scrutiny. Further study is required in order to ascertain whether it is a characteristic of the gathered sample or whether the PGSI is the most suitable measure for this type of behaviour.

Less than 50% of single channel gamblers were classified being problematic or potentially problematic gamblers, compared to over 80% of those who gambled across all channels, whether considering only established gambling activities or, additionally, the purchasing of loot boxes (Supplementary Appendix C). While causality cannot be determined, it seems that those who utilise more channels to participate in gambling are more likely to display problematic gambling behaviours. This finding is in line with previous research (Blaszczynski et al., 2016).

Limitations

The most significant limitation of this research is the use of an online survey to collect data; as such, it is open to the standard criticisms including that respondents were self-selected, that the findings lack generalisability and that certain behaviours may be over- or under-represented. In addition, the characteristics of social media platforms used to gather data may have influenced the sample. As such, the rates of problematic and potentially problematic gambling are potentially biased by both the nature of the sample selection and non-representative nature of the sample, potentially resulting in an inaccurate estimate of the true rates in the population of interest as a whole. The findings of this work, therefore, are indicative of the current situation, and further work is required which utilises alternative sampling methods in order to produce generalisable findings.

The potential problems of the data-gathering method are, however, mitigated by several factors. First, the sample is not small ($n = 582$), meaning that intentionally misleading responses are likely to be minimised. Second, that social media platforms, such as reddit, have been found to be as reliable sources for collecting data as either paid recruitment or using university students, which are themselves popular means of collecting data (Jamnik and Lane, 2017). Finally, it is not only online surveys to which the aforementioned criticisms can be applied; according to Griffiths (2010); using online surveys to collect data has a number of important advantages over other methods, most notably access, global reach and accuracy of data collection.

This research seeks to describe a population that is heavily engaged in the digital environment; therefore, traditional probability sampling is unlikely to generate a meaningful number of responses. In addition, the anonymity provided to respondents means that they are more likely to feel comfortable providing information about such sensitive topics as gambling or addiction, with responses being less likely to be guided by the desire to provide socially acceptable answers (Griffiths, 2010).

The fact that the majority of responses were from Western European and North American countries (Table 5) may be perceived as a limitation; however, a total of 61 different nationalities, from all continents, were recorded. Such diversity brings significant depth to the results due to the diversity of experiences and attitudes captured, mirroring the global reach of contemporary eSports and addressing the concerns of previous researchers (Forrest et al., 2016).

Finally, participants were only asked about their gambling history in the 12 months preceding the research. As such, no conclusions can be drawn as to whether the sample consists of those who are new to gambling or whether it reflects existing gamblers who have since become interested in eSports gambling. Although research exists which supports the latter interpretation (Gainsbury et al., 2017b), the prevalence of adolescents and young adults in the sample would suggest their opportunities to gamble have been limited by their age. In summary, it is likely that the sample includes a mixture of those who are existing gamblers and those who are new to gambling.

Implications and concluding remarks

A feature of the data gathered in this research was the number of young people who reported participating in gambling connected to video games and eSports, with almost 75% aged 25 or under. Much of these activities are facilitated by virtual items and are conducted via illicit and unregulated websites. In combination with the high rates of problematic gambling indicated by this work, we can see that there is a pressing need for increased attention from both regulators and scholars. The continued proliferation of video games and eSports into mainstream culture assures us that this need will only become more acute. Indeed, purchasing loot boxes was found to be the most popular individual activity, demonstrating that traditional definitions of gambling require attention and possible re-negotiation in light of newly emergent practices.

This research marks the first step in identifying both the participants and the specific practices of a newly emergent, but rapidly growing phenomenon: the convergence of gambling and the consumption of video games in the form of online eSports. Accordingly, there remains a great deal of work to be done in the area, most notably in renegotiating established concepts of gambling in light of the contemporary online environment. Another key task would be to conduct probability-based sampling in order to establish prevalence rates of gambling in the eSports community which can be compared to the general population. Other avenues of potential future work include investigating the motivations for gambling connected to video games and eSports, comparing them with those of established gambling activities and mapping the ecosystem in which eSports and gambling co-exist. Indeed, the scope for future work is significant due to the novelty of this field, requiring both qualitative and quantitative approaches to answer the many questions that will continue to be raised as the phenomenon grows in both social and economic importance.

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Notes

1. An in-depth examination of the legal issues surrounding virtual items and loot boxes can be found in the special issue of Gaming *Law Review* journal (Oct 2017) dedicated to eSports-related gambling.
2. During the writing of this article, the Netherlands Gaming Authority issued a press release detailing its decision that loot boxes whose prizes can be directly exchanged for real-world currency constitute gambling. Furthermore, all loot boxes, whether paid or free, transferable or non-transferable, 'are similar to gambling games such as slot machines and roulette in terms of design and mechanisms' and have the potential to become addictive (Netherlands Gaming Authority, 19th April, 2018): https://www.kansspelautoriteit.nl/publish/library/6/press_release_loot_boxes_19_april_2018_-_en.pdf

   In addition, the Belgian Gaming Commission also announced a judgement that any paid loot box opening constitutes a game of chance and, therefore, that even games such as Overwatch, where there is no possibility to directly exchange prizes for real-world currency, are in violation of their gambling laws (The Belgian Gaming Commission, 25th April, 2018).

Supplementary material

Supplementary material for this article is available online.

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Joseph Macey is a doctoral researcher whose research interests include problematic and potentially problematic media consumption, cognitive biases in media users, digital economies and virtual items. Prior to his academic career he worked in the public and private sectors and is a qualified Project Manager. His work has been published in international journals, and presented at various international conferences and seminars.

Juho Hamari is a professor of gamification and leads the Gamification Group across Tampere University of Technology, University of Turku on University of Tampere. Dr. Hamari's and his research group's research covers several forms of information technologies such as games and gamification, new media and online economies. Dr. Hamari has authored several seminal empirical, theoretical and meta-analytical scholarly articles on these topics from perspective of consumer behavior, human-computer interaction, game studies and information systems science which have been published in a variety of prestigious venues.

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Investigating relationships between video gaming, spectating esports, and gambling

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ABSTRACT

An established body of research exists in which playing video games has been associated with potentially problematic behaviours, such as gambling. An issue highlighted by the recent emergence of game-based gambling practices such as loot boxes, social network casinos, free-to-play game mechanics, and gambling using virtual goods and skins. This study investigates relationships between a range of gambling activities and the consumption of video games in general, and the newly emergent phenomenon of esports in particular. In addition, these practices are considered in relation to established measures assessing game addiction and problematic gambling. The study employs Partial Least Squares modelling to investigate data gathered via an international online survey (N = 613). Video game addiction was found to be negatively associated with offline gambling, online gambling, and problem gambling. Video game consumption had only small, positive association with video game-related gambling and problem gambling. Consumption of esports had small to moderate association with video game-related gambling, online gambling, and problem gambling. The primary finding of this study are that contemporary video games are not, in themselves, associated with increased potential for problematic gambling, indeed, the position that problem gaming and problem gambling are fundamentally connected is questioned.

1. Introduction

There is an established body of research which addresses the potential associations between playing video games and a range of problematic behaviours, from aggressive or violent behaviour (Anderson et al., 2010; Olson, Kutner, Baer, Beresin, Warner, & Nicholi , 2009) to substance abuse (Desai, Krishnan-Sarin, Cavallo, & Potenza, 2010; Williams, Yee, & Caplan, 2008). The relationship between video gaming and gambling is an aspect which has continuously received a significant amount of attention; the case has been made that gaming may serve as a pathway that increases the likelihood of developing problematic gambling behaviours. This position is one in which the structural similarities between gaming and electronic gambling are cited as a major influence (Fisher & Griffiths, 1995; Johansson & Götestam, 2004; Wood, Gupta, Derevensky, & Griffiths, 2004), as are the social benefits accrued for successful players (Griffiths & Wood, 2000), and misperceptions related to a sense of control (Gupta & Derevensky, 1996).

The concept of structural similarities between video gaming and gambling was first discussed almost three decades ago (Griffiths, 1991) and continues to be highly influential to this day (McBride & Derevensky, 2017). However, the focus of the original research was on coin-operated arcade games and gambling using slot machines (Griffiths, 1991; King, Delfabbro, & Griffiths, 2010a). It has been argued that, as both video games and gambling environments have undergone significant changes, the findings are no longer applicable to the contemporary practices of gaming and gambling (Forrest, King, & Delfabbro, 2016).

Driven primarily by online technologies (King, Delfabbro, & Griffiths, 2010b; King, Delfabbro, Kaptsis, & Zwaans, 2014) the convergence of gaming and gambling has taken on new forms

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(Lopez-Gonzalez & Griffiths, 2016). Technological developments have not simply changed the content of games, offering sophisticated immersive environments for example, but more significantly they have changed the way that games are played. The spaces of play have dispersed, no longer centralised in arcades or the home, player-versus-machine has become player-versus-player via networked sessions. Business models such as "free-to-play" (Alha, Koskinen, Paavilainen, Hamari, & Kinnunen, 2014; Hamari, Hanner, & Koivisto, 2017) and social network games have introduced gambling-like mechanics back into video games. In addition, the expansion of virtual economies and goods (Hamari & Keronen, 2017; Hamari, Alha, Järvelä, Kivikangas, Koivisto, & Paavilainen, 2017; Lehdonvirta & Castronova, 2014) has obfuscated the use of real money for gambling-like activities in games; gambling-like mechanics are no longer easily identifiable for users (Gainsbury, Russell, King, Delfabbro, & Hing, 2016; Kim, Wohl, Salmon, Gupta, & Derevensky, 2015; King et al., 2014).

All this is happening in an environment where the presence of games and game-like experiences is ubiquitous (Hamari, Huotari, & Tolvanen, 2015, p. 139; Raessens, 2006), one which has seen an increasing trend toward the liberalisation of gambling laws (Fong, Fong, & Li, 2011; Kingma, 2006; Markham & Young, 2015), and increased access to gambling activities via the internet and mobile devices (Choliz, 2016; Deans, Thomas, Daube, & Derevensky, 2016).

The phenomenon which most succinctly encapsulates these trends is that of esports; a form of sports where play is "facilitated by electronic systems", i.e. competitive video gaming organised into leagues and tournaments (Hamari & Sjöblom, 2017; Taylor, 2012). In esports, video games are the objects and the drivers of all activity, its "sportification" (Lopez-Gonzalez & Griffiths, 2016) has brought with it a host of activities associated with traditional sports: professionalization, regulation, fan communities, and gambling.

In addition to esports (Holden, Rodenberg, & Kaburakis, 2016), the convergence of gaming and gambling is evident in social gaming (Gainsbury, King, Abarbanel, Delfabbro, & Hing, 2015; King et al., 2014) and the free-play modes offered by online casinos (Bednarz, Delfabbro, & King, 2013). It is understandable, therefore, that concerns have been raised over the potential for video game players to be exposed to factors which may encourage problematic gambling (Bednarz et al., 2013; Griffiths, King, & Delfabbro, 2009; Parker, Taylor, Eastabrook, Schell, & Wood, 2008). Results have been mixed, with some studies showing a significant relationship between playing video games and increased participation in gambling (Gainsbury et al., 2016; Kim et al., 2015; McBride & Derevensky, 2017; Wood et al., 2004) while others have not found a clear relationship (Delfabbro, King, Lambos, & Puglies, 2009; Forrest et al., 2016; King, Ejova, & Delfabbro, 2012).

1.1. Aims of the research

An environment has developed in which the prevalence of both video gaming and gambling as leisure activities has been accompanied by technological and cultural convergence, increased ease of access, and liberalisation of gambling regulations. As such, it is imperative that relationships between video gaming and gambling require continued investigation, with specific focus on newly emergent phenomena such as esports.

Currently, there is a dearth of research which addresses esports and gambling, what published work there is largely addresses the question of legal and regulatory issues (Owens Jr, 2016; Schneider, 2015). This deficit requires urgent attention as industry analysts predict the number of global esports viewers to reach 375 million by the end of 2017, with active participants in formal, mainstream esports gambling already exceeding 2.25 million. Furthermore, it is estimated that over 3 million people actively participate in the informal markets surrounding in-game items, such as skins lotteries (Grove & Krejcik, 2015).

This study, therefore, seeks to investigate relationships between the consumption of video games, esports and three different forms of gambling: offline, online, and video game-related gambling. The final category includes activities such as: betting on esports matches, playing fantasy esports, paying to access randomly generated in-game items, using in-game items or currencies as wagers in third-party gambling sites, and social network gambling games. Both offline and online gambling refer to established practices such as betting, playing the lottery etc., in specific contexts. These factors give rise to the following research questions:

- RQ1: Is increased consumption of video games and esports associated with increased levels of gambling?
- RQ2: Are higher rates of problematic video gaming associated with higher rates of a) gambling activity, and b) problematic gambling?

The convergence of gaming and sports embodied by esports suggests that if video gaming is associated with increased gambling, it would be in this environment that any relationships would be most pronounced. Therefore, in order to investigate the stated research questions, the following target population was identified: video game players who also watched esports, and/or who had gambled within the previous 12 months. Online questionnaires with self-selected respondents are considered the most appropriate method of obtaining data from such populations (Griffiths, 2010). Advantages of this method include: increased access to target population, global reach, it is more cost-efficient than traditional random sampling techniques, and responses are less likely to be affected by the desire for social acceptance.

1.2. Research model

This research is concerned with the relationship between consumption of digital media, in the form of video games and esports, and gambling behaviour, as such an involvement model (Binde, 2013) was developed to answer the research questions detailed above.

Previous research has linked increased consumption of video games to increased participation in gambling and raised likelihood of developing problematic gambling behaviours (McBride & Derevensky, 2017; Wood et al., 2004). This relationship has been explained in terms of structural similarities between gaming and gambling (Fisher & Griffiths, 1995; Johansson & Götestam, 2004), the accrual of social capital (Griffiths & Wood, 2000), and maladapted cognitions such as an overdeveloped sense of control (Gupta & Derevensky, 1996). Therefore, it is hypothesised that *Video gaming habits* will be positively associated with *Offline Gambling Habits* (H_1), *Online Gambling Habits* (H_2), and *Video Game-Related Gambling Habits* (H_3). The association is expected to be most pronounced in relation to *Video Game-Related Gambling Habits* and weakest for *Offline Gambling Habits.*

An interest in esports is born out of an initial interest in video games, esports being considered a subset of the wider gaming environment (Lee & Schoenstedt, 2011), therefore, *Esports viewing habits* is anticipated to be an additional predictor of involvement in gambling, one which is itself influenced positively by *Video Gaming Habits* (H_4). Accordingly, *Esports Viewing Habits* is hypothesised as positively influencing *Offline Gambling Habits* (H_5), *Online Gambling Habits* (H_6), and *Video Game-Related Gambling Habits* (H_7). The association is expected to be strongest for *Video Game-Related Gambling Habits* and weakest for *Offline Gambling Habits.*

Problematic gaming behaviour in particular has been theorised as being associated with problematic gambling (Griffiths & Wood, 2000; Johansson & Götestam, 2004; Parker et al., 2008). It is a logical expectation that game addiction (*GAS*) is positively influenced by the habits surrounding the consumption of video games (H_8) and, by extension, esports (H_9). It has been interpreted as such, and used in the same way, in previous research (Forrest et al., 2016). Mirroring the relationships outlined in H_1-H_3 and H_5-H_7, *GAS* is expected to show positive associations with *Offline Gambling Habits* (H_{10}), *Online Gambling Habits* (H_{11}), and *Video Game-Related Gambling Habits* (H_{12}).

Video game-related gambling is the newest form of gambling (heavily dependent upon technological developments that have facilitated contemporary video game forms, business models and online communities (Scholz, 2011; Taylor, 2012). Therefore, it is anticipated that it will be influenced by gambling habits of pre-existing formats, both *Offline Gambling Habits* (H_{13}), and *Online Gambling Habits* (H_{14}), with the former being weaker than the latter.

Including a measure of problematic gambling when investigating possible relationships between video game consumption and gambling behaviour has been recommended by researchers in the field (Forrest et al., 2016). It is noteworthy that problematic gambling has been found to be more strongly associated with online gambling than offline (Griffiths, Wardle, Orford, Sproston, & Erens, 2009; Olason et al., 2011). As a result, problem gambling (*PGSI*) is expected to be positively influenced by all types of gambling behaviour, with the strongest associations predicted to be for *Video Game-Related Gambling Habits* (H15) and *Online Gambling Habits* (H16), and weakest in relation to *Offline Gambling Habits* (H17).

The path model used to investigate relationships between the consumption of both video games and esports and gambling activities is presented in Fig. 1:

2. Methods

The survey included two measures of problematic behaviour, the Game Addiction Scale (GAS; Lemmens, Valkenburg & Peter, 2009) and the Problem Gambling Severity Index (PGSI), derived from the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001). Playing video games, watching esports, and gambling habits were assessed using items which measured frequency, average weekly hours, and average monthly spend (in US$) for each activity.

2.1. Participants and procedure

A sample of 869 video gamers was collected, from a total of 2397 responses, via an online survey publicised across social media channels and online discussion forums dedicated to video gaming and esports. The survey was available for a period of one month, between November and December 2016. As an incentive to participate, valid respondents were entered into a prize draw to win a $50 gift-card. A filter question was included, those that failed were excluded from the sample, also excluded were those who reported playing no video games within the previous 12 months. The final sample consisted of 613 respondents, 25.57% of total responses, of which: the modal range was 18–21 (31.5%) (Table 1); 98.2% played video games once a week or more (Table 2); 50.1% watched esports once a week or more (Table 2); 32.8% gambled offline within the previous 12 months, 34.4% had gambled online and 47.5% had gambled in relation to video games (Table 3); 91.4% were male (Table 4), a figure also reflected in previous studies of both active esports players (Weiss & Schiele, 2013) and internet gamblers (Gainsbury, Wood, Russell, Hing, & Blaszczynski, 2012).

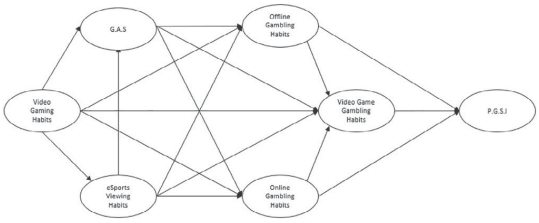

Fig. 1. Path Model. Model showing relationships between video game consumption and gambling activity.

2.2. Measurement

The GAS short form (Lemmens et al., 2009) is an established, previously-validated scale; it has been demonstrated to be as effective as the longer 21 item measure and was chosen in order to minimise participant fatigue. It addresses issues of salience, tolerance, mood modification, relapse, withdrawal, conflict and problems resulting from play. Items are rated on a five-point Likert scale, ranging from "never" to "very often", an item would be considered as being met if the respondent answered 3 (sometimes) or higher. The authors propose two approaches to categorisation: the monothetic, where all items must be met, and the polythetic, where four out of seven items must be met. An alternative approach, utilised by Forrest et al. (2016), was adopted by this study in which the total GAS scores are summed, providing a continuous scale of problematic gaming behaviour. This was felt to be a useful approach as it presents a more nuanced picture of problematic behaviour. Cronbach's alpha for the present study was $\alpha = 0.809$.

The PGSI (Ferris & Wynne, 2001) is a widely-used, 9 item self-assessment measure addressing a range of problematic gambling behaviours, as well as consequences of those behaviours. Possible responses to the items are "never", "sometimes", "most of the time", and "almost always", they are scored in order to assign participants to one of four groups. Scoring is as follows: "never" = 0, "sometimes" = 1, "most of the time" = 2, and "almost always" = 3. Cronbach's alpha for the present study was $\alpha = 0.822$.

The sample was classified according to each of the measures described above, results are provided in Tables 5–7.

Formative variables for habits relating to the consumption of video gaming, esports watching, offline gambling, online gambling, and video game-related gambling were created using the following items: frequency of activity, average weekly hours spent on activity,

Table 1
Demographics – age.

Age Ranges of Sample (n = 613)			
	n	%	Cumulative %
Information Not Provided	11	1.8	1.8
14 or Under	11	1.8	3.6
15–17	152	24.8	28.4
18–21	193	31.5	59.9
22–25	104	17.0	76.8
26–29	71	11.6	88.4
30–33	32	5.2	93.6
34–37	12	2.0	95.6
38–41	12	2.0	97.6
42–45	11	1.8	99.3
46–49	2	0.3	99.7
50 or Over	2	0.3	100.0
Total	613	100.0	

Table 2
Combined video game and esports consumption frequencies.

Video Game and esports Consumption Frequencies of Sample (n=613)						
	Video Game Play Frequency			Esports Viewing Frequency		
	n	%	Cumulative %	n	%	Cumulative %
Never	–	–	–	79	12.9	12.9
Less Than Once a Month	2	0.3	0.3	83	13.5	26.4
About Once a Month	4	0.7	1.0	50	8.2	34.6
2 - 3 Times a Month	5	0.8	1.8	94	15.3	49.9
About Once a Week	11	1.8	3.6	96	15.7	65.6
2 - 6 Times a Week	176	28.7	32.3	145	23.7	89.2
Every Day	415	67.7	100.0	66	10.8	100.0
Total	613	100.0		613	100.0	

Table 3
Gambling participation in last 12 months.

Gambling Participation Rates of Sample (n=613)						
Gambled in last 12 months?	Offline		Online		Video Game-Related	
	n	%	n	%	n	%
Yes	201	32.8	211	31.4	291	48.5
No	412	67.2	402	68.6	322	52.5
Total	613	100	613	100	613	100

Table 4
Demographics – gender.

Gender Breakdown of Sample (n=613)			
	n	%	Cumulative %
Information Not Provided	11	1.8	1.8
Male	560	91.4	93.1
Female	38	6.2	99.3
Other/Non-Binary	4	0.7	100.0
Total	613	100.0	

Table 5
PGSI categorisation.

PGSI Categorisation of Sample (n=613)			
	n	%	Cumulative %
Non-problem Gambler	318	51.9	51.9
Low Risk	162	26.4	78.3
Moderate Risk	107	17.5	95.8
Problem Gambler	26	4.2	100.0
Total	613	100.0	

Table 6
GAS addiction classification by alternative criteria.

Addiction Rates of Sample (n=613) by GAS Criteria						
	GAS Monothetic Criteria			GAS Polythetic Criteria		
	n	%	Cumulative %	n	%	Cumulative %
Not Addicted	573	93.5	93.5	322	52.5	52.5
Addicted	40	6.5	100.0	291	47.5	100.0
Total	613	100.0		613	100.0	

and average monthly spend on activity. Analysis was conducted using SmartPLS 3.

Table 7
GAS cumulative score statistics.

GAS Score of Sample (n=613)	
	Values
Valid	613
Mean	17.49
Std. Deviation	5.488
Variance	30.120
Range	28
Minimum	7
Maximum	35

3. Results

The model was tested using Partial Least Squares Structural Equation Modelling (PLS-SEM) as it is best suited to predictive studies (Chin, Marcolin, & Newsted, 2003) and those models featuring latent, formative and reflective constructs (Hair, Hult, Ringle, & Sarstedt, 2016). Furthermore, it is a form of multiple linear regression which is the recommended analytic method when using a self-selected data sample (Heckman, 2013).

The model utilises formative constructs to measure consumption habits, therefore, traditional methods of assessing construct validity, based on reflective constructs, such as factor loadings, AVE values, convergent validity, and discriminant validity are not applicable (Diamantopoulos & Winklhofer, 2001; Wang, French, & Clay, 2015). However, construct validity has been established as 11 outer VIF values are lower than 3.3, with the remaining four being lower than 5, meaning collinearity is not an issue (Diamantopoulos & Siguaw, 2006; Hair et al., 2016). Furthermore, bootstrapping showed all t-values for outer weights are greater than 2.57, providing clear evidence of the significance of the outer loading at $\alpha = 0.01$ (Hair et al., 2016). Full tables showing outer loadings and outer VIF values are included in the appendices.

With the validity of the constructs established, evaluation of the model can begin.

Fig. 2 shows the direct effects between the variables in the model, for the purposes of clarity only statistically significant effects are included. All 5 "habits" variables are latent variables comprising measures of: frequency of activity, average weekly hours spent on activity, and average monthly spend, in US$, on activity. Table 8 reports all direct effects and total effects.

In regard to H_2 and H_2 no statistically significant relationships were observed, those effects which were in evidence showed only small, negative associations. However, for H_3 a statistically significant, positive association was observed, although the effect size was small ($\beta = 0.116$). The expectation that the associations between video game consumption and gambling habits be most pronounced in relation to *Video Game-Related Gambling Habits* is supported as it

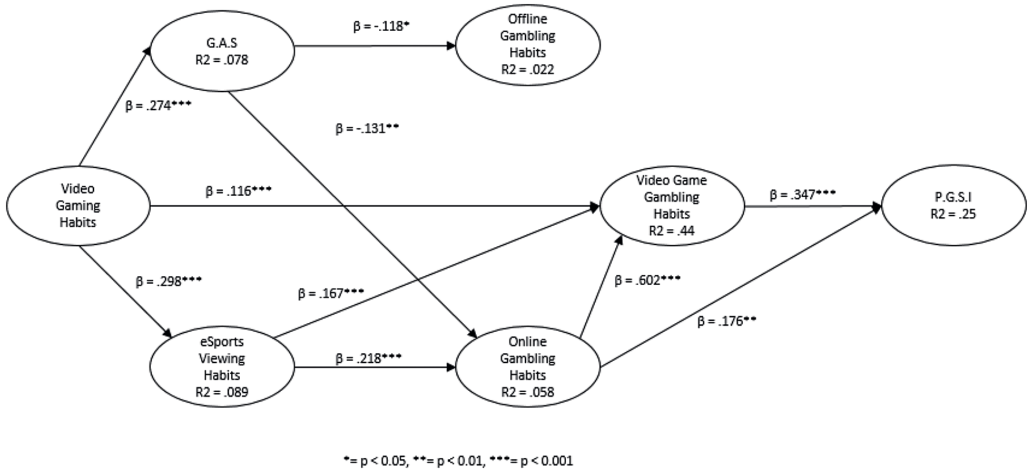

Fig. 2. PLS-SEM model with path coefficients and R2 values (significant relationships only). Path model showing coefficients for significant relationships and R2 values for all variables.

Table 8
Direct and total effects.

Direct and Total Effects								
	Direct				Total			
			95% CI				95% CI	
	β	P	Lower	Upper	β	P	Lower	Upper
GAS - > Off. Gam.	−0.118*	0.015	−0.207	−0.018	*same as direct*			
GAS - > On. Gam.	−0.131**	0.001	−0.206	−0.047	*same as direct*			
GAS - > VG Gam.	0.027	0.393	−0.033	0.089	−0.05	0.223	−0.131	0.031
Off. Gam. - > PGSI	0.051	0.343	−0.054	0.154	0.044	0.359	−0.048	0.14
Off. Gam. - > VG Gam.	−0.019	0.737	−0.119	0.103	*same as direct*			
On. Gam. - > PGSI	0.176**	0.005	0.055	0.298	0.385***	<0.001	0.294	0.473
On. Gam. - > VG Gam.	0.602***	<0.001	0.498	0.7	*same as direct*			
VG Gam. - > PGSI	0.347***	<0.001	0.237	0.452	*same as direct*			
VG Habits - > GAS	0.274***	<0.001	0.173	0.36	0.279***	<0.001	0.182	0.359
VG Habits - > Off. Gam.	−0.012	0.82	−0.11	0.093	−0.014	0.75	−0.092	0.078
VG Habits - > On. Gam.	−0.04	0.391	−0.124	0.055	−0.011	0.813	−0.095	0.089
VG Habits - > VG Gam.	0.116***	<0.001	0.051	0.177	0.167***	<0.001	0.084	0.256
VG Habits - > Esp. Habits	0.298***	<0.001	0.226	0.365	*same as direct*			
Esp. Habits - > GAS	0.018	0.692	−0.075	0.101	*same as direct*			
Esp. Habits - > Off. Gam.	0.104	0.152	−0.01	0.278	0.102	0.159	−0.014	0.275
Esp. Habits - > On. Gam.	0.218***	<0.001	0.132	0.331	0.216***	<0.001	0.129	0.328
Esp. Habits - > VG Gam.	0.167***	<0.001	0.09	0.25	0.296***	<0.001	0.204	0.403
GAS - > PGSI	*no direct effect*				−0.046*	0.028	−0.085	−0.002
VG Habits - > PGSI	*no direct effect*				0.055*	0.03	0.01	0.11
Esp. Habits - > PGSI	*no direct effect*				0.146***	<0.001	0.096	0.209

GAS = total score for Lemmens' Game Addiction Scale. PGSI = Problem Gambling Severity Index Categorisation. Off. Gam. = Offline Gambling Habits. On. Gam. = Online Gambling Habits. VG Gam. = Video Game-Related Gambling Habits. VG Habits = Video Game Playing Habits. Esp. Habits = Esports Watching Habits.
*= p < 0.05, **= p < 0.01, ***= p < 0.001.

was the only significant association.

Video Gaming Habits are a moderately strong predictor of esports consumption (β = 0.298), with the relationship being significant (p = <0.001), supporting H_4. The relationships between *Esports Viewing Habits* and both *Online Gambling Habits* (H_6) and *Video Game-Related Gambling Habits* (H_7) show statistically significant relationship was observed, with a moderate positive association (β = 0.218) and a moderate positive association (β = 0.218), respectively. No statistically significant relationship was observed in respect to *Offline Gambling Habits* (H_5), that which was observed showed a small positive association. The lack of association with offline gambling in part validates the stated expectation, however, counter to expectations the strongest association was found with *Online Gambling Habits* rather than *Video Game-Related Gambling Habits*.

Video Gaming Habits are a moderately strong predictor of *GAS* (β = 0.274), with the relationship being significant (p = <0.001), thereby validating (H_8). No statistically significant relationship was observed for esports (H_9), that which was observed showed a small positive association.

Surprisingly, no statistically significant relationship was observed in regard to H_{12}, however, for both H_{10} and H_{11}

statistically significant associations were observed, although the effects were small and, counter to expectations, negative ($\beta = -0.118$) and ($\beta = -0.131$), respectively.

Video Game-Related Gambling Habits had no statistically significant relationship with *Offline Gambling Habits*, as such H_{13} is not supported, whereas a statistically significant, and strong positive relationship was observed with *Online Gambling Habits* ($\beta = 0.602$). As such, H_{14} is endorsed, as is the expectation that the influence of *Online Gambling Habits* on *Video Game-Related Gambling Habits* is stronger than that of *Offline Gambling Habits*.

A statistically significant relationship was observed between problem gambling (*PGSI*) and *Video Game-Related Gambling Habits* and *Online Gambling Habits* with a strong positive association ($\beta = 0.347$) and a moderate positive association ($\beta = 0.176$), respectively. Therefore, both H_{15} and H_{16} are supported. No statistically significant relationship was observed for H_{17}, that which was observed showed a small positive association. The difference in effect size between *Video Game-Related Gambling Habits* and *Online Gambling Habits* is somewhat surprising. However, the total effects are very similar, with online gambling rising to $\beta = 0.385$. The mediated effects of *GAS* ($\beta = -0.046$) and *VG Habits* ($\beta = 0.055$) on *PGSI* are, again, significantly lower than that of watching esports ($\beta = 0.146$).

Overall, measures associated with video gaming account for just 2.2% of the variance of offline gambling habits, with the only statistically significant relationship being that of *GAS*. The negative relationship suggests that the higher the game addiction score, the less likelihood there is of participation in offline gambling. A similar relationship is in evidence between *GAS* and online gambling habits.

The amount of variance in online gambling habits explained by the model is higher than that of offline gambling habits, but is still very small ($R2 = 0.058$). Together these results suggest that video gaming in itself does not have any significant relationship to established gambling practices.

The strong relationship between online gambling and video game-related gambling is unsurprising, however, the degree of this relationship is unanticipated. Indeed, online gambling seems to be the biggest predictor of video game-related gambling, over and above either consuming video games or watching esports. That said, the total effect value of watching esports on video game-related gambling is almost double the direct effect, ($\beta = 0.296$), the relationship between the two is, therefore, a strong one.

The model explains 25% of the variance of *PGSI*, approaching the 26% required for the effect to be considered large (Cohen, Cohen, West, & Aiken, 2013). The direct effects of video game-related gambling on *PGSI* are substantially more than those of online gambling habits. Only 7.8% of *GAS* was explained, however, a clear and strong relationship with game consumption habits is evident. While the initial assumptions were not that video game consumption habits would entirely explain *GAS*, a more substantial overall effect was expected.

Considering RQ1, the situation appears to be more nuanced than expected as, despite the fact that the consumption of video games is a predictor of esports viewing habits, their individual relationships with different gambling activities vary somewhat. Both *Video Gaming Habits* and *Esports Viewing Habits* have statistically significant relationships with video game-related gambling. However, only *Esports Viewing Habits* shows any other statistically significant relationships, with *Online Gambling Habits*, and that is, somewhat surprisingly, stronger than with video game-related gambling.

We can say, therefore, that the consumption of esports is associated with increased gambling in mediated contexts (via video games and the internet) but not with offline gambling. The situation in respect to the consumption of video games is, however, more ambiguous, with only a small association shown to exist with video game-related gambling.

The situation in regard to RQ2 is more emphatic as the model shows that problematic video gaming is not associated with higher rates of either gambling activity or problematic gambling. In fact, it appears that higher rates of problematic gaming, as measured using GAS, seem to act against involvement in both online and offline gambling, and for the development of problematic gambling behaviour.

4. Discussion

The main findings of this research are that: first, there are no strong associations between the consumption of video games or esports, and gambling activity; and second, that problematic video gaming has a small, but significant, negative association with both gambling in general, and problematic gambling in particular. These, and other issues of interest arising from the study, are discussed below.

This research theorised that an interest in esports is born partly out of a pre-existing interest in, and consumption of video games, however, the small amount of variance of esports consumption explained by gaming habits suggests that this view is too simplistic, although there is evidence of a fairly strong relationship between the two. An almost identical relationship seems to exist between video gaming and GAS scores. This is particularly significant as researchers in the field of addiction studies have often used either frequency of gaming or time spent gaming as a primary indicator of addictive behaviour (Van Rooij, Schoenmakers, Vermulst, Van Den Eijnden, & Van De Mheen, 2011; Lemola et al., 2011; Weinstein, 2010; Festl, Scharkow, & Quandt, 2013). This research shows such an approach to be overly simplistic; even using a combination of consumption measures proves to be a poor indicator of potentially problematic gaming. This is clear evidence that problematic video game playing differs from other conditions for which consumption measures are a good indicator of addictive behaviour (Rehm et al., 2013; Sassen et al., 2011).

The small amount of variance in online and offline gambling habits explained by the range of game-related measures is at odds with the stated expectations of this research. This, and the fact that the model was unable to find statistically significant relationships between video game consumption and gambling activities not related to video games, is in contrast to a large body of work (Gainsbury et al., 2016; Kim et al., 2015; McBride & Derevensky, 2017; Wood et al., 2004). Instead, it provides support for research which questions proposed links between the practices of gaming and gambling (Delfabbro et al., 2009; Forrest et al., 2016; King et al., 2012). Indeed, the negative relationship between game addiction score and both online and offline gambling suggests that problematic gaming and problematic gambling are clearly distinct from one another. It seems instead that those who score more highly on measures of game addiction are unlikely to migrate to gambling behaviours, despite the apparent structural similarities (Johansson & Götestam, 2004; McBride & Derevensky, 2017; Wood et al., 2004). Critics of this position might reasonably argue that the negative correlation between game addiction score and gambling habits is due to limited resources; people are unable to participate in both activities concurrently, and if the opportunity to play video games were removed, they would be highly likely to seek similar gratifications from gambling. However, the results of this research refute such an argument as the overall, mediated relationship between game addiction score and *PGSI* is both negative and statistically significant. Furthermore, video game habits show statistically significant positive relationships with both game addiction score and *PGSI*, while the game addiction score has a

negative relationship with *PGSI*. There appears to be, therefore, an aspect of video gaming itself which serves to prevent the uptake of gambling and the development of associated problematic behaviours (Forrest et al., 2016).

Problematic gambling has a moderate to large amount of variance (25%) explained solely by behaviours relating to the consumption of gambling, (frequency, hours spent gambling per week and money spent gambling per month). This is noteworthy when compared to the low amount of variance (7.8%) for problematic gaming using the same measures, suggesting that the nature of problematic gaming is distinct from other behavioural conditions. As such, the findings support the call for specific measurement tools to be developed rather than using those derived mainly from substance use disorders (Demetrovics & Kiraly, 2016; Kardefelt-Winther, 2015; King & Delfabbro, 2016; Petry, 2013).

Although video game-related gambling habits have a more pronounced direct effect on *PGSI* than online gambling habits, the total, mediated, effects are comparable in strength. It is likely that the similarity of the overall influence of these two forms of gambling can be attributed to the fact that video game gambling is almost exclusively facilitated via online media. Aspects of online gambling such as increased ease of access, anonymity and the use of digitised/virtual currencies have been identified as characteristics of online gambling which facilitate problematic behaviours (Derevensky & Gupta, 2007; Gainsbury, Hing, Delfabbro, & King, 2014; Lopez-Gonzalez & Griffiths, 2016).

Further evidence of the strong relationship between online gambling and video game-related gambling can be found in the high β value between the two. Although the development of the model theorised that causality to run in a certain direction, it cannot be proved as this study is correlational in nature. It may be that those who are interested in games and who also gamble online are likely to then begin gambling in relation to video games, alternatively it may be that those who develop an interest in video game gambling then go on to explore other forms of gambling in the online environment.

A somewhat surprising finding was that video gaming habits had a reasonably small correlation with video game-related gambling, indeed it was the smallest of all observed relationships, both in direct and mediated effects. Of those variables related to video gaming in general, it was the consumption of esports that displayed the strongest relationship to video game-related gambling. Furthermore, it was the only measure that had any statistically significant, positive, relationship with either online or offline gambling. It seems clear, therefore, that rather than playing video games, it is the consumption of esports that is a more significant predictor of increased participation in gambling. Whether this is due to any specific characteristics of esports itself, or if gambling is associated with esports in the same way that it is with traditional sports (Hill & Clark, 2001; Udovicic, 1998) is something that requires further investigation.

4.1. Implications

The first notable implication of this research is that the use of gaming frequency or time spent gaming as a shorthand for addictive behaviour is over-simplistic and inaccurate. Therefore, researchers and professionals in the field of addictive behaviours must utilise more robust measures in order to minimise the risk of misdiagnosis.

A further lesson is that different approaches are required to understand and address problematic gaming and problematic gambling, ones which are based more on the individual circumstances and characteristics of each activity. Therefore, the approach whereby problem gaming is understood through the lens of gambling is questionable and likely to be ineffective. As such, criteria for assessing problematic gaming which have been developed from those based on problematic gambling or Substance Use Disorder, require a thorough overhaul.

Finally, the role and effect of esports, rather than video gaming per se, should be taken into consideration when evaluating the potential to develop problematic gambling behaviours. And, consequently, particular attention should be paid to this context when developing therapeutic approaches or treatment programmes.

4.2. Limitations

This research incorporated the lessons of previous studies by utilising more robust measures for consumption than simply using frequency of gaming, and by including a measure of problematic gambling (Forrest et al., 2016). Nevertheless, it remains the case that the most notable limitation of this research was the collection of data via an online survey, as such it is open to the standard criticisms directed at self-selected samples. The benefits of this approach, however, include greater access to the target population than techniques employed in probability sampling, and reduced scope for responses to be guided by social acceptance or feelings of embarrassment. This is especially pertinent in relation to potentially sensitive topics such as gambling or problematic gaming (Griffiths, 2010).

A potential issue specific to this particular survey was the seeming lack of diversity in respondents, with only 6.2% of participants being female. Whilst this is similar to other research (Gainsbury et al., 2012; Sjöblom, Törhönen, Hamari, & Macey, 2017; Weiss & Schiele, 2013) it is significantly lower than estimated levels of female participants in either video gaming, 41% (ESA, 2016), or watching esports casually, 36% (EEDAR, 2015). The characteristics of this dataset may be the result of the channels by which the data was collected; the most significant source of respondents was Reddit, a social news and discussion website which has previously been criticised for its lack of diversity (Speed, 2015; Zuckerman, 2012). An additional reason for the disparity between male and female respondents may be that this research is concerned with the relationship between video gaming and gambling, the latter is a pastime in which male participation largely outweighs female, and in which males favour sports betting, casino games and internet gambling in general (Gainsbury et al., 2012; Gupta & Derevensky, 1998; Hing & Breen, 2001; McDaniel & Zuckerman, 2003; Welte, Barnes, Wieczorek, Tidwell, & Parker, 2002) all of which are the predominant forms of gambling associated with video games.

5. Conclusions

Increased consumption of video games has a positive association with both game addiction score and video game-related gambling. However, as game addiction score has a negative correlation with both video game-related gambling and PGSI category there exists an unidentified aspect of video game play which serves to reduce the appeal of gambling for heavy gamers. On the other hand, increased consumption of esports is strongly associated with increased participation in online and video game -related gambling and moderately associated with increased potential for problematic gambling behaviour.

The findings of this study are that modern video games do not, in themselves, act as developmental pathways to gambling.

Furthermore, they question the claims that problem gaming and problem gambling are fundamentally connected. Instead, it seems that video games are simply a vehicle, like many other activities, employed to fulfil particular needs derived from the activity of gambling. The "sportification" (Lopez-Gonzalez & Griffiths, 2016) of video games, in the form of esports, is just one example of the way in which it is the convergence of digital culture, rather than video games themselves, that facilitates gambling.

6. Declaration

The research has been carried out as part of research project (40009/16) funded by the Finnish Funding Agency for Innovation (TEKES). In addition, this research was supported by a grant from The Finnish Foundation for Alcohol Studies. The authors wish to thank both organisations for their support. At no point were any of the funding bodies, or project partners involved in: the design of the study; data collection, analysis, or interpretation; the writing of the report; or decisions relating to submissions.

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Disclosure statement

No competing financial interests exist.

Appendix A. Outer Loadings

Outer Loadings					
	β	t	p	95% CI	
				Lower	Upper
GAS Sum < - GAS	1.000			1.000	1.000
Off. Gam. Freq. - > Off. Gamb.	0.974***	19.038	<0.001	0.809	0.999
Off. Gam. Spend - > Off. Gamb.	0.833***	9.838	<0.001	0.620	0.944
Off. Gam. Hours - > Off. Gamb.	0.877***	8.542	<0.001	0.595	0.986
On. Gam. Freq. - > On. Gamb.	0.976***	49.151	<0.001	0.920	0.996
On. Gam. Spend - > On. Gamb.	0.878***	21.235	<0.001	0.785	0.945
On. Gam. Hours - > On. Gamb.	0.893***	21.477	<0.001	0.799	0.960
PGSI Group < - PGSI	1.000			1.000	1.000
VG Gam. Freq. - > VG Gamb.	0.923***	33.091	<0.001	0.856	0.966
VG Gam. Spend - > VG Gamb.	0.895***	25.825	<0.001	0.812	0.948
VG Gam. Hours - > VG Gamb.	0.923***	30.332	<0.001	0.856	0.974
VG Play Freq. - > VG Habits	0.688***	7.568	<0.001	0.462	0.821
VG Play Spend - > VG Habits	0.472***	3.505	<0.001	0.218	0.742
VG Play Hours - > VG Habits	0.948***	21.437	<0.001	0.822	0.990
Esp. Watch Freq. - > Esp. Habits	0.836***	11.127	<0.001	0.650	0.942
Esp. Watch Spend - > Esp. Habits	0.653***	4.881	<0.001	0.366	0.880
Esp. Watch Hours - > Esp. Habits	0.916***	15.979	<0.001	0.761	0.980

GAS Sum/GAS = score for Game Addiction Scale. PGSI Group/PGSI = Problem Gambling Severity Index Categorisation. Off. Gam. = Offline Gambling Habits. On. Gam. = Online Gambling Habits. VG Gamb. = Video Game-Related Gambling Habits. VG Habits = Video Game Playing Habits. Esp. Habits = Esports Watching Habits. Off. Gam. = Off. Gambling. On. Gam. = Online Gambling. VG Gam. = Video Game-Related Gambling. VG Play = Video Game Playing Habits. Esp. Watch = Esports Watching Habits. Freq. = Frequency (of activity). Spend = Average Monthly Spend (on activity, in US$). Hours = Average Weekly Hours (on activity).

Appendix B. Outer VIF Values

Outer VIF Values	
	VIF
Off. Gam. Freq.	2.69
Off. Gam. Spend	3.658
Off. Gam. Hours	3.426
On. Gam. Freq.	3.125
On. Gam. Spend	3.552
On. Gam. Hours	3.81
VG Gam. Freq.	2.934
VG Gam. Spend	2.757
VG Gam. Hours	2.858
VG Play Freq.	1.334
VG Play Spend	1.091
VG Play Hours	1.415
Esp. Watch Freq.	2.17
Esp. Watch Spend	1.177
Esp. Watch Hours	2.152

Off. Gam. = Off. Gambling. On. Gam. = Online Gambling. VG Gam. = Video Game-Related Gambling. VG Play = Video Game Playing Habits. Esp. Watch = Esports Watching Habits. Freq. = Frequency (of activity). Spend = Average Monthly Spend (on activity, in US$). Hours = Average Weekly Hours (on activity).

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What predicts esports betting? A study on consumption of video games, esports, gambling and demographic factors

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What predicts esports betting? A study on consumption of video games, esports, gambling and demographic factors

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Abstract

The parallel media related to sports, gaming and gambling are expanding, exemplified by the emergence of esports and game-related gambling (e.g. loot boxes, esports betting). The increasing convergence of these phenomena means it is essential to understand how they interact. Given the expanding consumer base of esports, it is important to know how individuals' backgrounds and consumption of game media may lead to esports betting. This study employs survey data ($N = 1368$) to investigate how demographics, alongside consumption of video games, esports and gambling can predict esports betting activity. Results reveal that both spectating esports and participation in general forms of gambling are associated with increased esports betting, no direct association was observed between the consumption of video games and esports betting. Findings suggest that while games may act as a vehicle for gambling content, highlighting the convergence of gaming and gambling, there is no intrinsic aspect which directly encourages gambling behaviours.

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Keywords
Betting, consumption, convergence, digital media, esports, gambling, gaming, MSSC, video games

Introduction

The increased role of video gaming as a social and cultural force, combined with the development of online multiplayer games and video streaming services, has resulted in the growth of esports as a consumable media product. With its roots in the arcade culture of the 1980s and LAN parties of the 1990s, esports is very much a phenomenon that has emerged from the video gaming community (Borowy and Jin, 2013; Taylor and Witkowski, 2010). Its rapid growth and wide appeal has seen it gather increasing attention from mainstream media and, due to the appeal it holds for millennial audiences, businesses (Jenny et al., 2018; Newzoo, 2018).

Alongside the development and expansion of esports, a parallel trend can be observed: gambling as related to video games, and to esports in particular. Indeed, the two seemed to be inextricably linked, with the online technologies enabling contemporary esports also facilitating mass participation in previously localised practices (Scholz, 2011). There are, for example, emergent forms of in-game gambling in which in-game virtual items and currencies are used as stakes in-game events ultimately determined by random number generators. Furthermore, the online streaming of competitive video game play means that established gambling activities, such as sportsbook-style betting, can be transposed to this new arena (Macey and Hamari, 2019).

Recent years have seen the creation of a number of gambling activities directly associated with computer games. This includes those which have emerged from within the gaming community, such as skins lotteries and crash betting (Macey and Hamari, 2018, 2019), and those used to drive monetisation of games, such as loot boxes (Hamari and Lehdonvirta, 2010; King and Delfabbro, 2019). Concerns raised about the use of virtual items mean that the market is in a state of flux and that estimates of its size are constantly being revised. A further complicating factor is the fact that many sites offering gambling activities related to video games are not licenced. Indeed, there is an ongoing debate as to whether or not many of these activities can even be considered gambling and, consequently, whether or not they are subject to regulation (Abarbanel, 2018; Holden and Ehrlich, 2017; Macey and Hamari, 2019).

As the popularity of esports has grown, many established gambling operators have begun to offer sports books on esports events (Dos Reis, 2017). As a result, the size of the esports-related gambling market can be estimated with much greater confidence. The annual esports gambling market is estimated to be worth between US$2.3 billion (Eilers & Krejcik, 2018) and US$50 billion (Juniper Research, 2018), a significant increase in the size of the esports market itself, which in 2018 was valued between US$800 million (PwC, 2019) and US$869 million (Goldman Sachs, 2018). It is important, however, to maintain a sense of caution when considering such estimates as the underlying methodology is typically opaque in nature and may be used to further a specific agenda, such as encouraging investment.

Given the continued development of esports, ever-increasing prize-pools and an expanding consumer base, the already significant gambling market is also likely to continue growing. As such, it is important to understand how individuals' habits of gaming, gambling and consuming esports as well as demographic factors are associated with participation in esports betting. Many esports gambling opportunities are inextricably tied to video games, including both play and spectatorship activities. For example, player versus player (PvP) betting, in which video gamers can bet against one another based on their own performance, is growing in popularity (Grove, 2016). Gambling industry sponsorship of esports events, meanwhile, provides increasing exposure of gambling activities to esports spectators (Luongo, 2018). With this in mind, it is important to establish a holistic picture of the ways in which esports betting is associated with the consumption habits of media directly connected to the practice in order to understand how they interact with one another. This approach, therefore, lays the groundwork for further studies investigating these newly emergent practices and their relationships with existing behaviours. As such, this research is guided by the following question:

> RQ: How are demographic characteristics and the consumption of video game-related media (video games, esports and gambling) associated with esports betting activity?

This research will provide an overview of the changing ways in which video games are being consumed, both in the emergence of esports and of the betting activities associated therewith. Subsequently, this article outlines the hypothesised relationships between demographic characteristics, media consumption practices and esports betting practices before describing the research model employed in this study. After outlining the methods, measures, participants and procedures this article presents, the results of the study in reference to demographic characteristics and measures of consumption. The findings are discussed alongside their theoretical and practical implications, potential avenues of future research, and the limitations of this work.

This research will thus contribute to the growing body of literature related to the convergence of gambling and (video) gaming. Specifically, this study investigates the interrelations between the motivations for consuming esports, consumption of digital media products associated with esports and participation in esports betting. As such, this work will provide evidence as to whether esports betting replicates relationships present in traditional sports betting, or if this emergent activity is accompanied by novel relationships.

Background

The consumption of video games as sports

The emergence of arcade gaming has been presented as a key point marking the shift from the traditional, Fordist, approach to capitalism to a post-modern approach based around the commodification of experiences (Borowy and Jin, 2013). This early period of esports, as it is now known, combined the approach of traditional sporting events, technology and the marketing of experience as a commodity in itself. The scope of these

experiences ranged from watching celebrity players compete in local tournaments, to the showcase performances of the US National Video Game Team at events across the country. However, the transition to mainstream acceptance of arcade gaming as a sport seems to have been hampered by the constraints of the technology at the time; head-to-head competition between players was not possible, with performances instead being measured by high score (Borowy and Jin, 2013).

It was only with the introduction of Local Area Networks, and associated technologies, that competitive video gaming could move away from the player-versus-machine dynamic towards one characterised by PvP interactions (Griffiths et al., 2003). In this way, competitive video gaming could realistically be conceptualised as constituting a sporting venture.

This trend continued with the emergence of IPTV (Scholz, 2011) and streaming technologies (Hamilton et al., 2014; Hamari and Sjöblom, 2017) which have been credited with the rise of online communities centred around user-generated content. Such environments mean that developing and maintaining a community centred around esports has become much more feasible with contemporary consumption of esports taking place in a 'mediascape' of blogs, streams, podcasts and on-demand video (Taylor, 2012). Indeed, the development of streaming has facilitated and promoted both the consumption of esports and, in the wider context, of video game play as a media product in itself. Previous works have highlighted the ways in which esports has enabled gaming culture to move from the private domain into the public, and the new socio-technological relationships that this has engendered (Johnson and Woodcock, 2017; Taylor, 2018). Further research has examined the interactions between the consumers and the producers of streamed content, whether this be in regard to underlying motivations for consumption (Sjöblom and Hamari, 2017), or the changing dimensions of such shared experiences (Scully-Blaker et al., 2017).

The development of video game play as an entertainment product highlights the fact that online media constitute the basis upon which contemporary esports is built; facilitating large-scale consumption through online platforms and paving the way for the subsequent involvement of mainstream broadcast media. In this way, the development of esports can be seen to mirror that of traditional sports, where the introduction of mass media technologies was an event of huge historical significance (Carter and Gibbs, 2013; McChesney, 2008). The popularity of contemporary media services providing the means to spectate esports is, therefore, a natural and predictable development.

Modern live esports events often attract tens of thousands of attendees, sometimes even reaching over 100,000 spectators (ESL, 2019; Needleman, 2015; Taylor, 2016). The act of consuming video games simply as a spectator, rather than a player, or as both a player and spectator, is a problematic concept for many in wider society, where notions of consumption are focused on the interaction between the player and the game. However, both spectating and playing video games present aspects of a single spectrum rather than existing as distinct, binary states (Taylor and Witkowski, 2010). Previous work has also established the diversity of roles present in contemporary consumption practices associated with video games, revealing that there are many associated behaviours which also require attention (Seo and Jung, 2016).

Despite an ongoing debate within Game Studies concerning the nature of audience in relation to an actional, rather than passive media, spectating play has always been a fundamental aspect of the gaming experience (Taylor, 2016) and of other forms of play, including sports (Carter and Gibbs, 2013; Sutton-Smith, 2009). The role of technology and media in the popularisation of esports has been likened to that of traditional sports due to the way in which technological advances have facilitated mass consumption through new media (Carter and Gibbs, 2013).

A consistent theme within the scientific literature on esports has been the location of the activity in reference to established concepts of sport (Cheung and Huang, 2011; Jenny et al., 2017; Witkowski, 2012). Discussions have focused on defining esports, documenting it as a cultural phenomenon (Karhulahti, 2016; Taylor, 2012) and positioning the practice in relation to both traditional sports and to video games (Carter and Gibbs, 2013; Hamari and Sjöblom, 2017; Jonasson and Thiborg, 2010; Witkowski, 2012).

The study of digital play, and players, in physical environments has continued as esports has developed (Taylor, 2016; Taylor et al., 2014), while another consistent theme has been the motivations underlying esports consumption (Hamari and Sjöblom, 2017; Lee and Schoenstedt, 2011; Weiss and Schiele, 2013). Exploratory studies, such as that by Cohen and Avrahami (2005) have shown that measures designed for assessing sports in general, such as the Sports Fan Motivation Scale (SFMS: Wann, 1995) and the Motivation Scale for Sports Consumption (MSSC: Trail, 2012; Trail and James, 2001), can be applied to specific types of sport and in different cultural contexts. In addition, they can be used to differentiate between attendance at live events, 'active participation', and watching at home, 'passive participation' (Cohen and Avrahami, 2005).

With this in mind, the use of such measures to assess motivations for consuming esports is a natural and logical step (Hamari and Sjöblom, 2017; Lee and Schoenstedt, 2011), and early esports studies have revealed that spectators share many of the same motivations as traditional sports fans (Cheung and Huang, 2011).

Research into sports spectatorship and gambling motivational dimensions demonstrates a clear relationship. For some sports spectators, for example, gambling serves as a means of adding excitement to the spectating experience (Nelson et al., 2012; Petry, 2003). For others, it is the potential financial gains that drive a person's gambling during sports spectatorship (Wann, 1995). Gambling research has found similar motivational dimensions for sports betting (Abarbanel, 2014; Challet-Bouju et al., 2014; Flack and Stevens, 2019).

The MSSC (Trail and James, 2001) includes a series of constructs that parallel motives for gambling, such as 'vicarious achievement', 'acquisition of knowledge', 'drama' and 'escape'. The MSSC itself has also been shown to be associated with increased gambling behaviour, with individual sub-scales exhibiting varying degrees of influence (Karg and McDonald, 2009; Lopez-Gonzalez et al., 2018).

The MSSC was selected as the measurement instrument for this research as, like the SFMS, it has been found to be an appropriate measure for investigating the motivational drivers of sports consumption across different sports and contexts. However, unlike the SFMS, the MSSC has been used to investigate the motivations underlying the consumption of both esports and gambling, meaning that it is more likely to constitute an

appropriate measure for investigating esports betting. For a full discussion of extant measures assessing motivations for sports consumption, see Hamari and Sjöblom (2017).

Esports and betting

For purposes of this article, esports betting refers to wagering on any type of esports or video gaming event, irrespective of currency used (e.g. fiat currency, skins), licenced versus offshore site, and professional versus amateur competition. Furthermore, this article specifically investigates wagering behaviours and preferences as they relate to esports events and competition, and not gambling specific to video game play (e.g. loot boxes, casino/themed games in video games, in-game PvP gambling activities, or skins betting). While these gambling phenomena are all tied to video games, a focus on wagering parallels research of behaviours that centre upon the spectatorship of competition.

This focus on esports betting is also seen with traditional bookmakers, who are increasingly establishing esports markets within their offerings and sponsoring major esports events (Byrne, 2019). Meanwhile, the relationship between gambling and esports is a complex one. In esports, there are ongoing debates on the relationship between esports and sports, particularly in how the terms are defined (Jenny et al., 2017). This has a particular impact on betting markets, as many jurisdictions differentiate games, events and sports under different regulatory structures (Owens, 2016). And the rapid growth of esports, combined with its grassroots nature, does not exist within the same cohesive governance that is present for many sports (e.g. Fédération Internationale de Football Association for football, or the National Basketball Association for basketball; Dos Reis, 2017). Thus, potential game integrity issues (such as match-fixing or other forms of cheating) threaten gambling market integrity needs, and esports spectators do not always recognise the severity of integrity issues (Abarbanel and Johnson, 2019). While a significant portion of the esports betting market is still conducted in the opaque offshore markets (Eilers & Krejcik, 2018; Juniper Research, 2018), there is now a burgeoning field of research into esports betting behaviours, establishing a foundation for further research.

Early research in the field found that US esports fans were twice as likely to have gambled online than the average US-based Internet user. In addition, one-third of US esports spectators had gambled (measured across all gambling games) more than a few times per week in the prior year (Newzoo, 2016). We note, however, that these findings were published by market researchers and must be viewed with caution due to the lack of methodological transparency. However, given the lack of comparable academic research, they provide an indication of gambling habits in the contemporary esports environment. In another early survey of US esports bettors, Grove (2016) found that esports event wagering was the dominant form of gambling, followed by casino-style wagers using virtual items from video games (e.g. skins). A later study used a global reach, finding that esports bettors typically placed wagers on two different sites, with the most popular sites being traditional bookmakers (Grove and Abarbanel, 2016).

Existing research has shown that betting on traditional sports is influenced by both experiential and economic motives (Humphreys et al., 2013). Many of the same motives that influence fan spectatorship also influence sports bettors, such as closely matched games between high-quality opponents (Humphreys et al., 2013). Recent

market research has also found that the ability to bet on sports drives TV spectatorship, with sports bettors most interested in placing wagers on championship games and teams they follow (Bridge, 2019).

Esports bettors have been found to have higher involvement in gambling than sports bettors, demonstrating higher gambling involvement (e.g. higher frequency of play, greater number of games and platforms used), and are more likely to use unlicensed gambling sites (Gainsbury et al., 2017).

A 2017 report from the UK Gambling Commission estimated that 58% of esports bettors were men, and the predominant age group for esports betting was 25 years to 34 years (Gambling Commission, 2017). It is of note, however, that this report did not include adolescent respondents. A 2018 UK Gambling Commission study on youth gambling behaviour found that 3% had placed wagers using skins acquired from computer or app games, though the specific form of wagering was not specified (Gambling Commission, 2018).

Finally, research into associations between video gaming and gambling behaviours has produced mixed results. While several studies have found significant relationships between video gaming and gambling (Gainsbury et al., 2016; Kim et al., 2014), others have found that gambling may not be particularly associated with video game consumption (King et al., 2012; Forrest et al., 2016).

Macey and Hamari (2018) investigated the relationship between video gaming behaviours, esports spectatorship behaviours, and gambling behaviours, with a focus on problematic gambling. They found that esports spectatorship (measured by frequency of spectatorship, time and monetary spend) was associated with increased online and video game related gambling. Subsequent research builds upon this, finding that betting is the most popular online gambling activity among esports spectators (Macey and Hamari, 2019).

The research described earlier, justifies the formulation of a research model that includes interactions between esports spectatorship motivations, demographic characteristics, consumption of digital media and participation in established forms of gambling.

The research model

Stemming from the earlier discussion, the research model of this study is operationalised to investigate how individuals' consumption of video games, esports and gambling, in addition to demographic factors, are associated with esports betting behaviour. Moreover, as the motivations of esports spectating are pertinent to both esports consumption and esports betting, the model also investigates its association with the esports consumption and esports. This research utilises an involvement model (Binde, 2013) as, while both motivational factors and gambling involvement variables are included, the latter are more numerous.

Consistent with the discussion in the 'Background' section, we hypothesise that the MSSC will be positively associated with the consumption of esports (H1), esports betting (H2) and the use of dedicated esports betting sites (H3).

In addition to the established relationship between sport consumption and gambling, previous research has shown that increased engagement with esports is associated with

increased gambling connected to esports (Macey and Hamari, 2018). Therefore, the consumption of esports is expected to be positively correlated with both esports betting (H4) and the use of dedicated esports betting sites (H5).

Previous research has also shown that the spectating of esports has been associated with young males (Hamari and Sjöblom, 2017; Macey and Hamari, 2019), above average levels of educational attainment and household income (PwC, 2016). As such, the consumption of esports is expected to negatively correlate with age and to be associated with males, higher levels of education and higher levels of household income (H6).

The consumption of video games has been increasing as wider cultural acceptance of gaming has spread (Kuo et al., 2017; Muriel and Crawford, 2018) and, despite increasing numbers of women playing games, existing research has shown that it is positively associated with young males located in urban areas and with access to newer technologies (Borowiecki and Prieto-Rodriguez, 2015). The widespread consumption of video games – 60% of Americans play video games daily, with almost every household having a dedicated gaming device (ESA, 2018) – suggest that although game play is associated with younger males, it is unlikely to correlate with other demographics (H7).

Consumers of video games in general, and esports in particular, are younger than average demographic (Borowiecki and Prieto-Rodriguez, 2015; Seo, 2013), while gambling activities associated with these media are almost exclusively facilitated online (Macey and Hamari, 2018, 2019). As such, demographic characteristics associated with gambling consumption are likely to mirror those of (predominantly) online gamblers, rather than traditional profiles (H8), as seen in the work of Gainsbury et al. (2017).

Due to the prevalence of esports betting in the online context (Macey and Hamari, 2019), it is expected that esports betting participants will display the following similar characteristics: younger males, higher levels of education and household income (H9). It is not expected that any correlation will be found in regard to marital status. As the use of dedicated betting sites is dependent upon actual participation in esports betting activities, it is expected that the same demographic characteristics will be correlated with the use of dedicated sites (H10).

Esports is fundamentally characterised as competitive video game play (Hamari and Sjöblom, 2017). Therefore, it is expected that increased consumption of video games will also be positively associated with increased betting on esports (H11), as has been found in previous research (Macey and Hamari, 2018).

Previous works have also shown that as gambling involvement grows, the number of different activities and channels of participation also grows (Gainsbury et al., 2012; Macey and Hamari, 2018). As such, it is expected that increased participation in general forms of gambling will be reflected in increased esports betting (H12).

The path model used to investigate the research question stated earlier is presented below (Figure 1).

Method

A survey was used to collect data, with participants recruited from an online panel maintained by the market research company Qualtrics. The survey remained open during the period 11–19 April 2018. Due to the nature of the research, the following inclusion

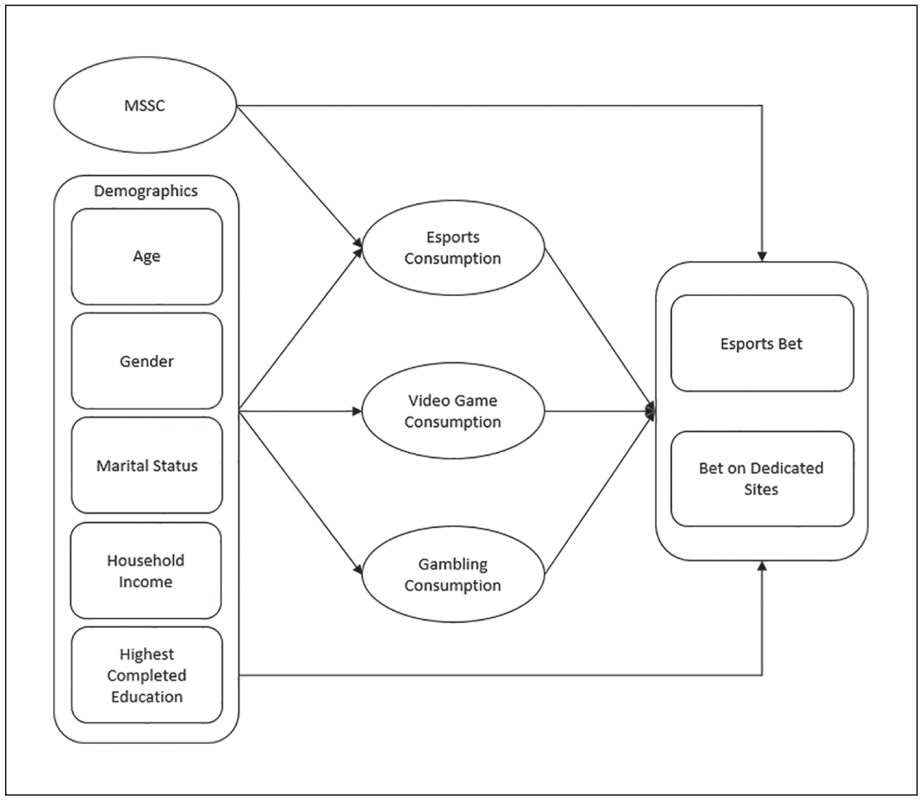

Figure 1. Research model.

criteria were stipulated that participants be aged 18 years or older and that they had played video games or watched esports at least once in the previous 12 months. The principles of informed consent were followed, with potential participants being advised that participation was entirely voluntary and that it could be withdrawn at any time. The informed consent document notified respondents that the survey was about video games, game play, spectating and gambling. Participants were required to sign a consent form prior to accessing the survey. No incentive was provided for completing the survey. Ethical approval for this study was provided by the Institutional Review Board at (University blinded for review).

A total of 2035 responses were received, 400 incomplete responses were removed, and a further 230 were removed as they did not meet the inclusion criteria. A total of 37 univariate and multivariate outliers were also removed, resulting in a finalised dataset of 1368 records. Participants were asked to complete items measuring the following demographic information: *Age, Gender, Marital Status, Annual Household Income* and *Educational Attainment*. Age was recorded as a continuous variable, meaning there were no pre-defined brackets or ranges that could be selected. Both Gender and Marital Status were nominal items, with the following response options: male, female, other/non-binary; single, married, unmarried (cohabiting), separated, divorced, widowed, other.

Annual Household Income and Educational Attainment were ordinal variables, response options were: from 'under US$20,000' to 'over US$1,000,000'; and from 'Less than High School/Secondary/Equivalent' to 'Graduate Degree'.

Measures

In addition to the demographic information listed earlier, the survey included items measuring the consumption of video games, esports and gambling activities. Motivations for consuming esports content were also collected through the inclusion of an esports-adapted MSSC (Trail and James, 2001). This research employs the updated version of the MSSC (Trail, 2012), a previously validated scale used in general terms and in reference to specific sports from Wrestling (Schaeperkoetter et al., 2016) to South African soccer (Stander and van Zyl, 2016). It has also been adapted for use in a wide range of sporting contexts, such as disability sports (Cottingham et al., 2014) and esports (Hamari and Sjöblom, 2017). The MSSC is a 31-item measure, with items being rated on a five-point Likert-type scale, possible responses range from 'strongly disagree' (1) to 'strongly agree' (5). The scale utilises 10 sub-constructs to assess consumer motivations and has been designed for use in multiple contexts. In order to reflect the focus of this research, 'esports' was inserted in the relevant fields throughout the scale, as per the manual (Trail, 2012). An example of an updated item is 'An individual player's "sex appeal" is a big reason why I watch esports'. In the structural model here, MSSC will be utilised as a single latent variable, rather than 10 distinct constructs. A Cronbach's Alpha value of .956 established the internal consistency of the scale.

The consumption of video games was assessed using a formative variable, *Video Game Consumption*, consisting of items measuring frequency of video game play, average hours spent per gaming session and the social context of game play. All questions were asked in reference to video game play habits over the preceding 12 months.

In addition to video games, the model also included items that constituted the independent variable *Esports Consumption*. As with any sporting activity, consumption can take the form of spectating or participating. As this research was concerned solely with spectating behaviours, all items explicitly asked respondents to consider the questions in respect to watching esports. Similar to *Video Game Consumption, Esports Consumption* utilised a formative variable consisting of several distinct aspects: prior year frequency of watching esports, average hours spent watching esports per session, the social context of watching esports and the type of esports broadcasts (live or pre-recorded) consumed.

Regarding the independent variable *Gambling Consumption*, participants were asked to provide information regarding their participation in gambling activities in the previous 12 months, no distinction was made between different forms of gambling (online versus offline, for example). Once again, consumption habits were assessed using a formative variable that included the following items: frequency of gambling, average hours spent per gambling session, and average dollar spend per gambling session.

Finally, the model included two dependent variables to specifically measure esports betting behaviour. The first, *Esports Bet* asked whether participants had wagered money on the outcome of an esports event in the past year, response options were yes, no and I cannot remember. The second dependent variable, *Esports Bet–Dedicated Site*, is an

ordinal variable measuring whether participants placed wagers through dedicated esports betting sites (e.g. Unikrn), general sportsbook providers (e.g. bet365), or both.

This study employs Structural Equating Modelling as the statistical techniques for analysing the data. SEM is a combination confirmatory factor analysis and multiple linear regression. In particular, we employ Partial Least Squares-Structural Equation Modelling (PLS-SEM analysed with SmartPLS 3 software package) which uses an iterative approach for maximising the explained variance of endogenous constructs, using a combination of multiple linear regression and confirmatory factor analysis, and more efficiently addressing the issue of multicollinearity in regression problems (Fornell and Bookstein, 1982; Wold et al., 1984). PLS-SEM is advisable when the model includes a combination of both formative and reflective latent variables and where the focus is on prediction rather than in trying to established the most fitting model (Chin et al., 2003; Hair et al., 2016). Descriptive statistics were produced using SPSS version 24 for Windows.

Results

Established methods for assessing validity and reliability are based on reflective constructs. However, the specified research model utilises formative constructs to measure consumption habits, meaning that standard practices are not applicable (Diamantopoulos and Winklhofer, 2001; Wang et al., 2015). Construct validity is thus established here using assessment of Variance Inflation Factors (VIFs). All VIF values except 1, were under 3, with the largest VIF value still under the standard threshold of 5, indicating that collinearity was not present and meaning that the constructs used were robust (Diamantopoulos and Siguaw, 2006; Hair et al., 2016). In the MSSC variable, 27 of the 30 items have outer VIF values lower than 3, all were under the threshold of 5.

Demographics

Participants ranged from 18 years to 80 years of age ($M=37.83$), with the majority reporting their gender as male (58.4%). Participants reported being either single or married at approximately equal rates, 35.1% and 37.9%, respectively, the majority (56.9%) earned less than US$50,000 per year per household, with a minority having completed a 2-year college/university degree or higher qualification (37.8%). Full details of demographic statistics are provided in Online Appendices A to E, with a summary table provided in Online Appendix F. Participants were overwhelmingly from the United States ($N=1152$; 97.9% of those who provided their nationality). The data sample included a further 21 nationalities, of which none totalled more than 0.2% of the sample.

The mean age in the sample is higher than in some similar studies investigating gambling, video game play, and spectatorship (e.g. Macey and Hamari, 2018, 2019), but is in line with others (e.g. Gainsbury et al., 2017). This sample is also more balanced in gender distribution (recent studies have ranged from 62%–91% male, for example), but represents lower income and education levels. Given the relative youth of this field, however, we note that there is not currently a baseline for what constitutes a truly representative sample.

Table 1. Media consumption frequencies.

	Play video games		Watch esports	
	Count	%	Count	%
Never	37	2.7	718	52.5
Less than once per month	61	4.5	81	5.9
1–3 times per month	189	13.8	187	13.7
Once per week	134	9.8	90	6.6
2 times or more per week	936	68.4	272	19.9
Total	1357	99.2	1348	98.5
Missing	11	0.8	20	1.5
Total	1368	100.0	1368	100.0

Table 2. Media consumption–average hours per session.

	Play video games		Watch esports	
	Count	%	Count	%
upto 1 hour	21	1.5	21	1.5
1 < 2 hours	323	23.6	193	14.1
2 < 3 hours	298	21.8	152	11.1
3 < 4 hours	142	10.4	94	6.9
4 < 5 hours	103	7.5	45	3.3
5 < 10 hours	137	10.1	64	4.6
10 < 15 hours	40	2.9	30	2.2
15 < 20 hours	15	1.1	7	0.5
20 < 25 hours	29	2.1	12	0.9
25 < 30 hours	5	0.4	3	0.2
30 < 35 hours	3	0.2	4	0.3
35 < 40 hours	8	0.6	1	0.1
40–45 hours	–	–	5	0.4
Missing	244	17.8	737	53.9
Total	1368	100.0	1368	100

Consumption measures

The majority of participants (68.4%) reported playing video games at least twice a week or more, with average play sessions of up to 2 hours (57%). The mean length of play sessions was 3.92 hours (Table 1).

Almost half (47.5%) of the participants reported watching esports, of whom 47.3% reported watching twice a week or more. Esports spectating mirrored video game consumption with the median average session length being 2 hours. The majority of respondents (58%) reported average spectating sessions of up to 2 hours, and the mean duration of sessions spent watching esports was 3.94 hours (Table 2).

Table 3. Average Spend Per Gambling Session.

Dollars ($)			Time (hours)		
	Count	%		Count	%
upto US$1	23	1.7	upto 1 hour	39	2.9
US$1	14	1.0	1 < 2 hours	165	12.1
US$2	12	0.9	2 < 3 hours	169	12.3
US$3	6	0.4	3 < 4 hours	101	7.3
US$4	0	0	4 < 5 hours	54	3.9
US$5–US$9	42	3.1	5 < 10 hours	59	4.3
US$10–US$14	77	5.6	10 < 15 hours	19	1.4
US$15–US$19	9	0.6	15 < 20 hours	3	0.2
US$20–US$29	125	9.1	20 < 25 hours	20	1.5
US$30–US$49	45	3.3	25 < 30 hours	4	0.3
US$50–US$99	103	7.5	30 < 35 hours	7	0.5
US$100–US$149	115	8.4	35 < 40 hours	4	0.3
US$150–US$199	15	1.1	40 < 50 hours	2	0.1
US$200–US$299	37	2.7	50 to 100 hours	30	2.2
US$300–US$399	13	1	Missing	694	50.7
US$400–US$499	1	0.1	Total	1368	100
US$500–US$999	21	1.5			
US$1000–US$5000	19	1.4			
Missing	692	50.6			
Total	1368	100			

In total, 718 respondents reported playing video games but not watching esports (52.5%), 37 reported watching esports but not playing video games (2.7%), and 613 (44.8%) reported both playing video games and watching esports within the previous 12 months.

The majority (52.1%) of respondents reported gambling at least once within the previous 12 months, however, a notable minority (approximately 13.5%) gambled once a week or more. Most participants reported average length of gambling sessions of up to 2 hours (55.3%, median: 2 hours). The mean length of gambling sessions was 7.06 hours. Participants reported spending between US$0 and US$5000 per session, with median spend at US$40 and mean spend at US$108.27 (Table 3). Online Appendix G shows reported gambling frequencies.

For the purposes of analysis, participants who answered 'I can't remember' for the *Esports Bet* item were coded as non-bettors. Of those who reported betting on esports, an overwhelming majority reported using only dedicated esports betting sites (71.74%), with a further 13.77% using both dedicated and general betting sites.

Figure 2 shows the total effects for the research model. For purposes of clarity, only statistically significant relationships are displayed. A table detailing all direct and indirect effects is provided below in Table 4.

The MSSC was found to positively correlate with esports consumption, as stated in H1, however, the path coefficient can be considered weak, $\beta = .187$, $p < .001$

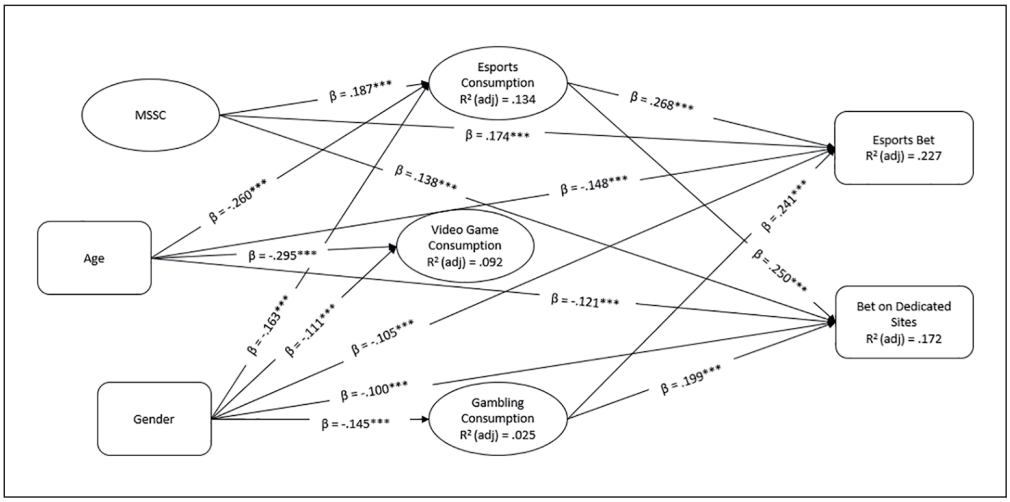

Figure 2. Path model showing total effects, significant relationships only.
***p = <.001.

(Cohen, 1988). Both H2 and H3 were also supported, as the MSSC was found to positively correlate with both esports betting and the use of dedicated sites, albeit with weak overall effects, ($\beta = .174$, $p < .001$ and $\beta = .138$, $p < .001$, respectively). The consumption of esports was also found to have positive correlations, of moderate strength, with both esports betting and the use of dedicated esports betting sites ($\beta = .268$, $p < .001$ and $\beta = .250$, $p < .001$, respectively), supporting both H4 and H5.

While the consumption of esports was found to be associated with younger participants ($\beta = -.260$, $p < .001$) and male gender ($\beta = -.163$, $p < .001$), no statistically significant relationships were observed with respect to marital status, annual household income, or highest level of educational attainment, in partial support of H6. As predicted, the consumption of video games was also associated with younger males, but no other demographic characteristics (H7).

Of all demographics, only gender was found to have a statistically significant relationship with the general consumption of gambling activities, meaning that H8 was unsupported: *Gender -> Gambling Consumption* $\beta = -.145$, $p < .001$.

As with H6, participation in esports betting was associated with younger males ($\beta = -.148$, $p < .001$ and $\beta = -.105$, $p < .001$, respectively), but no other demographic measure. Therefore, H9 was partially supported. H10 was supported, as the relationship between esports betting and demographic characteristics was replicated, almost exactly, in the use of dedicated esports betting sites.

Contrary to expectations, no statistically significant relationships were observed between the consumption of video games and esports betting activity, meaning H11 was not supported.

Finally, H12 was supported, with increased participation in general forms of gambling positively associated with increased betting on esports and the use of dedicated sites ($\beta = .241$, $p < .001$ and $\beta = .199$, $p < .001$, respectively).

Table 4. Direct and total effects.

	Direct			Total		
	β	T Stats	*p*	β	T Stats	*p*
Age -> Esports bet	–.057	2.521	.012*	–.148	6.692	<.001***
Age -> Esports bet dedicated sites	–.036	1.575	.115	–.121	5.573	<.001***
Age -> Esports consumption	–.257	9.91	<.001***	–same as direct–		
Age -> Gambling consumption	–.024	.8	.424	–same as direct–		
Age -> Game consumption	–.295	10.428	<.001***	–same as direct–		
Esports consumption -> Esports bet	.269	7.953	<.001***	–same as direct–		
Esports consumption -> Esports bet dedicated sites	.249	7.928	<.001***	–same as direct–		
Gambling consumption -> Esports bet	.239	7.843	<.001***	–same as direct–		
Gambling consumption -> Esports bet dedicated sites	.198	6.326	<.001***	–same as direct–		
Game consumption ->Esports bet	.052	1.813	.07	–same as direct–		
Game consumption -> Esports bet dedicated sites	.055	1.833	.067	–same as direct–		
Gender -> Esports bet	–.021	0.953	.341	–.105	4.534	<.001***
Gender -> Esports bet dedicated sites	–.026	1.168	.243	–.1	4.538	<.001***
Gender -> Esports consumption	–.159	6.437	<.001***	–same as direct–		
Gender -> Gambling consumption	–.145	5.808	<.001***	–same as direct–		
Gender -> Game consumption	–.111	4.276	<.001***	–same as direct–		
Highest education -> Esports bet	.02	0.836	.403	.023	0.842	.4
Highest education -> Esports bet dedicated sites	.019	0.818	.413	.021	0.819	.413
Highest education -> Esports consumption	.002	0.063	.95	–same as direct–		
Highest education -> Gambling consumption	.016	0.512	.609	–same as direct–		

(Continued)

Table 4. (Continued)

	Direct			Total		
	β	T Stats	*p*	β	T Stats	*p*
Highest education -> Game consumption	–.028	1.001	.317	–same as direct–		
Household income -> Esports bet	.008	0.341	.733	.03	1.158	.247
Household income -> Esports bet dedicated sites	.004	0.154	.877	.022	0.926	.355
Household Income -> Esports consumption	.031	1.139	.255	–same as direct–		
Household Income -> Gambling consumption	.053	1.775	.076	–same as direct–		
Household Income -> Game consumption	.007	0.24	.811	–same as direct–		
MSSC -> Esports bet	.122	4.254	<.001***	.174	6.721	<.001***
MSSC -> Esports bet dedicated sites	.089	2.926	.003**	.137	4.94	<.001***
MSSC -> Esports consumption	.193	5.255	<.001***	–same as direct–		
Marital status -> Esports bet	.019	0.78	.435	.008	0.315	.753
Marital status -> Esports bet dedicated sites	.01	0.368	.713	.001	0.019	.985
Marital status -> Esports consumption	–.02	0.667	.505	–same as direct–		
Marital status -> Gambling consumption	–.025	0.807	.419	–same as direct–		
Marital status -> Game consumption	.016	.539	.59	–same as direct–		

MSSC: Motivation Scale for Sports Consumption.
*$p < .05$; **$p < .01$; ***$p < .001$.

Discussion

Investigating relationships between the use of digital media associated with video games and gambling activities has revealed that as consumption of esports and general gambling increases, so does esports betting. However, consumption of video games was not associated with increased betting on esports. In addition, a MSSC motivations adapted for use in esports shows only weak predictive power in this context, while also demonstrating small, but statistically significant, associations with esports betting activity. The MSSC was positively associated with the consumption of esports (H1),

betting on esports (H2) and the use of dedicated esports betting sites (H3), meaning all three hypotheses are supported. However, the path coefficients were weak in magnitude, despite previous works finding that the MSSC is a good predictor of both sports consumption and sports gambling participation (Karg and McDonald, 2009; Lopez-Gonzalez et al., 2018; Trail and James, 2001). As such, it may not be the optimal measure for assessing motivations underlying esports consumption. This is further supported by the findings of previous studies which show that only a limited number of MSSC constructs exhibit statistically significant relationships in the context of esports consumption (Hamari and Sjöblom, 2017).

The finding that consumption of esports positively correlates with betting on esports (H4) mirrors established practices in traditional sports betting; increased consumption serves to build the knowledge base utilised in sports betting. In addition, there is ample evidence of sports fans demonstrating sentiment bias by betting on a positive result for their favoured team (Feddersen et al., 2017). Somewhat counter-intuitively, the reverse is also true. Some studies have found that fans may bet against their own team in order to lessen the blow of a negative result, a practice known as 'hedging' (Agha and Tyler, 2017). The concept of fandom may be a particularly strong driver for betting in the context of esports due to its robust and vibrant community, also potentially explaining the preference for the use of dedicated esports betting websites (H5), with many of these sites developed from within the community. This is in contrast to established sports betting companies, who may have only recently added esports lines to their books. As those who spectate esports are more familiar with the games, they may potentially look to sites that are specifically focused on these games, rather than a site that is designed for more general gambling/sports betting. Such behaviours support the perspective that esports consumers are more than simply players or spectators, and that there are numerous interrelated practices associated with the consumption of video game play (Seo and Jung, 2016).

The fact that only age and gender demographic items have statistically significant relationships with the consumption of esports (H6) serves to confirm the findings of previous research (Gainsbury et al., 2017; Hamari and Sjöblom, 2017; Macey and Hamari, 2019). Similarly, the consumption of video games is only associated with younger consumers (H7). These results tell us that consumption of media related to video games is becoming more mainstream as its reach extends across nearly all socio-economic markers, something which has been well documented by both academia and market research organisations.

The relationships of age and gender with consumption measures (H6 and H7) appears to confirm results of previous research, in that they suggest a stronger association with the consumption of esports and video games than that which is presented by market research organisations. It may be that this is a result of the eligibility requirements for this survey (participants qualified if they had gamed or gambled in the prior 12 months), but as other studies have had different criteria for inclusion it is unlikely.

Given that previous works have found that esports bettors are similar in demographic makeup to early adopters of online betting (Gainsbury et al., 2017), it was somewhat surprising that similar characteristics were not present in this study. It may be that as the consumption of digital media associated with both video games and esports becomes

ever more widespread, socio-economic distinctions are becoming less apparent, as discussed earlier.

The results of H9 and H10 conform to existing knowledge concerning participation in sports betting. Increased participation is associated with males, although esports betting has a less pronounced division than traditional sports betting (Gainsbury et al., 2017). In addition, it confirms that there is a significant, and fairly robust, association between the consumption of esports and wagering on esports events, as discussed in the 'Background' section.

Increased consumption of video games was expected to be associated with increased participation in esports betting activity (H11), however, no statistically significant relationships were observed. That the p values were in the region of .07 suggests that this finding may just be a characteristic of the data sample employed in this research, and as such it is worthy of further investigation. Conversely, it may be that games simply act as a mediator for esports betting, a relationship observed in previous research. In addition, this study looked at all forms of gambling related to video games, not solely esports betting (Macey and Hamari, 2018).

The statistically significant relationship between increased consumption other forms of gambling with betting on esports (H12) also reinforces findings from previous works (Gainsbury et al., 2012; Macey and Hamari, 2018). We can see, therefore, that the emergence of gambling activities associated with esports is neither novel, nor unexpected.

Implications

The findings of H1-3 suggest that the MSSC may not be the most appropriate measure for assessing motivational drivers of esports consumption. As such, it feeds into the ongoing discussion concerning the equivalence of esports to traditional sports (Jenny et al., 2017) and, while the competitive nature of esports is undeniable, it may be that the computer-mediated context of consumption fulfils different motivational needs for consumers.

An avenue for future study would be the assessment of the MSSC in the context of esports consumption. Indeed, the field would benefit from such work in relation to all extant measures. Such work would establish whether any existing scales are valid measures for esports, or if the development of a dedicated scale is required. Given the highly mediated nature of esports consumption, it may also be that motivations differ between online consumption and attendance at live events.

This research supports previous works that found stronger associations between the consumption of video games, spectating esports, gender, and age, than those presented in published market research and discussed in the 'Background' section of this work. Therefore, a valuable direction for future work would be to continue to build on consumer studies in order to establish a reliable picture of contemporary media consumers by market segment (e.g. video games, esports, other streams).

Given the established findings that betting appears to be a significant aspect of engaged esports fandom, it is no surprise to see similar relationships present in this sample. A potential avenue for future work could be to understand whether this behaviour is derived from similar motivations to traditional sports (e.g. Vicarious Achievement,

Drama, etc.) or as the result of video game consumption (e.g. self-perception of increased skill development leading to a preference for skill games rather than chance games).

Finally, the findings associated with H11 lend weight to a growing body of work that questions the traditional position that video game play is associated with increased participation in gambling (Delfabbro et al., 2009; Forrest et al., 2016).

Limitations

The most significant limitation of this study was the use of a questionnaire distributed to an online panel. Participants are self-selected, and this form of recruitment may oversample higher games, spectating and gambling involvement, particularly considering that the survey specifically sought those who had participated in video games or esports. As such, the results may not reflect the wider population and, consequently, lack generalisability. The limitations of survey-based research, indeed any form of data collection which relies of self-reported data, also extend to the potential for responses to be influenced by the participants' desire to be perceived favourably, or through inaccurate recollection. However, the use of a third-party organisation to recruit participants may also reduce the potential for self-selection bias to affect results. Indeed, using a third-party organisation in this case resulted in a sample that was more representative of wider society than many other recent works in the field.

The primary aim of this research is to investigate the ways in which the consumption of esports video content, video game play and gambling activities are related to participation in esports betting. As such, the eligibility criteria for participants were that they had played video games and/or watched esports within the prior 12 months. With this in mind, results here may not be applicable to people who bet on esports, but do not watch esports nor play video games.

This research also only investigated the relationships between betting and spectating esports when defined at the level of competitive video game play, and not within individual sub-genres. As such, a fruitful avenue for future study would be the comparison of consumption behaviours between different esports genres, such as First-Person Shooter (FPS) or Multiplayer Online Battle Area (MOBA) games. Considering the distinct structural characteristics of the games, the former has a much shorter and quicker rounds that the latter, there may be different betting behaviours associated with each.

This work utilised a version of the MSSC adapted for use in the context of esports consumption. While all amendments were made in accordance with the stipulations of the original measure, the predictive power was not as strong as had been anticipated. As such, it may be that the MSSC is not the optimal measure for assessing motivations underlying the consumption of esports.

Conclusion

This study examined how the consumption of video games, esports and gambling are associated with esports betting. The results demonstrate associations between spectating esports and betting on esports, a pattern also observed with respect to participation

in more established gambling activities. Contrary to the stated hypotheses, no direct association was observed between the consumption of video games and betting on esports. It may be that video games act as a mediator, as there cannot be esports without video games, yet there is no intrinsic aspect of game play that was associated with gambling behaviours. This finding builds on an existing body of research that questions such relationships in contemporary digital culture. However, the associations between spectating esports, participating in gambling and participation in esports betting mirror gambling behaviour in traditional sports betting. Although causality cannot be established, such findings serve to highlight the growing convergence of video gaming and gambling in digital media as a result of games and gaming culture being incorporated into novel contexts.

Finally, adapting the MSSC for use in the context of esports revealed that there is a potential need to develop a dedicated measure for assessing motivations for consuming esports. Such a measure is likely to provide a valuable contribution to theoretical discussions surrounding distinctions between traditional sports content and that of esports.

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Supplemental material

Supplemental material for this article is available online.

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PUBLICATION 4

GamCog: A measurement instrument for miscognitions related to gamblification, gambling, and video gaming

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GamCog: Adapting the Gambling Related Cognitions Scale (GRCS) for video game-related gambling

Joseph Macey and Juho Hamari

Abstract

"Gamblification" is a rapidly emerging form of media convergence between the more chance-based activity of gambling and the more skill-based activity of (video) gaming, for example in the competitive video gaming known as esports. The marriage of video gaming and gambling has been theorised as bringing about new forms of gambling-related cognitive processes in individuals and affecting the ways in which they approach and evaluate gambling situations. As such, a pertinent research problem is whether existing measurement instruments designed to identify gambling related cognitions can be employed in this new context and population, and if not, how they can be adapted. Therefore, in this study, we investigate the psychometric properties of Gambling Related Cognitions Scale (GRCS) and a series of items developed following a review of existing literature. We employ three separate datasets gathered from video game players who also gamble (N = 442; 391; and, 335). The results indicate that the GRCS is not a robust measure to use for video game players who gamble; the new GamCog measure was, therefore, developed to address this gap. The study implies that the most significant cognitive differences between video game players and the wider population are the ways in which concepts of skill and luck are perceived, potentially due to the sense of personal agency engendered by video games.

Keywords: Gamblification, Gambling, Virtual goods, Video games, Cognitive bias

1 Introduction.

Gambling has become increasingly normalised as part of contemporary western culture, with increased regulatory liberalisation a characteristic of recent years (Kingma, 2006; Markham & Young, 2015). This trend is evident in the "gamblification" of media spaces, an example being the convergence of video gaming and gambling which has become a prominent online phenomenon (D. King, Delfabbro, & Griffiths, 2010a; Lopez-Gonzalez & Griffiths, 2016; Macey & Hamari, 2018). The convergence of video gaming and gambling is usually associated with esports (Gainsbury, Abarbanel, & Blaszczynski, 2017), virtual items and currencies (Lehdonvirta, 2009; Hamari and Keronen, 2017) and the free-to-play business model (Gainsbury, Russell, King, Delfabbro, & Hing, 2016). Concerns about the potential effects of gamblified media have resulted in a debate about the moral, ethical, and legal status of gamblified products and services (Griffiths, 2018; King & Delfabbro, 2018; Martinelli, 2017).

Researchers in the field have theorised that the combination of skill-based video gaming and chance-based gambling may result in cognitions which differ from those endorsed by non-gaming gamblers. Examples of such potential cognitions can be found in respect to: the effect of gaming on perceptions of control over chance-based events (King, Ejova, & Delfabbro, 2012); the role of Locus of Control (Toprak, 2013); the desirability of gambling (Gainsbury *et al.*, 2015; Gainsbury, King, *et al.*, 2016); and manner of video game consumption (Gainsbury, et al., 2016).

Cognitions related to gambling have been shown to be heavily influenced by an individual's cultural background, and further reinforced through social connections such as family (Okuda, Balan, Petry, Oquendo, & Blanco, 2009). With this in mind, it appears that treating, measuring and understanding newly emergent forms of game-related gambling by simply utilising existing cognitive frameworks may prevent us from fully understanding these new

phenomena. For example, the role of skill development in video game play may serve to reduce superstitious beliefs, such as the influence of a “lucky” colour, or routine. Therefore, ways to measure cognitive processes related specifically to video game-related gambling are needed.

Several measurement instruments exist for identifying gambling-related cognitions, developed for use in clinical and non-clinical environments, and for specific gambling activities. However, the newly emergent activities of video game-related gambling have created a new context for participation, resulting in a gap in this space.

The primary aim of this research is, therefore, to investigate the psychometric properties of an existing instrument (Gambling Related Cognitions Scale) in order to investigate the validity and fit of the instrument in the context of video game-based gambling. Additionally, this work will investigate cognitions theorised to promote problematic gambling behaviour in video game players. An example of which would be that proficiency in playing video games engenders a false perception of mastery of electronic systems, including those where the outcome is defined by chance not skill, as in digital gambling (King et al., 2012).

By integrating these two aims, this work will refine GRCS, both in context of video game players who gamble and in relation to the newly-emergent activities associated with video game-related gambling. The study employs three distinct sets of survey data gathered from regular video game players who also gambled within the preceding 12 months (N = 442; 391; and, 335).

2 Background

2.1 Heuristics as part of the cognitive process

The human cognitive process utilises heuristics as a means to optimise decision-making in a range of situations, especially those in which information is unknown or other constraints are present (Tversky & Kahneman, 1974). However, this tendency to employ heuristics, essentially cognitive short cuts, can lead to erroneous beliefs, or cognitive biases. These cognitive biases have been identified as contributing to a range of behavioural problems and addictive behaviour, such as that of problematic gambling (Kouimtsidis *et al.*, 2007). Both Cognitive and Cognitive Behavioural interventions have been found to reduce gambling behaviours (Petry et al., 2006; Champine & Petry, 2010). Indeed, gambling is an area in which cognitive biases influence many interactions, whether they are part of problematic behaviour or not, for example research has found that temporal and psychological distance affects perceptions of probability (Kirby, Petry, & Bickel, 1999; Sagristano, Trope, & Liberman, 2002) and that reminders of previous wins shape attitudes to risk (Ludvig, Madan and Spetch, 2015). Despite the efficacy of CBT in particular, there have been calls for continued investigation of treatments and tools used to address problematic gambling (Rash & Petry, 2014).

Cognitive approaches to addiction highlight the role of maladapted beliefs, or cognitive biases, in the development and continuation of problematic behaviour (Kouimtsidis *et al.*, 2007). Cognitive biases are a natural product of the human reasoning process, occurring as a result of the tendency to employ heuristic models, or "rules-of-thumb", when making decisions, particularly in risky or uncertain situations (Kahneman, Slovic, & Tversky, 1982). While these heuristics are often beneficial to us in day-to-day situations, economising cognitive effort, they may also work against our well-being, such as in the case of

procrastination, or in over-valuing low-value options (Nicolle, Symmonds and Dolan, 2011). A case in point, and that which is the particular focus of the present study, is gambling.

The biases born out of heuristic thinking affect all aspects of the cognitive process, from reasoning and judgement to memory and recall and have been shown to play an important role in the development of problematic behaviour and addiction, whether it be in relation to substance abuse (Verdejo-Garcia *et al.*, 2018), Internet use (Davis, 2001), or video games (Forrest, King and Delfabbro, 2016b). Gambling is no exception, indeed, the study of cognitive biases associated with gambling is well established with work in the 1970s laying the groundwork for the later development of cognitive-behavioural approaches to addiction (Oldman, 1974; Langer and Roth, 1975).

Maladapted beliefs related to gambling are manifold, but predominantly concern the nature of chance and probability (Tversky and Kahneman, 1974), misattributing the outcome of events (Gilovich, 1983), mistaken recollections and superstitious beliefs (Toneatto, 1999). A large body of work has shown that problem gamblers endorse higher rates of cognitive biases than do non-problem gamblers (Goodie & Fortune, 2013), with those activities thought to contain elements of skill, such as betting or card games, potentially being more prone to the influence of maladapted beliefs (Cantinotti, Ladouceur and Jacques, 2004).

2.2 Measuring Cognitions Related to Gambling

A number of gambling-related cognitions have been identified by researchers, with several measures having been designed to screen for cognitive biases in gamblers (Delfabbro & King, 2015; Toneatto, 1999). However, there are a number of problems with these scales, ranging from methodological issues to potential suitability for use outside of clinical settings.

The Video Gaming Device Inventory (VGDI; Pike, 2002) was one of the first to be developed which specifically addressed cognitions related to gambling. Two sub-scales,

Interest and Effects, constitute the 45-item scale, with the latter sub-scale reflecting the fact that the primary aim of the author was to identify problem gamblers, rather than gambling-related cognitions. An issue which further limits the wider use of this scale is that it was developed specifically to assess gamblers who use Electronic Gaming Machines (EGMs), such as video poker, blackjack, and so on.

The Gambler's Beliefs Questionnaire (GBQ; Steenbergh, Meyers, May, & Whelan, 2002) is a 21-item scale comprised of two sub-scales: Illusion of Control, and Luck/Perseverance. The first of these sub-scales addressed beliefs about skill and knowledge related to gambling, whilst the second assessed a range of behavioural patterns associated with gambling. The GBQ has been found to perform well in a number of studies, however, the two constructs overlap and no reliability indices were reported by the authors.

A further measure divided into constructs addressing perceptions of skill and luck is the Gambling Cognitions Inventory (GCI; McInnes, Hodgins and Holub, 2014), once again the sub-scales contain theoretically diverse items. Furthermore, the GCI is said to focus solely on the cognitive distortions around gambling and does not include gambling-related cognitions which are more general in scope. As such, it may be that the measure is more suited for clinical assessment than for use in more general populations or in research.

The Gambling Related Cognitions Scale (GRCS; Raylu & Oei, 2004) is a 23-item measure which was specifically designed to be used in non-clinical settings. It consists of five sub-scales: Illusion of Control (IC); Gambling Expectancies (GE); Inability to Stop Gambling (IS); Predictive Control (PC); and Interpretive Bias (IB). Three of which (IC, PC, and IB) address categories proposed by Toneatto et al. (Toneatto *et al.*, 1997) and which are specifically related to gambling, whilst the final two (GE and IS) are wider in scope, addressing aspects of personal control and motivations to gamble. The authors acknowledge

high levels of inter-factor correlation, as with GCI, but found sufficient unique variance to justify retaining the conceptually-discrete factors (Raylu and Oei, 2004).

As can be seen above, a number of measures exist which have been designed to investigate cognitions related to gambling (see table 1, below, for a summary of measures), however there are some common issues which serve to limit their potential use. First, many of the extant measures utilise a one- or two-factor model, often grouped around perceptions of skill and luck. Indeed, the role of luck, or more specifically the ideas surrounding the concept of luck, was a major focus of the Gambler's Beliefs Questionnaire (Steenbergh et al., 2002), one of the first attempts to create a measure by which cognitions related to gambling could be assessed. In addition, the authors of the Gambling Related Cognitions Scale (Raylu & Oei, 2004) noted a high correlation between constructs they labelled "predictive control" (PC) and "Illusion of Control" (IC). A higher order construct was theorised as potentially accounting for this relationship, however, it can be considered to be yet another example of the fundamental division between skill and luck. The common theme of "control" in the two constructs PC and IC refers to the attempts of gamblers to influence the outcomes of gambling events. Examination of the individual items constituting these constructs reveal that two distinct ways in which attempts are made to influence outcomes: the rational, via the development of skill and knowledge; and the irrational, through superstition and the acquisition of luck. The fact that these factors contain theoretically diverse items, meaning that they fail to meet face validity, a problem shared by other extant measures. The second issue limiting potential use is that several of the scales attempt to address a specific type of gambling activity, or are designed for use only in clinical settings, and therefore, their applicability in a range of gambling-like contexts may be limited.

Table 1: Structure of Existing Measures Assessing Cognitions Related to Gambling

Name of Measure	*# of Items*	*# of Factors*	*Name of Factors*	*Source*
The Video Gaming Device Inventory (VGDI)	45	2	Interests Effects	Pike, 2002
The Gambler's Beliefs Questionnaire (GBQ)	21	2	Illusion of Control Luck/Perseverance	Steenbergh, Meyers, May, & Whelan, 2002
Gambling Cognitions Inventory (GCI)	33	2	Skill and Attitude Luck and Chance	McInnes, Hodgins and Holub, 2014
The Gambling Related Cognitions Scale (GRCS)	23	5	Illusion of Control Predictive Control Interpretive Bias Gambling Expectancies Inability to Stop Gambling	Raylu and Oei, 2004

The primary aims of this research are: to investigate the suitability of existing measures for identifying gambling-related cognitions in respect to a population of video gamers who gamble, and to supplement the existing measure with new items in order to create a robust measure for use in this specific population. In accordance to the review above; the wider scope of the GRCS (Raylu and Oei, 2004), means that it is the preferred instrument for use in this study. Furthermore, the GRCS has been validated cross-culturally and in respect to pathological measures. Finally, the authors explicitly called for it to be validated in the context of specific gambling activities and distinct populations (Raylu and Oei, 2004).

2.3 Video Game-Related Gambling.

Gambling connected to video games is often associated with esports (Gainsbury, Abarbanel, & Blaszczynski, 2017; Macey & Hamari, 2018), where it takes the form of sportsbook-style betting on the outcome of matches and tournaments, or of fantasy esports.

The range of gambling activities associated with video games is, however, more substantial than simple betting, it is an area which continues to grow and develop[1]. In addition to

[1] An example of the constantly changing context is provided by the increasing regulation of loot boxes, see Macey and Hamari (2019), and Griffiths (2018) for detailed summaries.

established forms, such as sportsbook betting and fantasy sports mentioned above, there are emergent activities which have land-based analogues, one example being skins lotteries which are a form of sweepstake/jackpot-style lottery. The use of particular mechanics in contemporary digital games has also led to concerns about the promotion of gambling and gambling-like behaviours. The most contentious example of which are loot boxes, which have been likened to scratch cards and slot machines, and have been associated with problematic gambling behaviours (Macey & Hamari, 2019; Zendle & Cairns, 2018). Truly novel forms of gambling have also emerged from the video game community, ones such as crash betting which have no analogues in established forms. See Macey & Hamari (2019) for a full summary of these activities. Within video games we can find simulated gambling, i.e. where a gambling game, such as poker or roulette, forms part of the main game, usually in the form of a mission or a mini-game (King et al., 2010a). Also present within games is player-led emergent gambling, as has been seen in the game *Runescape* (Pips, 2013), among others. Finally, there are Social Network Casino games (SNCs) which offer simulated gambling to players using the Free-to-Play (F2P) business model (Gainsbury, Russell, *et al.*, 2016). Whether or not all these activities constitute gambling according to legal definitions, they highlight the fact that video game-related gambling is considerably more nuanced than simply transferring existing gambling activities to a new context.

The question of whether existing measures, used to identify cognitions in established gambling activities, are valid for the newly-emergent practices associated with gambling related to video games has significant implications. The first of which is screening for cognitions in at risk populations (Petry & Blanco, 2013) and, second, for the potential efficacy of treatments such as CBT (Rash & Petry, 2014). It especially pertinent when considering the fact that for video game players, participation in gambling is lower than in the wider population, but rates of problematic gambling are higher (Macey & Hamari, 2019).

3 Method

The aim of this research is twofold: first, to examine whether the GRCS constitutes a robust measure in regard to a newly emergent phenomenon, that of video game-related gambling, in a population of video gamers (stage 1); second, to explore the potential to supplement the GRCS with additional items related to cognitions concerning skill and luck (stage 2); and finally, additional items related to cognitions derived from the consumption of video games (stage 3). This research will then bring together the finalised constructs together, and will conduct a final assessment of the overall validity and reliability of the consolidated scale (stage 3). All analysis was conducted using SPSS and AMOS versions 25. This research was conducted in accordance with all relevant ethical guidelines of the University and conforms to the ethical standards of the APA.

3.1 Participants and Procedure

The target population is video game players who also gamble, while there is little existing research in this area, recent works allow us to outline certain characteristics which can be used to identify this population. Video gamers who gamble tend to be young males who often gamble using multiple channels, primarily online (King, Delfabbro and Griffiths, 2010; Forrest, King and Delfabbro, 2016a; Sally M. Gainsbury, Abarbanel and Blaszczynski, 2017; Macey and Hamari, 2018). Furthermore, they are not limited to any particular region or country, irrespective of local laws which may restrict access to traditional gambling products (Macey and Hamari, 2019).

Three separate datasets were collected, with each being randomly assigned for use in a single stage (as described above), they were each named according to the stage in which they were used (e.g. “dataset 1”, “dataset 2”, and “dataset 3”). For all datasets, a link was posted with

text which detailed the aims of the study, funding, and eligibility criteria. No geographical restrictions were applied, although the survey was only available in English. Responses were received from across the globe, all three datasets included responses from every continent, with over 90 different nationalities being represented in total: dataset 1 (70); dataset 2 (49); and dataset 3 (68). The top three nationalities represented in the data were USA (14.96%), the UK (7.91%), and India (5.13%).

In order to participate respondents had to have both played video games and gambled at least once within the previous 12 months. Furthermore, respondents had to be at least 18 years of age, or to have permission from their legal guardians to participate in the research. The surveys included a filter question which asked participants to select a specific answer, those who failed to respond appropriately were removed from the sample

Datasets 1 and 3 were collected at different points in August 2019, via an online survey, with participants being recruited through the online service Pollfish, with ineligible respondents being disqualified in real-time. Those who failed the filter question were also disqualified before completing the survey. In total the datasets comprised 442 and 335 responses, sets 1 and 3, respectively.

Respondents in dataset 1 were predominantly male, 63.6%, with 33.5% being under 30 years of age. They reported being regular game players, 78.1% played once a week or more, while 50%, 47.5%, and 35.1% reported participating in offline gambling, online gambling, and video game-related gambling once a week or more, respectively.

In regard to dataset 3, 57.8% reported being male, and 36.7% were aged 30 or under. Once again, the respondents can be categorised as regular gamers, with 80.9% reporting playing once a week or more, while 43.3%, 48.1%, and 19.6% reported participating in offline gambling, online gambling, and video game-related gambling once a week or more, respectively.

For dataset 2, participants were recruited using an online survey, published on various social media sites and discussion forums dedicated to video games and esports. In order to encourage participation, valid respondents were offered the option of taking part in a prize draw to win one of five $50 gift vouchers.

In total, 2,397 responses were received, incomplete responses and those that failed to answer the question correctly were removed from the final data set, along with those respondents who reported that they had not gambled in the preceding 12 months. After filtering, the final dataset consisted of 391 records.

The finalised dataset 2was skewed towards young, male respondents, with 85.7% of respondents aged under 30, 93.4% were male. In regard to consumption habits, 98.2% reported playing video games at least once a week, 13.1% gambled offline at least once a week, 18.7% gambled online, and 21% participated in video game-related gambling at least once a week.

3.2 Criteria for Psychometric Validity

Hu and Bentler (1998) proposed the use of two indices: SRMR and one of either NNFI (TLI), CFI, GFI, or RMSEA. Kline recommends a more robust approach which advocates reporting χ^2, p-value, degrees of freedom, RMSEA, SRMR, and CFI (Kline, 2011). Given that Kline's recommendation incorporates that of Hu and Bentler, this work will adopt this approach. PCLOSE is the p-value associated with RMSEA and will also be reported. Additionally, the parsimony-adjusted CFI value (PCFI) will also be reported. Finally, as χ^2 is sensitive to sample size, especially when the sample exceeds 200, the normed χ^2 (χ^2/df; Wheaton, Muthén, Alwin, & Summers, 1977) will also be reported. The following cut-off values (table 2) are commonly accepted, however, as they are sensitive to both sample size and the number of variables, they are to be used as a guideline only.

Table 2: Goodness-of-fit Indices

Index	*Cut-off values/Thresholds*	*Source*
χ^2/df	< 3 good < 5 good	(Kline, 2011) (Wheaton et al., 1977)
CFI	> .95 very good > .9 acceptable	(Hu & Bentler, 1998); (Schreiber et al., 2006)
PCFI	No commonly agreed cut-off, but > 0.5 = acceptable	(Mulaik et al., 1989) (Hooper, Coughlan, & Mullen, 2008)
SRMR	< .08	(Hu & Bentler, 1998)
RMSEA	< 0.01 excellent < .05 good < .08 fair > 0.1 unacceptable	(MacCallum, Browne, & Sugawara, 1996)
PCLOSE	> 0.05	(Kenny, 2012)

Legend: $\chi 2/df$ = chi-squared divided by degrees of freedom; CFI = Bentler Comparative Fit Index; PCFI = CFI adjusted for parsimony; SRMR = Standardized Root Mean Square Residual; RMSEA = Root Mean Square Error of Approximation; PCLOSE = probability that the model is a close fit.

After goodness-of-fit has been established the next stage is to ensure that the proposed model structure meets the accepted criteria for reliability and validity. Convergent validity is established if the Average Variance Explained (AVE) of a factor is greater than .5, Discriminant Validity is established if both the Maximum Shared Variance (MSV) is less than the AVE and the square root of the AVE is greater than the absolute value of inter-factor correlations. Reliability is established when the Composite Reliability (CR) value is greater than .7 (Hair *et al.*, 2006). Finally, Cronbach's alpha is calculated for the overall scale and each of the sub-scales in order to assess internal consistency, commonly accepted cut-off values are as follows: $\alpha < .5$ = unacceptable; $.5 \leq \alpha < .6$ = poor; $.6 \leq \alpha < .7$ = questionable; $.7 \leq \alpha < .8$ =acceptable; $.8 \leq \alpha < .9$ = good; $.9 \leq \alpha$ = excellent (DeVellis, 2012).

3.3 Instrumentation

The GRCS (Raylu and Oei, 2004) is an established measure consisting of 23 items, rated on a Likert-scale, ranging from 1 = "strongly disagree", to 7 = "strongly agree". The GRCS comprises of five sub-scales: Gambling Expectancies (GE); Illusion of Control (IC); Predictive Control (PC); Inability to Stop Gambling (IS); and, Interpretive Bias (IB). Following a literature review, a number of supplementary items were included in addition to

the GRCS. These items were selected as they were found to address issues not covered by the GRCS, most notably in relation to the perception of skill and beliefs about luck.

A full list of supplementary items, and their sources, can be found in appendix A.

4 Stage 1. Testing the GRCS in a Sample of Video Gamers.

4.1 CFA of Gambling Related Cognitions Scale

A Confirmatory Factor Analysis (CFA) for the original, five-factor, GRCS was conducted using a sample of video gamers who reported gambling in the preceding 12 months (dataset 1). The model used the "Maximum Likelihood" estimator.

4.1.1 Model Fit.

The results of the model fit indices were: χ^2 = 681.362, DF = 199; χ^2/DF = 3.424, p = < .001, CFI = 0.92, PCFI = 0.792, SRMR = .0508, RMSEA = .074, and PCLOSE = < .001. As with the χ^2 and p values of the model, PCLOSE is likely to be affected by the sample size as it is considered "large" and, therefore, will always return statistically significant values, as such it should be disregarded in favour of other indicators (Marsh, Balla and McDonald, 1988; Kenny, 2012). χ^2/DF, RMSEA, and CFI are within the range of values showing an acceptable model fit, while the PCFI and SRMR can be considered good. However, it must be noted that reasonably large sample sizes often result in inflated χ^2 value, and making it unlikely to produce non-significant results (Marsh, Balla and McDonald, 1988; Kenny, 2012).

4.1.2 Reliability and Validity

Cronbach's α (0.95) suggests a good level of internal consistency for the overall scale. Of the five sub-scales, 4 had moderate to high reliability (GE α = .882; IS α = .899; PC α = .822; and IC α = .833), while one (IB) was very low, with an α of .638. This final issue is further emphasised by the fact that the composite reliability value for IB is less than .7 (.641).

There were a number of significant concerns relating to discriminant validity as the square root of the Average Variance Extracted (AVE) values was less than the absolute value of (at least) one correlation with another factor all five factors. In addition, the AVE for two factors, PC and IB, was less than the Maximum Shared Variance (MSV).

Finally, there are also concerns about convergent validity as the AVEs for 2 factors, (PC, and IB) were less than .5: .446 and .378 respectively. Full validity and reliability information is provided below in table 3, factor loadings and factor correlations are provided in tables 4 and 5, respectively.

Table 3: Validity and Reliability Matrix for CFA of GRCS

						Factors				
		CR	*AVE*	*MSV*	*MaxR(H)*	*GEx*[1]	*IoC*[1]	*PC*[1,2,3]	*ItSG*[1]	*IB*[1,2,3,4]
	GEx[1]	0.885	**0.65811**	0.875	0.892	**0.811**				
	IoC[1]	0.836	**0.561**	0.861	0.838	0.803***	**0.749**			
Factors	*PC*[1,2,3]	0.827	**0.446**	1.118	0.838	0.864***	0.928***	**0.668**		
	ItSG[1]	0.9	**0.643**	0.693	0.908	0.774***	0.832***	0.741***	0.802	
	IB[1,2,3,4]	**0.641**	**0.378**	1.118	0.661	0.936***	0.867***	1.057***	0.742***	**0.615**

Legend. [1]Discriminant Validity (DV) concern: square root of the AVE for factor is less than its correlation with other factor(s); [2]DV concern: AVE for factor is less than MSV; [3]Convergent Validity concern: AVE is less than .5; [4]Reliability concern: CR is less than .7; *** $p < 0.001$

Table 4: Factor Loadings for GRCS CFA

Factor	Item	Std Loading	p value
GEx	GEX4	0.732	< .001
GEx	GEX3	0.829	< .001
GEx	GEX2	0.865	< .001
GEx	GEX1	0.812	< .001
IoC	IOC4	0.757	< .001
IoC	IOC3	0.78	< .001
IoC	IOC2	0.749	< .001
IoC	IOC1	0.707	< .001
PC	PBC3	0.607	< .001
PC	ICL1	0.552	< .001
PC	PDC3	0.661	< .001
PC	PDC2	0.664	< .001
PC	PDC1	0.742	< .001
PC	PBC4	0.757	< .001
ItSG	ISG5	0.856	< .001

ItSG	ISG4	0.785	< .001
ItSG	ISG3	0.806	< .001
ItSG	ISG2	0.698	< .001
ItSG	ISG1	0.854	< .001
IB	INB3	0.483	< .001
IB	INB2	0.654	< .001
IB	INB1	0.689	< .001

Table 5: Factor Correlations for GRCS CFA

Correlation			Estimate	P value
GEx	<-->	IoC	0.803	< .001
GEx	<-->	PC	0.864	< .001
GEx	<-->	ItSG	0.774	< .001
GEx	<-->	IB	0.936	< .001
IoC	<-->	PC	0.928	< .001
IoC	<-->	ItSG	0.832	< .001
IoC	<-->	IB	0.867	< .001
PC	<-->	ItSG	0.741	< .001
PC	<-->	IB	1.057	< .001
ItSG	<-->	IB	0.742	< .001

4.2 Analysis and Discussion

The GRCS does not appear to be an optimally fitting measurement model in the context of video game players who gamble, despite the model fit indices being considered acceptable. This is due to the significant number of problems with: convergent validity (two of five factors), discriminant validity (five of five factors), and composite reliability (one of five factors). A final issue is the high level of inter-factor correlation present in the model: notable examples are correlations between PC and IB (1.057), GE and IB (.936), and between IC and PC (.928), while the correlations between PC and GE, and between IC and IB also exceed the threshold of .85 (Kenny, 2012), please see table X. Of the five factors none proved to be robust, as all failed tests of discriminant validity and high levels of inter-factor correlation

were observed. The large degree of inter-factor correlation suggests that reorganising and consolidating the constructs is likely to prove beneficial, while the addition of further items relating to skill and chance may also offer more clarity.

5 Stage 2: Revising the GRCS scale with additional items – Developing GamCog (Part 1).

In stage 1 the Confirmatory Factor Analysis of the GRCS revealed a number of significant problems with the measure for a sample of video gamers who gamble, as such, analysis could not continue according to the planned structure. Accordingly, it was decided to pool the 23 GRCS items with eight additional items addressing cognitions related to luck and skill in gambling. Viable constructs could then be extracted by subjecting dataset 2 to exploratory factor analysis (EFA). CFA would then be performed on dataset 3 in order to explore the validity and reliability of the newly extracted constructs.

5.1 Exploratory factor analysis

Extracting factors based on Eigen values of more than 1 (K1 test; Kaiser, 1960) is a common approach when conducting EFA, examination of the data showed six factors with Eigen values over 1. However, extracting factors based on Eigen values has been shown to over-estimate the total number of factors (Fabrigar, Wegener, MacCallum, & Strahan, 1999). As such, the scree-test (Cattell, 1966) and Parallel Analysis (PA; Horn, 1965) have been proposed as alternative methods for determining the total number of factors to retain in EFA (Costello & Osborne, 2005).

An initial examination of the scree-plot showed two points of inflection, after the fourth and seventh factors (figure 1), thereby justifying the use of PA. Parallel analysis was setup using

the following criteria: 5,000 parallel datasets; 99th percentile confidence; principal axis/common factor analysis method; and that data was not assumed to be normally-distributed. PA indicated the presence of six factors which were extracted from the data using the principal axis factoring method with promax rotation. However, examination of the extracted pattern matrix showed there were several cross-loading and low-loading items.

A finalised scale should balance parsimony with representativeness, i.e. the total number of factors should be reduced while remaining representative of the underlying themes (Fabrigar *et al.*, 1999; Hayton, Allen and Scarpello, 2004). Given that the scree-test suggested a break point after four factors it was decided to examine the potential for a four-factor solution: once again a principal axis factoring with promax rotation was performed on section 1 of the split sample, with a Kaiser-Meyer-Olkin (KMO) value of .908 suggesting that factor analysis will yield both distinct and reliable factors (Hutcheson and Sofroniou, 1999). Relationships between variables were demonstrated by a p value of < 0.001 for Bartlett's test of Sphericity. After removing cross-loading and low-loading items, those under .32 (Vignoles *et al.*, 2016), four factors with at least five items each were revealed. The full pattern matrix is provided in appendix B.

6 CFA of Four Factor Model

A confirmatory factor analysis was performed on the four extracted factors, using dataset 3, the model had a $\chi 2$ value of 705.642 with DF = 269.

6.1 Model Fit

The model fit indices were as follows: $\chi^2/DF = 2.623$, p = < .001, CFI = .911, PCFI = .817, SRMR = .0544, RMSEA = .07, and PCLOSE = < .001. The model, therefore, shows good fit values for all indices.

6.2 Validity and Reliability

Cronbach's α = .949 suggests a good level of internal consistency for the four-factor model. All four of the sub-scales also showed good internal consistency (IC α = .877; PGS[2] α = .881; IS α = .889; and BOG[3] α = .846). However, there several issues relating to both discriminant and convergent validity: the AVE of Factor IC was under .5 (.451); the AVE for factor IC was less than the MSV; the square root of the AVE for three factors, IC PGS, and IB, was less than correlations with other factors. See appendix C validity table.

In order to improve reliability two items with loadings of 6.5 or less were removed from Factor IC, ICL3= .363 and ICL1 = .64 (DeVellis, 2003). Consequently, the AVE of IC improved to .513.

An additional four items with loadings of .65 or less were removed iteratively, with validity and reliability being examined at each step: PBC3 (.57) was deleted from factor IC; PDC3 (.61) was removed from factor PGS; and GEX4 (.62) and INB1 (.65) were removed from factor BOG. After these deletions, all issues relating to discriminant validity were solved with the exception of factor IC, where the square root of the AVE was less than correlations with factors PGS and BOG. Of the six remaining items in factor IC, there were two which shared loadings of .67, IOC1 and IOC2. Examining these items, it was felt that IOC1 was very similar to IOC4, and as such was deleted, thereby removing the outstanding issues in regard to discriminant validity. Full validity and reliability information is provided in table 6, below, with factor loadings and factor correlations presented in tables 7 and 8, respectively.

With these changes made the revised χ^2 value was 344.827 with 129 degrees of freedom, the model fit indices were as follows: $\chi^2/DF = 2.673$, p = < .001, CFI = .943, PCFI = .795, SRMR = .0496, RMSEA = .071, and PCLOSE = < .001. With the exception of the overall p

[2] The factor originally named "predictive control" (PC) in the GRCS has been re-named "perceived gambling skill" (PGS). Please see discussion section.

[3] The factor originally named "gambling expectancies" (GE) in the GRCS has been re-named "benefits of gambling" (BOG). Please see discussion section.

value and PCLOSE, as discussed previously, all indices showed either good or acceptable model fit. That α = .943 continues to suggests a high level of internal consistency, as do the four the sub-scales (IC α = .866; PGS α = .882; IS α = .889; and BOG α = .852).

Table 6: Validity and Reliability Table for CFA of GamCog

						Factors			
		CR	AVE	MSV	MaxR(H)	IOC	PGS	ISG	BoG
Factors	IOC	0.868	0.569	0.566	0.874	0.754			
	PGS	0.885	0.609	0.609	0.898	0.750***	0.781		
	ISG	0.889	0.617	0.539	0.893	0.731***	0.635***	0.785	
	BoG	0.855	0.663	0.609	0.862	0.752***	0.780***	0.734***	0.814

Legend: *** p < .001

Table 7: Factor Loadings for CFA of GamCog

Factor	Item	Std Loading	p value
IOC	IOC3	0.778	< .001
IOC	ICL2	0.807	< .001
IOC	IOC2	0.654	< .001
IOC	IOC4	0.783	< .001
IOC	ICL4	0.741	< .001
PGS	INB2	0.809	< .001
PGS	IOC6_PS	0.856	< .001
PGS	IOC5_PS	0.826	< .001
PGS	PBC2	0.638	< .001
PGS	PDC1	0.755	< .001
ISG	ISG3	0.8	< .001
ISG	ISG2	0.73	< .001
ISG	ISG4	0.8	< .001
ISG	ISG5	0.832	< .001
ISG	ISG1	0.762	< .001
BoG	GEX2	0.858	< .001
BoG	GEX3	0.818	< .001
BoG	GEX1	0.764	< .001

Table 8: Factor Correlations for CFA of GamCog

Correlation			Estimate	P Values
IOC	<-->	PGS	0.75	< .001
IOC	<-->	ISG	0.731	< .001
IOC	<-->	BoG	0.752	< .001

PGS	<-->	ISG	0.635	< .001
PGS	<-->	BoG	0.78	< .001
ISG	<-->	BoG	0.734	< .001

6.3 Analysis and Discussion

The four factors that were extracted were found to be conceptually coherent and, as such, were preferred over the anticipated 7-dimensional model. It is also preferable to reduce the number of discrete factors in a measurement scale whilst retaining sufficient variation (Fabrigar & Wegener, 2011), the final structure, therefore, reflected this principle.

The GRCS comprises of 23 items, of these 13 were retained in the new factor structure, with only one construct (IS) remaining unchanged. Of eight additional items, five were retained. Five individual items were deleted, prior to conducting the CFA, due to the fact that they either loaded poorly onto the extracted factors (i.e. had loadings under .32) or that they cross-loaded onto more than one factor, thereby justifying their removal (Costello & Osborne, 2005). Interestingly, the majority of these items can be seen to share a common theme: they are all cognitions which relate to a lack of understanding concerning the nature of probability. A further seven items were removed in order to improve factor validity and reliability. All had loadings of less than .67, meaning that those retained can be considered “substantial” (DeVellis, 2003), thereby producing robust factors. The deletion of these items can also be justified theoretically, in addition to the methodological justification detailed above. First, PBC3 is not an item that fits with the others in the factor (IC) as it describes a cognitive error concerning the nature of probability, rather than addressing the conceptualisation of luck. From the same factor, IOC1 can be considered as constituting a specific example of the more general concepts captured by IOC4. In regard to IOC, ICL1 and ICL3 address the concept of luck as an inherent state, one in which individuals are either abundant or deficient. All the other items are concerned with acquiring luck, meaning that it is viewed as something

transitory, something which can be accrued or encouraged. These two views are mutually exclusive, justifying the decision to delete ICL1 and ICL3.

Factor PGS contains items which reflect cognitions concerning personal skill, as such the removal of PDC3 can be theoretically justified as it is not directly associated with this idea; indeed, the wording of the item could equally apply to outcomes which are seen to be affected by luck or superstition. Item INB1 can be seen to act as a potential driver of gambling activity, rather than a beneficial effect in the same way as the other items in factor BOG. In addition, it relates solely to the financial outcomes, whereas the other items in the factor refer to more general concepts of well-being, as such it is theoretically divergent from the other items in the construct. Finally, GEX4 can be seen as a specific example of the more general concepts captured by other items, once again justifying its removal.

All deleted items are detailed in appendix D for reference.

It is worth noting that the construct "Inability to Stop Gambling" (IS), part of the original GRCS, is the only one to remain unchanged throughout, meaning that it can be considered highly robust. At the other extreme "Interpretive Bias" (IB) entirely disappeared, with only one of the original items being retained at the conclusion of the CFA. This is perhaps unsurprising due to the high level of inter-factor correlation between IB and others found in study 1.

The construct "Predictive Control" (PC) also underwent radical change, with only one of the original six items being retained. Once again, a likely outcome of the high amount of inter-factor correlation with two other factors which was revealed in study 1. The newly amended construct has been named "Perceived Gambling Skill". Of the six original items only two PDC1 was retained; it references a form of personal agency that is dependent upon skill rather than on more "irrational" concepts such as instinct (PDC4) or fate (PDC2). Item INB2 features in the new factor, it deals explicitly with the idea of skill as an influence on the

outcome of gambling events. This perspective is further addressed by the items IOC5_PS and IOC6_PS, which both refer to “skills” and “knowledge” as important factors in deciding outcomes.

The GRCS included a construct named “Gambling Expectancies” (GE) in this study (3), the core principle of the original construct remains, with three of the four items belonging to the original construct. The finalised construct has been re-named “Benefits of Gambling” as it is felt that this is more descriptive.

Originally, the emphasis of the construct “Illusion of Control” (IC) was exclusively on the ways in which gamblers attempted to influence or control the outcomes of gambling events. The addition of items ICL2 and ICL4 complement this theme in that they address conscious efforts to acquire, and control, the somewhat nebulous concept of “luck”.

We can see, therefore, that the items constituting the revised four-factor model satisfy face validity. Furthermore, the five model fit indicate that the additional items and re-formulated factors constitute an effective measure.

In summary, several core concepts of the GRCS have been retained: the fact that, for some, gambling is an addiction or compulsion; that gambling is an attractive activity as it offers particular benefits to participants; and that certain ideas are present which reflect attempts to control potential outcomes. The last of these has benefitted from being re-framed in terms of active attempts to influence events based on either rational or irrational terms, i.e. skill and knowledge versus luck and fate.

The initial aim of the work was to supplement the GRCS with additional items, however, the work described in this stage has resulted in a scale which is significantly different from the GRCS. The final outcome is a scale which is particularly suited to for use in a population of video gamers who gamble. As such, an appropriate name for this new measure is: GamCog – A Scale for Video Game-Related Gambling Cognitions.

7 General Discussion.

A primary aim of this work was to examine the suitability of the GRCS as a robust measure for use with a population who participate in the growing area of video game-related gambling. The GRCS was found to be unsuitable for use in the context of video game players who gamble as there were problems with the model fit indices, convergent validity, discriminant validity, composite reliability, and inter-factor correlation. As such, items originally intended to supplement the GRCS were pooled with the original items, and subjected to EFA which revealed a four-factor structure, in place of the original five-factors. A key point of interest regarding the reframed GRCS constructs is that Illusion of Control (IC) and Predictive Control (PC) were amended to account for the way in which luck and skill were perceived by the sample. The revised version of IC reflects attempts to actively acquire good fortune, rejecting those items from the original GRCS which described a more passive stance on the part of the game player. In much the same way, PC underwent a number of changes which resulted in the finalised items referencing a form of skill-based personal agency on the part of the players.

Finally, the large samples aided the conduct of this work, lending weight to the findings as all stages utilised datasets where the ratio of the sample to items exceeded10:1, meaning that stable factors could be extracted (Fabrigar et al., 1999; Kaiser, 1970).

7.1 Implications

The growing convergence of video games and gambling means that the new scale is a potentially beneficial tool for identifying cognitions that may lead to problematic gambling in regular video game players. Furthermore, it provides a way to direct, and to enhance, treatments, such as CBT, for problematic gamblers from this specific population.

The revised scale, GamCog, presented in this work naturally requires further validation in different populations in order to assess whether it is an effective measure for gambling related cognitions in general, or if the findings are specific to those regular video game players who also gamble. No matter the outcome of such a study, it appears as though the GRCS itself would benefit from the addition of more items specifically addressing conceptualisations of skill and luck as this is a fundamental aspect of understanding gambling experiences.

Of the five sub-scales constituting the GRCS, Predictive Control was found to be the only one which could not significantly predict problem gambling scores, with its effect seemingly masked by Illusion of Control (Raylu and Oei, 2004). The authors stated that the sub-scale was intended to address cognitions concerning attempts to control the outcome of gambling events (hence the inclusion of items addressing skill, luck, and misunderstanding probability). However, the results of this research suggest that skill-based attempts to control outcomes differ significantly from luck-based approaches and that separating such cognitions results in more robust sub-scales. It would be highly beneficial to examine this approach in light of other gambling populations and of the general population as it is likely to improve the predictive capabilities of the GRCS in all contexts.

7.2 Limitations and directions for future research

A potential limitation of this work is that the factor structure of the finalised measure was initially identified, via EFA, using a data sample which was highly skewed towards young males, and as such may have unduly affected the retained items. An example of the potential way in which this particular sample may have influenced the final measure is in the removal of an item reflecting “the gambler’s fallacy” (PBC4). Although the removal was justified, even required, by established methodological practice, it runs counter to established theory and requires further attention. The example of the gambler’s fallacy is particularly interesting

as previous work has found evidence that it, and other cognitive biases based on misunderstanding probability, are more common in males than females (Suetens and Tyran, 2012; Donati, Chiesi and Primi, 2013). However, given that the effects of the gambler's fallacy have also been found to decrease with age (Fischbein and Schnarch, 1997) it seems likely that this result is directly associated with the preference for video gaming, rather than the age or gender of respondents in dataset 2. This position is supported by the fact that the subsequent CFA was conducted using a sample in which 58% (approx.) were males and more than 60% were over 30 years of age. In order to counter any potential effects of age and gender on the factor structure of the finalised GamCog measure it is recommended that any future validation of GamCog includes all deleted items (see appendix. D).

A further potential limitation could be the reliance on theoretical perspectives, identified by literature review, to develop additional items. This could be addressed through the use of the "thinking aloud" method, or by conducting interviews with a range of esports viewers who gamble. The results of such studies could then be compared to the finalised model, GamCog, in order to identify discrepancies. Any new items resulting from such work would require testing and validation.

Finally, the clinical validity of this model is reduced as a result of the self-selected nature of the three datasets, however, this means it is likely to hold true as a measure for the wider population of esports fans and regular video game players.

8 Conclusion.

This study has found that the Gambling Related Cognitions Scale is not a robust measure for use in a population of video game players who gamble, either in respect to established activities or those newly-emergent forms facilitated by video games. As the GRCS has been designed for use in non-clinical populations and is broader in scope than many other scales

addressing gambling related cognitions, it is likely that the above finding holds true for all extant measures.

Perceptions of skill and luck were found to be the principle factors which accounted for the GRCS's lack of suitability for the sample population. Therefore, it seems that an interest in video games and esports is associated with the development of cognitive biases which differ from the non-gaming population. With these facts in mind, the GamCog scale was formulated for use in the target population, incorporating items both from existing measures and those theorised by researchers in the field but not previously tested. A full list of items and constructs constituting the GamCog scale is provided in Appendix E, and a manual describing the implementation of GamCog is included in appendix F.

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10 Appendices

Appendix A:

Items Supplementing GRCS

Theory	*Item Code*	*Item*	*Source*
Influence of Skill	IOC5 - PS	My knowledge and skill in gambling contribute to the likelihood that I will make money.	Steenbergh et al., 2002
	IOC6 - PS	My gambling wins prove that I have skills and knowledge related to gambling.	
Predictive Control	PDC4	I use instinct or feelings to guide my choices when I gamble.	Toneatto et al., 1997
	PBC1	If I am on a losing run, I just have to keep going until I start winning again.	
	PBC2	There are certain circumstances or situations that increase my chances of winning.	

Concepts of Luck	ICL1	I often wait until I am experiencing a period of good luck before gambling.
	ICL2	I have some superstitions which make me lucky when I gamble.
	ICL3	I believe that some people are naturally luckier than others when they gamble.
	ICL4	If I know someone who is lucky, I try to be around them so that their luck rubs off on me.

Appendix B:

Pattern Matrix

	Factor			
	IOC	PGS	ITSG	BOG
IOC3	0.747			
ICL2	0.704			
IOC2	0.661			-0.117
ICL1	0.657			
IOC4	0.652			
ICL4	0.633			
IOC1	0.600			
PBC3	0.501			
ICL3	0.468			
PBC4[1]	**0.326**			0.311
INB2		0.928		-0.214
IOC6_PS		0.842		
IOC5_PS	-0.171	0.722		0.161
PDC3		0.634		
PBC2	0.225	0.622		
PDC1	0.121	0.596		
ISG3			0.968	
ISG2			0.812	-0.121
ISG4			0.684	-0.112
ISG5	-0.114		0.604	0.297
ISG1			0.559	
GEX2		-0.125		0.852
GEX3				0.752
GEX1	-0.152	0.181		0.660
GEX4				0.548
INB1			0.128	0.540

Legend: [1] Deleted due to crossloading;
Note: Items with loadings under .32 not shown here.

Appendix C:

Table X: Initial Validity and Reliability Table for CFA of GamCog

					Factors			
CR	AVE	MSV	MaxR(H)	IOC[1,2,3]	PGS[1]	ISG	BoG[1]

Factors	IOC[1,2,3]	0.877	0.451	0.637	0.895	0.671			
	PGS[1]	0.886	0.567	0.696	0.901	0.784***	0.753		
	ISG	0.889	0.617	0.56	0.893	0.728***	0.641***	0.785	
	BoG[1]	0.856	0.547	0.696	0.873	0.798***	0.834***	0.748***	0.74

Legend. 1Discriminant Validity (DV) concern: square root of the AVE for factor is less than its correlation with other factor(s); 2DV concern: AVE for factor is less than MSV; 3Convergent Validity concern: AVE is less than .5.

Appendix D:

List of Deleted Items

Item Code	*Deleted Item*	*Reason for Deletion*	*Stage Deleted*
PDC2	When I have a win once, I will definitely win again.	Cross-/low-loading (under .32)	EFA
PDC4	I use instinct or feelings to guide my choices when I gamble.	Cross-/low-loading (under .32)	EFA
INB3	When I lose it is because I was unlucky, or there were circumstances that could not be predicted.	Cross-/low-loading (under .32)	EFA
INB4	Relating my losses to probability makes me continue gambling.	Low-loading (under .32)	EFA
PBC1	If I am on a losing run, I just have to keep going until I start winning again.	Cross-/low-loading (under .32)	EFA
PBC4	Losses when gambling are bound to be followed by a series of wins.	Cross-loading	EFA
GEX4	Gambling helps me reduce my levels of tension and stress.	Loading under .65	CFA
IOC1	Praying, or thinking positively, helps me win.	Low-loading (.67) and redundancy	CFA
PBC3	If I keep changing my numbers, I have less chance of winning than if I keep the same numbers every time.	Loading under .65	CFA
PDC3	I have some control over predicting my gambling wins.	Loading under .65	CFA
INB1	Remembering how much money I have won previously makes me want to continue gambling.	Loading under .65	CFA
ICL1	I often wait until I am experiencing a period of good luck before gambling.	Loading under .65	CFA
ICL3	I believe that some people are naturally luckier than others when they gamble.	Loading under .65	CFA

Legend: CFA = Confirmatory Factor Analysis; EFA = Exploratory Factor Analysis

Appendix E:

GamCog Scale: List of Items by Sub-Scale

Sub-Scale	*Short Name*	*Item*
Benefits of Gambling	BOG	Gambling makes me happier.
		Gambling makes things seem better.
		Gambling makes the future seem brighter.
Inability to Stop	IS	I can't function without gambling.
		It is difficult to stop gambling as I am so out of control.
		My desire to gamble is so overpowering.

		I'm not strong enough to stop gambling.
		I will never be able to stop gambling.
Illusion of Control	IC	Specific numbers and/or colours help me win.
		I collect specific objects that help increase my chance of winning.
		I have specific rituals and behaviours that increase my chance of winning.
		I have some superstitions which make me lucky when I gamble.
		If I know someone who is lucky, I try to be around them so that their luck rubs off on me.
Perceived Gambling Skill	PGS	There are certain circumstances or situations that increase my chances of winning.
		A series of losses will provide me with a learning experience that will help me win later.
		My knowledge and skill in gambling contribute to the likelihood that I will make money.
		My gambling wins prove that I have skills and knowledge related to gambling.
		When I win it is mainly due to my skill and knowledge in the area.

Appendix F:

GamCog: A Scale for Measuring Gambling-Related Cognitions in Video Game Players.

The following statements relate to gambling experiences, please indicate the extent to which you agree or disagree with each. (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neither Agree Nor Disagree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree)		Please use this column to respond to each statement. 1 2 3 4 5 6 7
1	I will never be able to stop gambling.	○ ○ ○ ○ ○ ○ ○
2	A series of losses will provide me with a learning experience that will help me win later.	○ ○ ○ ○ ○ ○ ○
3	I have some superstitions which make me lucky when I gamble.	○ ○ ○ ○ ○ ○ ○
4	I'm not strong enough to stop gambling.	○ ○ ○ ○ ○ ○ ○
5	Specific numbers and/or colours help me win.	○ ○ ○ ○ ○ ○ ○
6	It is difficult to stop gambling as I am so out of control.	○ ○ ○ ○ ○ ○ ○
7	My knowledge and skill in gambling contribute to the likelihood that I will make money.	○ ○ ○ ○ ○ ○ ○
8	There are certain circumstances or situations that increase my chances of winning.	○ ○ ○ ○ ○ ○ ○
9	If I know someone who is lucky, I try to be around them so that their luck rubs off on me.	○ ○ ○ ○ ○ ○ ○
10	My desire to gamble is so overpowering.	○ ○ ○ ○ ○ ○ ○
11	Gambling makes me happier.	○ ○ ○ ○ ○ ○ ○
12	Gambling makes the future seem brighter.	○ ○ ○ ○ ○ ○ ○
13	My gambling wins prove that I have skills and knowledge related to gambling.	○ ○ ○ ○ ○ ○ ○
14	I can't function without gambling.	○ ○ ○ ○ ○ ○ ○
15	When I win it is mainly due to my skill and knowledge in the area.	○ ○ ○ ○ ○ ○ ○
16	I collect specific objects that help increase my chance of winning.	○ ○ ○ ○ ○ ○ ○

17	I have specific rituals and behaviours that increase my chance of winning.	○ ○ ○ ○ ○ ○ ○
18	Gambling makes things seem better.	○ ○ ○ ○ ○ ○ ○

To obtain scores for each sub-scale, sum the individual scores for each item in the sub-scale.
To obtain the overall GamCog score, sum the individual scores for the six sub-scales.
To obtain mean scores for each sub-scale, sum the individual scores for each item in the sub-scale and divide by total number of items in the sub-scale (see table below).
To obtain the overall mean GamCog score, sum the mean scores for all sub-scales.

Sub-Scale	*Sub-Scale Code*	*Number of Items*	*List of Items by number*
Benefits of Gambling	BOG	4	11, 12, 18
Inability to Stop Gambling	IS	5	1, 4, 6, 10, 14
Illusion of Control	IC	5	3, 5, 9, 16, 17
Perceived Gambling Skill	PGS	6	2, 7, 8, 13, 15