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The role of psychology in understanding the impact of computer games

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ABSTRACT

Over the last 40 years, computer games have become an extremely popular leisure activity and more recently there has also been interest in the potential of serious games to help in learning, skill acquisition and attitude and behaviour change. Initially public interest in computer games focused on concerns about their violent and gender stereotyped content and their potentially addictive properties, but more recently the benefits of games have also been recognised. Psychology is at the interface between science, cognitive science and social science and in this paper we examine the role that theories and research in psychology have played in understanding the impacts of playing games, the appeal of games and the potential of games in supporting learning and behaviour change.

1. Introduction

Since the introduction of the video games Pong and Space Invaders into the UK during the 1970s, computer games have had a transformational impact on how we spend our leisure time. As the computer games generation has grown up, adults as well as children and adolescents spend substantial amounts of time playing digital games. The computer games market is one of the fastest growing leisure markets and games are now as profitable as films [1]. Figures from GfK Chart-Track, UK [2] show that videogames revenue in the 12 months to the end of 2009 was 44% higher than films. More recently attention has also turned to the potential of computer games for learning, skill acquisition and attitude and behaviour changes [3].

Developing engaging computer games and evaluating their effectiveness present an interdisciplinary challenge. Psychology is uniquely placed at the interface between biological, cognitive and social sciences and has an important role to play in addressing this challenge. Psychologists can help in explaining the compelling appeal of digital entertainment games, designing better games and exploring the potential of serious games in learning and behaviour change. Psychologists have developed an extensive knowledge base about attitudes, behaviours, cognitions and emotions as well as expertise in a range of qualitative and quantitative methodologies. This paper will consider the contributions that psychologists can make to understanding and evaluating the impact of computer games.

2. Negative impacts of playing games

Despite their immense popularity, much of the early interest in the impact of computer games focused on the detrimental effects of games on the behaviour of children and adolescents. The public perception of entertainment games is that they promote violence, are gender stereotyped and potentially addictive. Psychologists have applied their knowledge of aggressive behaviours, sex role acquisition and addictive behaviours to understanding these negative aspects of computer games.

2.1. Video violence

The majority of the most popular digital entertainment games on the market include violent content and this has led to concerns that playing violent games will make players more aggressive. Anderson and Bushman's [4,5] meta-analyses of the literature provided support for this claim. The authors used the General Aggression Model, which is based on psychological theories of aggression, to explain how exposure to violent games, along with characteristics of players, leads to increases in aggressive emotions, cognitions and behaviours and decreases in pro-social behaviours. Over time, exposure to violent games will lead to permanent changes in an individual's beliefs and attitudes, perceptual and expectation schemata and scripts which underlie their behaviour.

However conclusions about the impact of violent games are contested [6]. Ferguson [7] for example argued that research reporting the effects of violent games on aggression is subject to a publication bias, such that studies showing significant effects of violent content on aggression are over-represented in the literature. Jansz [8] used psychological theories of mediated emotion such as Oatley's [9] sim-

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ulation theory to explain the attractions of violent games for adolescent boys. Jansz argued that computer games provide a laboratory-type of environment where young males experience a variety of both positive and negative emotions and can test out their reactions to these emotions in a safe and controlled environment which is removed from reality and which allows them to explore their self-identity.

2.2. Gender stereotyping in games

It is clear that males are more attracted to violent games than females are. Analyses of game content have shown that there are few female characters in computer games and that these characters have very restricted roles. This has raised concerns that playing these games will promote stereotyped attitudes to males and females and lead to problems with gender identity [10]. The finding that playing action games facilitates visual perceptual skills has also raised concerns that in playing games, males are acquiring greater expertise in visual spatial skills than females at an early age, and this will have an enduring impact on disciplines selected at school and subsequently on the selection of more lucrative, technology based careers [11].

2.3. Addictions

As with other intrinsically enjoyable behaviours, game playing can become excessive if not regulated. The appeal of computer games is so strong that concerns have been expressed that young people in particular are spending too much time playing games and using the internet and that this can lead to game and internet addiction [12]. These authors found links between addiction to games, the internet and gambling and found that these behavioural addictions were all related to problems in emotional intelligence. Online games seem to be particularly addictive and Kim et al. [13] showed that individuals with narcissistic personality traits, aggression, low levels of self control and less effective social relationships were at more risk of online game addiction. Even for those who are not addicts, the compelling appeal of games can lead to problems in regulating the amount of time spent playing games. Lee and LaRose [14] found that playing games for negative reasons such as relieving boredom, reducing loneliness, passing the time or providing an escape can lead to players losing control over their ability to regulate the amount of time they spend playing games. Psychologists have an extensive research base in understanding a variety of substance and behavioural addictions which is of relevance here.

3. Positive impacts of playing games

Despite these concerns about problems linked to games, it has been suggested that computer games can also have positive effects on players. For example Durkin and Barber [15] found that adolescents who play games had more favourable outcomes with respect to family closeness, school engagement, involvement in other leisure activities, positive mental health, substance use, self-concept, friendship network and obedience to parents.

3.1. Engagement in entertainment games

One of the most intriguing aspects of games is their immense popularity. Players clearly find playing games an extremely enjoyable activity and games companies are interested in designing ever more enjoyable games. As Sweetser and Wyeth [16] claim: "player enjoyment is the single most important goal for computer games". While player enjoyment of games is self evident, it has been deceptively difficult to explain [17]. Vorderer et al. [18] proposed that subjective feelings are at the heart of any explanation of media enjoyment. These feelings have affective, cognitive and physiological components and manifestations or correlates, such as laughter, exhilaration, achievement and sensory delight. They also proposed that a comprehensive account of media enjoyment should address media and user characteristics. Psychologists have a research base in all of these areas.

3.1.1. Subjective feelings experienced while playing games

Theoretical constructs such as flow [19], immersion [20] and presence [21] have been proposed to explain the subjective feelings experienced while playing games. Each of these constructs has a slightly different focus. Both flow and immersion are characterised as multi-factorial constructs. The concept of flow was explicitly developed by Csíkszentmihályi [22] as an account of the enjoyment experienced while taking part in favoured work and play activities and Sherry [19] applied flow theory to explaining enjoyment felt in playing computer games. Flow focuses on cognitive features of an experience, highlighting the fit between the challenge of a task and the skills of a player, but also including concentration and focus, goals and feedback, control, loss of self-consciousness, transformation of time and the feeling that the activity has become autotelic. The balance between skills and challenge typical of flow experiences is very similar to Vygotsky's ideas about the zone of proximal development, where progress is made when learners are presented with tasks which are just beyond their current level of ability but which they can complete with the help of a more experienced teacher. Questionnaire based measures of flow tend to address a subset of the features mentioned above. Weibel et al. [23] measured involvement, concentration and challenge while Lee and LaRose [14] assessed enjoyment, concentration and merging of action and awareness.

Jennett et al. [20] developed a questionnaire based measure of immersion which included affective and cognitive components, as well as a sense of real world dissociation, challenge and control while playing the game. Attention and concentration are important cognitive constructs in explaining both immersion and flow. Attention determines what is within the player's awareness and is related to the feeling of being present in the game. Research on attention in cognitive psychology has characterised attentional processes, distinguishing for example between controlled and automatic processing [24] which are relevant here. Presence focuses on the feeling of being present in a game and physical and technological features of the game are especially important in this respect [23].

The main emotion experienced in playing games is enjoyment and flow essentially provides an account of the component features which contribute to enjoyment felt while taking part in freely chosen activities. However Jennett et al. [20] were also interested in the role of negative emotions in understanding immersion in games. They examined whether anxiety felt in playing fast paced games could add to player enjoyment, although their results were inconclusive. The role of negative emotions in contributing to enjoyment is an area where further research is required.

In trying to link subjective feelings experienced while playing games with harder, more objective measures, studies have examined a variety of physiological correlates of the emotions felt while playing games, including increases in blood pressure [25], changes in heart rate and increases in skin conductance, muscle activity and skin temperature [26] and changes in facial expressions [27].

3.1.2. Reasons for playing games

As well as providing explanations of the subjective experiences felt while playing games, motivational theories developed by psychologists have also been used to explain the appeal of games

and reasons for playing games. Przybylski et al. [28] used Ryan and Deci's [29] self-determination theory to explain players' motives for playing games. This theory provides an account of very broad based needs for competence, autonomy and relatedness that drive human behaviour and proposes that people enjoy activities more if they meet intrinsic rather than extrinsic needs. In a rigorous series of questionnaire-based and experimental studies, Przybylski et al. [28] confirmed that playing games meets players' intrinsic needs for competence and autonomy. Playing games to address players' needs for competence is consistent with the theories of flow and immersion which identified challenge as an important feature of enjoyment of games. Autonomy refers to the ability to take part in freely chosen activities and is similar to the need for control described in theories of subjective experience. Interestingly, despite the popularity of violent games, Przybylski et al. [28] found that the violent content of games did not predict enjoyment of games once the self determination variables, competence and autonomy, were accounted for.

Uses and Gratifications (U&G) theory was developed as a theory of communication which looks at consumers' more specific media-based needs. Lucas and Sherry [30] applied U&G theory to playing games and found that, in addition to challenge, players play games for the rather contradictory reasons of emotional arousal and relaxation, to compete against other players, for the ability to take part in fantasy activities which would not normally be possible and to interact socially with other players.

Several theoretical accounts of the appeal of entertainment games have been proposed, focusing on subjective feelings of immersion as well as satisfaction of very general or more specific media related needs. Models of game enjoyment have been criticised as they tend to comprise lists of features rather than coherent theoretical models [19]. Research in this area is in its early days and we are still working towards a complete account of game enjoyment. Vorderer et al. [18] model of media enjoyment provides a more structured and integrated account of media enjoyment including subjective experience and their correlates, precursors and outcomes.

3.1.3. Perceptual and cognitive impacts of playing entertainment games

While entertainment games are played primarily for fun and enjoyment, it soon became evident that players of Commercial Off-the-Shelf (COTS) games also appeared to be acquiring new skills. The strongest evidence about the effects of playing games on skill acquisition comes from research suggesting that playing action games has a positive impact on visuo-motor coordination and spatial representation, iconic skills and visual attention [31]. Green and Bavelier [32] for example found that game players performed much more accurately than non-game players on an enumeration task where an array of squares is flashed up quickly on a screen. Players were also better than non-players at tracking multiple objects simultaneously. On average, games players could enumerate and track two more items than non-players. These findings are interesting since these entertainment games were not explicitly designed to improve visual-perceptual abilities but did so unintentionally. This research used tasks designed by perceptual psychologists to assess the range of perceptual skills examined in these studies.

Given the solid evidence base of visual-perceptual advantages which accrue as a result of playing games, there has also been interest in whether these skill improvements extend to other cognitive abilities and skills. However the evidence about the potential of games in improving other cognitive skills is weaker. Boot et al. [33] compared performance of expert game players and non-game players on a range of memory, reasoning and executive control tasks. They found that the video games experts showed a range of cognitive benefits, including tracking objects moving at greater speeds, performing more accurately in a visual short-term memory test, switching between tasks more quickly, and making decisions about rotated objects more quickly and accurately, although a number of effects that had previously been found were not significantly different. The weight of evidence seems to suggest that playing games is more important in enhancing lower level attentional and visual perceptual abilities than higher level skills.

Steinkuehler and Duncan [34] took a different approach to examining the impact of playing games on the acquisition of higher order thinking skills. Their observations of players' contributions to the discussion fora in the online game, World of Warcraft (WoW), led them to predict that players of these games frequently engage in high-level discussions and arguments as they tackle the difficult and sometimes ill-defined problems which are presented during these games. A rigorous qualitative analysis of these player dialogues confirmed that players displayed an impressive range of higher order scientific reasoning skills in the discussion fora, such as using data and argument, building on others' ideas and using system based reasoning.

While players of COTS games do seem to acquire some useful perceptual and cognitive skills, limitations in the use of COTS games for learning have also been recognised [35]. The main difficulty arises in matching the functionality of a game with the desired learning outcomes and objectives.

4. Serious games

While playing COTS games can lead to knowledge and skill acquisition, serious games are games which are intentionally designed for the purpose of learning, skill acquisition and training. Serious games are "games that are driven by educational goals not entertainment" [2], but the term also includes games designed to support attitude and behaviour change. Bogost [36] also describes persuasive games, such as advertising games, health games and social and political advocacy games which are designed to change people's attitudes and behaviours across a range of issues, such as discouraging smoking, increasing votes for a political party and encouraging recycling.

The diversity of serious games has led to criticisms that the area is fragmented and lacking in coherence [37]. For example there is a lack of consistency in definitions of what a serious game is, no agreed organisational framework for serious games and little structured guidance about how to develop a serious game in a particular domain. In trying to bring some order to the area, Sawyer and Smith [2] developed a taxonomy of serious games, categorising games according to the game discipline/ function of the game (games for health, education, business etc.) as well as the sectors in which the games might be used (government and defence, healthcare, advertising, education, industry etc.). Just as research in psychology has contributed towards developing a better understanding of the enjoyment of entertainment games, so psychologists have a wealth of theoretical and practical knowledge relating to learning, and attitude and behaviour change which is relevant to developing a less fragmented, more coherent approach to understanding serious games.

Games Based learning (GBL) is a subset of serious games focusing on the use of games for learning, skill acquisition and training. Psychologists are highly receptive to the idea of learning through play and many psychologists have explored play as the main way in which young children learn [38]. Children are intrinsically motivated to understand the world and play provides informal, freely chosen opportunities to explore the properties of materials and objects in their environment. As children get older, cooperative play with others becomes increasingly important for language acquisi-

tion and learning about social roles. Formal schooling introduces a new, more rigid and structured approach to learning, but the digital generation increasingly finds formal learning unattractive and there is increasing interest among educationalists in identifying the features of informal learning environments which can lead to successful learning. Computer games provide opportunities for people of all ages to capitalise on the advantages of learning through play and games for learning have been developed in the areas of health, business, military training, computer science, science, maths and biology [39]. Games for learning vary from simple puzzle type games to complex Massively Multi-player Online Role Playing Games (MMORPGs).

Interest in the potential of using digital games for learning initially emerged from optimism that the motivating features of entertainment games could be deployed in games for learning, engaging players in appealing activities which could help them to learn. Some games have focused on a rather limited view of the motivational features of games. Cameron and Dwyer [40] for example used a board game type format to increase students' knowledge of heart attacks, where players were rewarded with progress towards a goal if they answered questions correctly. Other authors have used broader theories of motivation. For example Malone and Lepper [41] argued that intrinsic motivation is more important than extrinsic motivation in designing educational games to make them more enjoyable. They identified four individual factors, challenge, fantasy and curiosity and control, and three interpersonal factors, cooperation, competition, and recognition as key ingredients for game enjoyment. Papastergiou [42] successfully used these motivational principles in developing a game for students to learn computer memory concepts. Fu et al. [43] added a knowledge improvement scale to Sweetser & Wyeth's model of GameFlow in developing a measure of enjoyment of educational games.

There remain a number of concerns about the compatibility of fun and learning in games with respect to the motives underlying games for learning. Entertainment games and games for learning have fundamentally different aims. Educational games might be very good fun, but they are designed primarily so that players can carry out specific tasks effectively and efficiently. The fun experienced in playing the game might be orthogonal to the learning goal of the game in which case players' desire for fun might actually detract from their learning. Okan [44] expressed the concern that games might encourage students to take the view that learning should be easy, whereas in reality effective learning will always require hard work on the part of the student.

An important aspect of entertainment games is that playing these games is usually a voluntary, freely chosen activity. In contrast playing an educational game will frequently involve an element of obligation which may reduce the sense of autonomy players experience in playing the game. Games for learning allow players some autonomy in the choices and decisions that they make while playing the game, but playing an educational game might be an obligatory part of a pupil's learning experience, reducing their autonomy and possibly their enjoyment of the game.

However the motivational features of games are only half the story vis à vis the potential of games for learning. Probably a more important reason that games based learning might provide effective learning experiences is that games seem to offer activities which are highly consistent with modern theories of effective learning proposed by psychologists and educationalists. Learning in games provides activities which support learning that is active, experiential, situated, problem based, provides immediate feedback, is consistent with cognitive theory and involves communities of practice which provide collaborative support to players as they learn. Learning with computer games is consistent with constructivist theories of learning which emphasise learning as an active process in which learners construct new ideas or concepts based upon their current/past knowledge and where learning is individualised according to characteristics of the player [45]. Games based learning is situated in that learning is viewed as a function of the activity, context and culture in which it occurs [46]. Games based learning is also consistent with problem-based learning which proposes that learning is most effective when it poses significant, contextualized, real world situations and provides resources, guidance, and instruction to learners as they develop content knowledge and problem-solving skills [47]. Games based learning, especially in Massively-Multiplayer Online Games (MMOGs), utilises cognitive apprenticeship and communities of practice, where novices develop content knowledge and problem-solving skills by modelling the processes and strategies used by experts as they tackle significant, contextualized, real world situations [48,49].

Gentile and Gentile [50] argue that violent video games promote aggression because they systematically incorporate well-established principles of effective learning and consequently teach players to think and behave more aggressively. These principles include: having clear objectives; presenting tasks at multiple levels of increasing difficulty; adapting to the prior knowledge, skills and pace of each learner; presenting tasks that require active learning; providing practice and feedback to the point of mastery; over-learning both knowledge and skills and including both intrinsic and extrinsic motives. This paper makes an interesting connection between entertainment games and games for learning, arguing that games which are designed for entertainment can help in learning because they instantiate principles of effective learning.

Several authors have made claims that games have the potential to be at their most useful in supporting higher level cognition such as critical thinking, problem solving, decision making, argumentation and hypothesis testing [51] and in helping to support the 21st century skills necessary for success in the workplace, such as self-regulation, creativity, and effective communication, cooperation, collaboration, negotiation and working in teams [52]. Skills based models downplay learning as knowledge acquisition, emphasising that effective learning requires skill acquisition in conjunction with knowledge acquisition [53]. Games provide an ideal medium to support skills based learning.

Games which support higher level thinking have been developed for business applications where they are used to help players make effective decisions in complex real world scenarios where differing perspectives and positions prevail. For example Bos et al. [54] describe an online role playing/simulation game for business students to help them to think through the kinds of ethical dilemmas faced by global businesses. Zwikael and Gonen [55] describe Project Execution Game which aimed to improve students' project management knowledge by training them to manage unexpected but real life events that might crop up while managing a project. Psychological research on decision making and moral reasoning is relevant in designing such games.

Psychologists have developed knowledge bases relevant to many of the areas in which serious games are being developed, especially in health, exercise, advertising and moral decision making. In the area of health, games have been developed which can increase players' knowledge about illnesses and health problems, support patients in rehabilitation, increase physical activity and support health promotion and therapy [56]. Kato and Beale [57] developed Re-mission, a game about cancer. They found that the majority of their young cancer patients agreed that a game-based approach to learning about cancer was acceptable and they would play the game. Beale et al. [58] found that playing the game led to significant increases in knowledge about cancer. Goodman et al. [59] reported a non-curricular use of games in increasing concussion knowledge in young ice hockey players. There has also been much interest in the use of games for therapy. Goh et al. [60] de-

scribe the use of games for supporting mental health problems, Wilkinson et al. [61] describe the potential of online game therapies for the treatment of aggression, anxiety, adhd and autism, while Ma and Bechkoum [62] examine the use of games for physiotherapy for stroke victims. The design of these games makes use of theory and research in health psychology, cognitive behavioural therapy, play therapy and applied behaviour analysis.

Dance and exercise games have also become increasingly popular and there is much optimism that the motivational properties of these games could help young people to keep fit [63,64]. These games might best be categorised as entertainment games but they also aim to change behaviour. Studies suggest that exercise game applications have the potential to elicit affective benefits but, as with other kinds of game, there needs to be careful examination of the circumstances under which these benefits are most likely to occur. For example Sell et al. [65] found that more experienced players of the dance game Dance Dance Revolution benefited more from playing it than less experienced players. Russell and Newton [66] found that, while using an exercise bike improved mood compared to a sedentary activity, incorporating a game element into the exercise bike did not lead to further enhancements of mood.

Games for learning, training and skill acquisition are an important subset of serious games but serious games also include games designed to change attitudes or provide support for behaviour change. Of course changing behaviour is a difficult task, but research in social psychology has developed theoretical models of attitude and behaviour change and persuasion which are relevant to developing games of this kind. The theory of planned behaviour for example is an influential theory of attitude and behaviour change which proposes that attitudes, i. e. generally positive or negative dispositions towards a behaviour, perceived behavioural control, i. e. the extent to which an individual feels in control of their participation in the behaviour, and social norms, i. e. other people's views of the individual executing that behaviour, are important predictors of people's intentions to behave in a particular way [67]. The theory also proposes that behavioural intentions are good predictors of behaviour.

Bogost's persuasive games differ from educational games in that their aim is change attitudes and behaviours rather than to teach. Bogost claims that persuasive games provide a genuinely new way of presenting information, which he calls procedural rhetoric. Just as verbal rhetoric is a means of presenting verbal arguments with the aim of influencing other people's opinions, procedural rhetoric is a powerful new, visually based means of presenting arguments in a procedural or active way that offers unique opportunities to persuade other people and change their opinions. Psychologists with an interest in persuasion, language and representation would also have an interest in the potential for games to be used in this way.

5. Discussion

Over the last forty years computer games have had a transformational impact on how many people choose to spend their leisure time. More recently there has been increasing interest in developing games for more serious purposes. Games provide highly engaging activities which are stimulating, generate strong emotions, require complex information processing, provide challenges and can potentially support these more serious purposes of learning, skill acquisition and attitude and behaviour change. Developing and evaluating games for specific purposes whether learning or behaviour change is a very complicated enterprise requiring an understanding of the design of games, knowledge of the relevant content or subject area, knowledge of motivation, pedagogy and behaviour change, an understanding of how to select a game which will address the required learning or behavioural outcomes and evaluation techniques. These issues present an interdisciplinary challenge. In this paper it has argued that psychologists have an established knowledge base across a wide range of human behaviours, cognitions and emotions, as well as expertise in a range of qualitative and quantitative methods which are relevant to many of these issues.

Games are very varied in terms of their characteristics. Games provide voluntary, enjoyable and challenging activities with varying conditions which can specify goals, objectives, rules, moves, constraints, feedback, payoffs and consequences. They include one or more players and can involve conflict, competition (against oneself, the game or others) and cooperation. They are artificial in that they are separate from the real-world, they frequently involve interaction and representation of story. New platforms and technologies, such as mobile games, online games, ARGs, increasingly offer players new experiences and opportunities for engagement. Research requires more detailed examination of the characteristics of different kinds of game and game genre and the relative importance of these characteristics in different games. Psychologists can help in exploring and systematising the characteristics of different games and in helping to understand the different kinds of enjoyment and potential for learning linked to specific game characteristics. Psychologists can also contribute to research looking at different player characteristics, such as gender, age, personality and game preference [13].

Interestingly the link between psychology and games is not all a one-way street. It has also been suggested that as well as psychologists helping to study games, games provide a new tool or methodology for testing psychological theories. For example van Reekum et al. [26] used known properties of games, i.e. their ability to evoke emotional reactions, to study links between self-reported emotions and underlying physiological measures. It seems likely that games could also be used as a tool to test psychological theories in other areas such as perception and complex decision making.

6. Conclusion

To summarise, this paper has shown that theories and research from many different areas of psychology including social, cognitive, behavioural, health and physiological psychology have played an important role in helping to understand the characteristics and impacts of computer games. Inevitably this paper has considered only a small subset of relevant papers. As interest in games grows it seems likely that psychologists will continue to work in close collaboration with researchers in other disciplines in systematising our understanding of computer games and helping to overcome the fragmentation which is evident in this area.

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