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Article

Reducing Extrinsic Burdens on Players of Digital Games: An Integrated Framework

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Abstract
Increasingly complex gameplay and gameworlds are placing greater demands on players, while grander approaches to help them cope, such as heads-up displays (HUDs), maps, notifications, and real-time statistics, may often create even more layers of complexity, and thus burdens, further detaching players from core gameplay. In this article, we distinguish between 'intrinsic' (fundamental to gameplay) and 'extrinsic' (peripheral or extraneous to gameplay) game elements, where the latter may be seen to increase burdens on players unnecessarily, subsequently affecting engagement. We propose a framework, comprising core, interaction, and interface layers, that reveals how extrinsicality may be minimised to better facilitate intrinsic gameplay and engagement.

Keywords
digital games; flow; framework; gameplay; immersion; involvement; player engagement; presence

Issue
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1. From Demands to Burdens in Digital Games

Fun has been found to be a prevalent motivation among gamers (Reid, 2012), albeit not universally applicable to all (Jørgensen, 2016), and a key element of the entertainment that games provide is through the provision of multiple challenging and competitive situations that players feel a necessity to resolve (Vorderer, Hartmann, & Klimmt, 2003). As Bernard Suits (1978) defined it:

> To play a game is to engage in activity directed towards bringing about a specific state of affairs, using only means permitted by rules, where the rules prohibit more efficient in favour of less efficient means, and where such rules are accepted just because they make possible such activity. (p. 34)

The overcoming of obstacles of some kind is therefore a major aspect of most gameplay. However, as digital games have developed, technology has extended the realms of what is possible, enabling more complex gameplay and vaster gameworlds, ranging from single player to large-scale multiplayer gaming, including multiplayer first-person shooters (Pirker, Rattinger, Drachen, & Sifa, 2018), multiplayer online battle arenas (MOBAs; Mora-Cantallops & Sicilia, 2018), and e-Sports (Martončik, 2015), such that digital games now often require a considerable amount of time to learn and play (Bouchard, 2015). For example, massively multiplayer online role-playing games (MMORPGs) have endless narratives and a never-ending system of goals and achievements, leading to prolonged and extended engagement with the game as players continually challenge their abilities (Gray &

Huang, 2015). It is not surprising, then, that a recent international survey (Limelight Networks, 2019) found that more than half of players have missed sleep and more than a third have missed a meal due to gaming. It is clear that many modern games now require much more from their players than they have historically.

Such complexity places significant demands on players' intelligence. For example, expertise in MOBAs has been correlated with fluid intelligence due to the strong demands on memory, tactics, and strategy over hand-eye coordination (Kokkinakis, Cowling, Drachen, & Wade, 2017), and it has also been demonstrated that player performance deteriorates over periods of sustained engagement, even where collaboration with others may help overcome fast-paced, complex tasks and where player experience may reduce the effects (Sapienza, Zeng, Bessi, Lerman, & Ferrara, 2018). Digital games have been found to have more complex effects on stress outcomes as they do not share the same characteristics as other mental stressors due to the interactive player experience (Porter & Goolkasian, 2019). Alternative approaches have sought to develop ever grander approaches to providing players with information to help them cope with increasingly vaster and intricate gameworlds, such as heads-up displays (HUDs), maps, notifications, and real-time statistics. Even the addition of a third hand (controlled by the foot) into a game has been trialled (successfully) for reducing physical and mental burdens (Abdi, Burdet, Bouri, Himidan, & Bleuler, 2016). However, when not implemented carefully, these approaches often result in additional layers of complexity being added on top of the game, thereby further increasing the burden on players and creating additional barriers that may detach them from the core gameplay.

At the other extreme, particularly on smartphones and in browsers, we have witnessed the emergence of casual games (Juul, 2010), abstract persistent progressive massively multiplayer asynchronous games (APPMMAGs), which have little story and no vividly-expressed gameworld (Bouchard, 2015), and idle or incremental games, which incorporate extended periods of just waiting where the player's participation is optional and may even be redundant (Cutting, Gundry, & Cairns, 2019; Fizek, 2018). Such games especially appeal to those who prefer simpler game mechanics and more acceptable, accessible, and flexible gameplay experiences (Kultima, 2009). Indeed, a large factor driving the enjoyment of mobile gaming has been found to be persistent ease of use, primarily arising from a simple interface and gameplay (Merikivi, Tuunainen, & Nguyen, 2017), and casual single-player games in particular have now risen to become the most popular type of game worldwide (Limelight Networks, 2019).

Hence, as digital games place an ever-increasing combination of interactive, cognitive, emotional, physical, and social demands on players (Bowman, 2018), what were once reasonable and appropriate demands for digital games, necessary in order for them to provide sufficient entertainment, may now be seen as shifting towards being burdens, which players may be struggling to cope with on multiple dimensions and may be considered unnecessary. The notion that the gameworld itself is an interface (Jørgensen, 2013) is an important one here. Jørgensen argues that information integrated into the gameworld is part of it, regardless of how it is presented, and it exists to support meaningful gameplay and help the player understand its workings. Thus, the gameworld need not be natural or offer fictional coherence, but needs to provide clear, consistent and context-appropriate information for meaningful gameplay in order to create a sense of engagement and attachment. Hence, burdens should not be forced to be alleviated by reducing the complexity of gameworlds or game mechanics (as in APPMMAGs and many casual games), nor by making gameworlds more transparent so that they appear as unmediated as possible, nor by offering 'narrative' or 'easy' modes to circumvent complex gameplay in favour of a story or exploratory experience (e.g., as in Red Dead Redemption 2, The Witcher 3, Mass Effect Andromeda, and Assassin's Creed Odyssey). Rather, we argue that this should be achieved by striking a balance, such that meaningful gameplay is facilitated, not hindered, and unnecessary burdens to it are alleviated in an effective manner. As Salen and Zimmerman (2003) posit, the goal of game design is to create meaningful play, and this meaningful play emerges from the relationships between player actions and system outcomes when those relationships are both discernible (the result of the game action is communicated to the player in a perceivable way) and integrated into the larger context of the game (actions have immediate significance and also affect play experiences at a later point). Therefore, we may consider a burden to be anything within the gameworld which causes an overhead that hinders, compromises, or does not facilitate meaningful play, and thus impairs player engagement.

To better understand how unnecessary burdens may be alleviated in an effective manner, we find it valuable to distinguish between 'intrinsic' and 'extrinsic' elements of digital games, where the former are fundamental to the gameplay, such as game mechanics, while the latter are peripheral or even extraneous to the core gameplay, such as information players require that is not clearly discernible or tasks they must undertake in order to support the mechanics prior to or which interrupt play. In Section 2, we argue that the extrinsic elements unnecessarily increase the demands on the player creating burdens which subsequently reduce or break player engagement. Subsequently, in Section 3, we propose a framework that helps to reveal how extrinsic elements may be minimised so that intrinsic gameplay is better supported and stronger degrees of engagement are facilitated. The framework encapsulates and integrates a range of emerging technological approaches reported in the literature and comprises three layers: 'core' (intrinsic gameplay support); 'interaction' (reduces extrinsic player interactions); and 'interface' (reduces extrinsicality at the user interface [UI]). Finally, in Section 4, we draw some conclusions and distinguish the main areas of potential framework usage.

2. Intrinsicality and Extrinsicality in Digital Games

In order to consider burdensome aspects of digital games, we interpret them from a perspective of whether they reduce or break player engagement. We adopt a view of engagement as being progressive, as in the Revised Game Engagement Model (R-GEM), proposed by Procci, Bowers, Jentsch, Sims, and McDaniel (2018). We use this model as it is empirically validated, rooted in over two decades of prior research, and helps to reduce inconsistency in current games research terms while enabling consideration of all key constructs. R-GEM interrelates four key constructs that have proven critical to games research (each construct is substantially explored within their paper and definitions are based on those used within the model): 'immersion' (being enveloped by the games' stimuli and experiences); 'involvement' (motivation to play); 'presence' (feeling physically located within and interacting with the game, requiring a high level of immersion); and 'flow' (optimal experience of intrinsically-motivated and goal-driven enjoyment where temporal perception is distorted, requiring a high level of involvement, which occurs when a careful balance is achieved between task difficulty and player skill). In R-GEM, attention leads to low-level, reciprocal engagement states of 'immersion' and 'involvement,' which must be experienced prior to high-level engagement states of 'presence' and 'flow.' High-level engagement states are less easily attainable than low-level states, and thus the potential for burdensome aspects to affect high-level engagement is much greater. In addition, the more a player's cognitive effort is spent focusing their attention, the fewer cognitive resources remain for them to become further engaged; thus, minimising burdensome aspects also helps the player sustain their attention. The model also reflects the fact that immersion and involvement are reciprocal (e.g., more immersion is likely to lead to the player becoming more invested and thus more involved, while non-immersive games can become immersive through strong player determination to be involved). Thus, while presence and flow are presented as distinct states directly influenced by immersion and involvement respectively, there may also be some indirect influences which are acknowledged by the model. Such overlaps have been extensively discussed in the literature. For example, Csikszentmihalyi (1975, 1990), who first introduced flow, proposed various elements, some of which coincide with notions of immersion, such as concentration and the merging of action and awareness, while others help to distinguish it from presence, such as loss of self-consciousness (not being preoccupied with self). Alternatively, Michailidis, Balaguer-Ballester, and He (2018) have argued that flow is not substantially different from immersion and the terms can be used interchangeably, while Lombard and Ditton (1997) have argued that presence is conceptualised as immersion which makes players feel involved. Calleja (2011) considered involvement to be a precursor to presence or immersion where his notion of incorporation has been shown to align with R-GEM. It is also important to note that R-GEM only presents likely influences leading to progression, rather than conclusive progression (it is not deterministic), due to its focus on subjective player experience.

Using this model, we consider digital game elements from a viewpoint of being primarily either 'intrinsic' or 'extrinsic' to gameplay (while these terms have connotations stemming from psychological disciplines and gamification, we do not use them here in the same way). 'Intrinsic' game elements are fundamental to gameplay and serve to support engagement directly without being burdensome. Effectively, these serve what Salen and Zimmerman (2003) refer to as the internal, intrinsic qualities of games, relating to rules and play. Hence, intrinsic game elements will typically be focused on game mechanics, which contribute to involvement and flow by regulating the levels of challenge in the game, around well-crafted narratives involving in-game characters that players are able to empathise and identify with thus supporting intrinsic motivation and leading to involvement, or around high-sensory aesthetics which assist player control and encourage players towards immersion and presence (Alexiou & Schippers, 2018). Intrinsic game elements necessarily place demands on players and may involve overheads, but these facilitate rather than impair player engagement, e.g., such demands form part of the challenge needed for flow, and therefore do not evolve into burdens. It is therefore important that intrinsic game elements take into account the gaming experience and cognitive skills of the player so that engagement is not prevented (Sherry, 2004), and that choices are embedded into gameplay mechanics so that players are actively able to control and facilitate their in-game flow (Chen, 2006, 2007). However, if engagement is overly facilitated, the player may become engaged excessively, such that the experience of flow or presence does not serve to provide meaningful growth that they value (Salisbury & Tomlinson, 2016), e.g., to the point of addiction (Loton, Borkoles, Lubman, & Polman, 2016) or such that they feel an obligation to achieve (Molesworth & Watkins, 2016). This too, then, would be burdensome. Therefore, we might consider the relationship between player engagement and burdens to be a bell curve, centred around an engagement 'sweet spot,' though further consideration is beyond the scope of this paper.

In contrast, 'extrinsic' game elements are peripheral or even extraneous to gameplay. They unnecessarily increase player overheads and create excessive demands that may be considered burdens, which subsequently reduce or break their engagement. This may include information players require or tasks they must undertake in order to support the game mechanics before they can get on with the matter of just playing the game or which interrupt gameplay, effectively serving as the bureaucracy of the game, and game elements which detract or distract from meaningful gameplay, such as interfaces and controls that are too difficult to master or understand. Such difficulties are not the same as challenges or demands necessary for games, e.g., for facilitating flow, but typically occur as a result of less effective game design. For example, PaRapper the Rapper 2 requires buttons to be pressed in time with the music, which necessitates continued focusing on visual guidance at the top of the screen thereby detracting from the rest of the screen which tends to reduce player engagement, whereas, in contrast, Just Dance 2020 uses on-screen dancers performing the routine in the centre of the screen as core guidance, with only intermittent glances necessary to the pre-emptive dance icons at the bottom, making this less extrinsic. Likewise, the 'viewpoint synchronisation' element in the Assassin's Creed franchise is required for the player to view in-game objectives and get oriented to their current location, which requires consulting a map to locate a viewpoint (typically a tall building or tower), navigating to that viewpoint, and then climbing it, potentially manifesting multiple layers of game bureaucracy. However, the use of climbing and 'leap of faith' mechanics (to drop down on to a haystack) adds a level of challenge to the otherwise extrinsic element which encourages involvement and thus flow, while the inclusion of a 360-degree view of the surrounding area at the top of the viewpoint provides the player with an immersive form of information and new locations, which, coupled with realistic views of historical locations, has a likely influence on presence. There is therefore some overlap between extrinsicality and what Procci et al. (2018) refer to as internal and external distractions, some of which may be reduced through more usable designs and less obtrusive game peripherals that limit external sensory interference.

It is important to note that the distinction between intrinsic and extrinsic is not the same as internal and external to the gameworld, where the former are firmly contained within the realm of the game while the latter are outside and serve as a form of mediator between the player and the game, such as how players map to game controllers (Liebold, Bowman, & Pietschmann, 2018). While this distinction may similarly be used to understand demands on players, such as the physical demands required by controllers (Bowman, 2018), and thus may overlap somewhat, the perspective of intrinsic and extrinsic does not fully align. For example, consider where the player needs to read a large amount of in-game text with direct relevance to the game, e.g., where some events and characters are not depicted directly on screen. This may be considered internal to the gameworld but requires some imagination and internal processing on the part of the player and thus some overhead. If this text is not carefully presented so that it facilitates player engagement, we may consider it overly demanding, and therefore burdensome and extrinsic. Thus, while text may be intrinsic to the gameworld, it may not be intrinsic to meaningful gameplay. For this reason, a distinction in terms of gameplay rather than gameworld is preferred in this work.

3. Framework for Reducing Extrinsicality

Following from the above, we propose a framework, depicted in Table 1, comprising key emerging technological approaches surveyed from the literature which individually or in combination may serve to minimise extrinsicality (and thereby facilitate intrinsicality) and positively influence low- to high-level player engagement. At the base layer are core technological approaches used to realise digital game elements, which support the layers above and typically focus on intrinsic gameplay support. The middle layer comprises interaction technologies, in conjunction with the core layer below and in support of the higher interface layer, in order to effectively facilitate non-burdensome interaction between player and game. The top, interface layer encapsulates technological approaches that may be used to reduce extrinsicality at the player UI, typically the screen but may also include controllers and any physical interaction spaces, to improve the effectiveness of the UI. Figure 1 illustrates how these layers relate to the digital game elements and player engagement discussed in Section 2. Given that in R-GEM, immersion is a necessary antecedent for presence and involvement is a necessary antecedent for flow, technologies will generally influence progressive engagement pathways (i.e., immersion–presence and/or involvement–flow), rather than individual construct levels within those pathways, and may also influence the reciprocity between immersion and involvement, as was discussed in Section 2. Thus, we denote these influences as: immersion–presence (IP), involvement–flow (NF), and immersion–involvement (IN) in Table 1 and the rest of this section.

3.1. Core

The core layer consists of technologies which support higher level layers in achieving intrinsic gameplay support through minimising extrinsicality. Mostly these are concerned with 'game mechanics,' where game elements challenge and engage cognitively, physically, or emotionally, thereby influencing involvement, and as these progress, influencing the player to transcend into flow (Huang et al., 2018; Procci et al., 2018), supporting the NF engagement pathway. Many games enable the selection of different gameplay modes and difficulty levels, however, game mechanics which are specifically designed to reduce the cognitive load on the player have been shown to increase involvement (Nelson, Bowman, Bowman, & Kim, 2018). 'Dynamic difficulty adaptation' (DDA; a.k.a. scaling) undertakes adjustment of difficulty

Table 1. The proposed framework.

Layer	Example technological approaches generating digital game elements	Engagement pathways influenced*		
		IP	NF	IN
Interface (top)	Fluid UI	X	X	
	Diegetic interfaces	X	X	
	Gamespace awareness	X	X	X
	Playful-consumption experiences	X		
Interaction (middle)	Pacing	X		
	Isomorphic controllers	X		
	Personalisation and player profiling	X	X	X
	Model matching	X	X	
	Incentivisation		X	
	Emergent collaboration		X	
	Believable agents	X	X	X
	Persuasive technologies		X	
Core (base)	Game mechanics		X	
	Dynamic difficulty adaptation (DDA)		X	X
	Procedural content generation (PCG)	X	X	X
	Narrative optimisation	X		

Notes: I = immersion, P = presence, N = involvement, F = flow.

during the game and has been identified as core to facilitating engagement, predominantly involvement and flow (NF). For example, Silva, do Nascimento Silva, and Chaimowicz (2017) use DDA to minimise and avoid frustrations commonly caused by the lower autonomy and higher challenge elements of MOBAs, via a game agent that adapts its behaviour dynamically to player performance as evaluated via a metric based on certain game features (level, death count, and towers destroyed). Similarly, in FlowAI (Cruz & Uresti, 2017), a DDA module is responsible for adapting any tangible gameplay feature that might change the perceived level of difficulty, specifically non-player character (NPC) behaviour, quests or scenarios, and game mechanics. However, FlowAI also includes a specific immersion module, responsible for breaking down barriers that could limit a player from immersing in a game by adapting NPC behaviour, quests or scenarios, and controls, thus DDA may also help to fa-

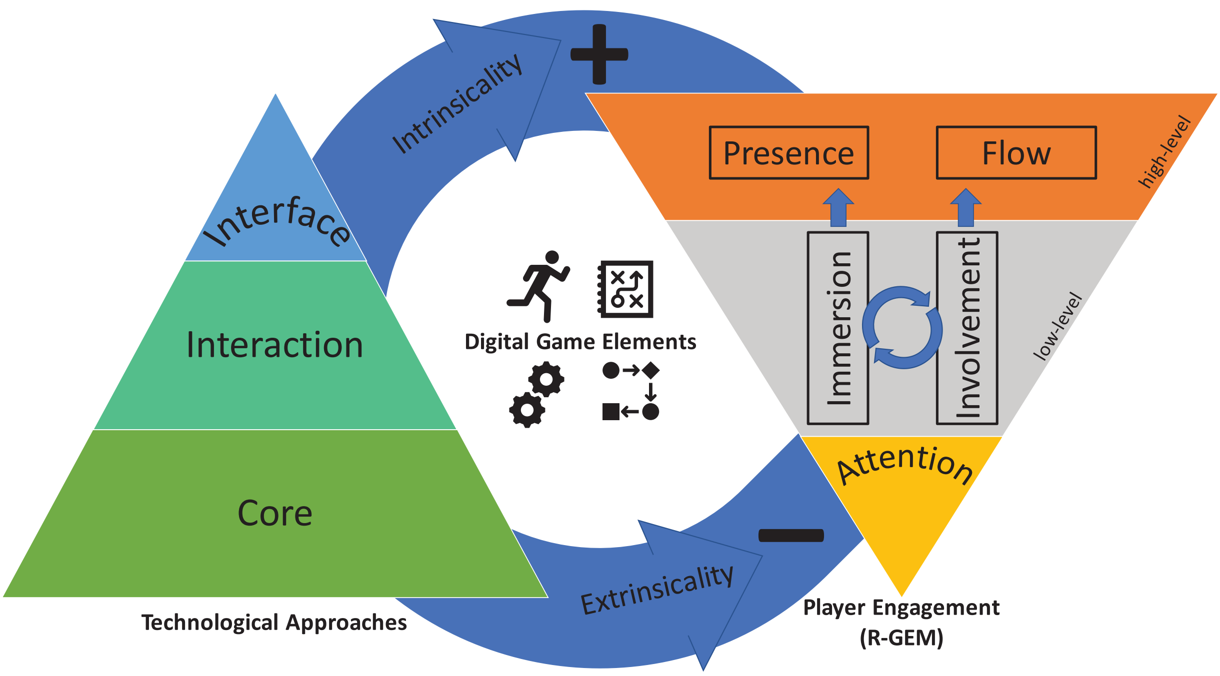

Figure 1. How the framework relates to digital game elements and player engagement. Note: Player engagement model is adapted from Procci et al. (2018).

cilitate immersion–involvement reciprocity (IN). Indeed, even when DDA is not actually present but players are told that the game they are playing will adapt, players actually report feeling more immersed (Denisova & Cairns, 2019). Primarily though, DDA has the potentially to perfectly balance challenges against player skill and increase player confidence (Constant & Levieux, 2019), ensuring players feel more in control and remain in a state of flow (Chen, 2007), and may thus mitigate against other extrinsic elements thereby alleviating extraneous player burdens.

Intrinsic game content is key for facilitating and maintaining player engagement. However, manual content production is costly and not scalable. As games have increased in complexity, developers have turned to 'procedural content generation' (PCG) to algorithmically and automatically generate all kinds of game content, including game bits (e.g., textures, fire, sound), gamespaces, game systems, game scenarios, game designs, and derived content (e.g., news, leaderboards), which may be generated using a variety of techniques ranging from pseudo-random number generators, generative grammars and image filtering, through to spatial algorithms, modelling and simulation of complex systems, and artificial intelligence (AI; Hendrikx, Meijer, van der Velden, & Iosup, 2013). Such game content may be generated at runtime during gameplay, during the design stage or prior to gameplay. Studies (e.g., Connor, Greig, & Kruse, 2017) have found that overall there is no statistically-significant difference between manually-generated content and PCG, but that there are particular areas where PCG may not succeed in engaging players as well, indicating that the PCG method should be appropriate and implemented in a way that maximises the ability to generate content facilitating immersion. One means in which PCG may be considered appropriate is by avoiding burdensome extraneous content and focusing on intrinsic game content. For example, generated derived content should not be used in an extrinsic manner such that it interrupts or distracts from the core gameplay, such as interrupting the player with news items to flatter them or generating music (Jordan et al., 2012; Summerville et al., 2018) that distracts and burdens the player. Instead, it should be based on player actions and game state to heighten the experience and further engender immersion. When used intrinsically, PCG avoids repetitiveness and creates the opportunity for games to be experienced repeatedly as being new and engrossing for the player. This influences motivation and thus involvement and flow (NF), while increasingly realistic game content can influence immersion and thus presence (IP). Given the importance of game content to the gameworld and meaningful gameplay, PCG can also reinforce the reciprocity of immersion and involvement (IN).

'Narrative' is central to many game genres and compelling and engaging narratives are often what enable games to be particularly meaningful (Oliver et al., 2016). Several narrative properties have been identified as being key to improving immersion (Verbrugge & Zhang, 2010), which would facilitate intrinsicality and the IP engagement pathway, notably logical consistency, continuity of story elements, level of tension or atmosphere, as well as gameplay issues such as ensuring player progress, and adequate coverage of potential player choices. Players are also more likely to immerse in a narrative if they empathise with the characters, even when the characters are morally ambiguous or questionable (Dechering & Bakkes, 2018). Narratives that do not adequately fulfil these properties may potentially create an extraneous cognitive burden for the user leading the narrative towards extrinsicality. This was the case in Frequency 1550 (Admiraal, Huizenga, Akkerman, & Ten Dam, 2011) where players paid attention to the intrinsic procedures and technology of the game but did not take the story seriously and paid little attention to the embedded narrative messages within the game. Similarly, Arjoranta (2017) has studied how the narratological concepts of focalisation (narrative viewpoint), granularity (narrative fineness/coarseness and richness of included elements), and mode of narration (tellers vs. reflectors) can be used as tools for creating cognitive responses from players, which must be carefully balanced to avoid being burdensome. While narrative does not tend to influence player involvement and flow per se, game mechanics which are designed to complement the narrative have been found to do so (Moser & Fang, 2015), and thereby help to avoid the need to introduce extrinsic elements into the game. For example, The Walking Dead utilises the narrative as a progression mechanic, where the player chooses from multiple dialogue options, one of which is frequently to say nothing and even this choice can progress the narrative and game, e.g., in the first instalment, during Chapter 2, Episode II, the player can take Kenny's or Lilly's side, stay neutral, or stay silent. Other games such as Assassin's Creed, Borderlands, Red Dead Redemption and even the campaign modes of Call of Duty, where narrative is bi-directionally complementary to the game mechanics, allows for the narrative to also increase immersion. In such games, players may develop their character based on their own perception of it, through the making of ethical choices or an honour system, and thereby influence the game narrative. When ethically-heavy choices are forced on the player (otherwise the game would not progress), such as to destroy Megaton in Fallout 3 or to execute the sick people of Kefalonia in Assassin's Creed Odyssey, the choices are demanding, primarily from a moral perspective, but they are not extraneous to the gameplay and thus are intrinsic rather than extrinsic and serve to further engagement rather than be burdensome. Interactive narratives have also been found to influence presence (IP) in direct correlation with the player's perceived sense of control over their character (Seif El-Nasr, Milam, & Maygoli, 2013), which is further heightened, through cognitive, emotional, and behavioural responses, when players create their own narratives (Riches, Elghany, Garety, Rus-Calafell, & Valmaggia, 2019). This relates to such narratives being core and thus intrinsic to the game.

3.2. Interaction

The interaction layer consists of technological approaches that exploit core layer technologies and work in conjunction with interface layer technologies to deliver a reduction in extrinsic player interactions. Immersion here is often supported by technological provision of immersive cues, such as realistic interactivity and input mechanisms, and the stronger these are, the easier it is to reach the higher-level engagement state of presence (Procci et al., 2018). However, the 'pacing' of interaction has been found to cause players to experience significantly different levels of state anxiety and negative affect (Jennett et al., 2008), suggesting that pacing should be adapted appropriately to facilitate immersion (IP) and to avoid interaction becoming burdensome. 'Isomorphic controllers' may help to improve the pacing of interaction. The manipulation and mapping interface layers in the Historical-Analytical Comparative System (HACS; Therrien, 2017) correspond closely with the interaction layer of our framework. The manipulation interface layer provides a broad typology of symbolic to isomorphic controllers, ranging from screen-augmented (visually encoded props) to corporeal (detection of body movements). Greater isomorphism has the potential to facilitate immersion (IP), e.g., mouse-based manipulation of windows, icons and pointers tends to create overhead that frustrates gameplay and therefore engagement. The mapping interface layer also extends from symbolic to isomorphic and associates primitive manipulations with represented or virtual actions, ranging from punctual (automation of virtual actions) to symbiotic (equivalence). Greater isomorphism and symbiosis here, made possible by controllers such as Leap Motion and Oculus Touch, similarly facilitates immersion (IP) by limiting the need for complicated motor activations, such as wiggling joysticks.

However, perhaps the most predominant technological approach at the interaction layer is 'personalisation,' which enables tailoring of gameplay information and social and group dynamics, often using AI, so that players and teams are not overburdened. Frequently this involves the use of 'player profiling' (a.k.a. player modelling), which groups players into common cognitive and emotional archetypes, and recent evidence shows that this can improve immersion (Denisova & Cairns, 2019), thereby facilitating the IP engagement pathway. Systematic Multiple Level Observation of Groups (SYMLOG) has been used in a non-intrusive manner to build collaborative profiles of a group of players in an online game working together towards a common goal (Berdun, Armentano, Berdun, & Cincunegui, 2019), which avoids extrinsic means for gathering profile data from players such as questionnaires. In FlowAI (Cruz & Uresti, 2017), discussed above, the DDA module responsible for adapting gameplay features relies on a player profile to create a personalised gaming experience that is reactive to players and thus can ensure that only necessary, intrinsic interactive demands are placed on the player and extrinsic game interactions are reduced or avoided completely. When used in this way, personalisation and player profiles can directly affect goal and challenge elements thereby influencing involvement and flow (NF). When combined with approaches that capture player interactions across multiple game environments (Scoular, Care, & Awwal, 2017), much richer profiles may be built that allow for inferencing of indicative player knowledge, skills, behaviour, and performance, which can be exploited for effectively managing extrinsicality, and facilitating the reciprocity of immersion and involvement (IN). 'Model matching theory' is related to this and helps to predict player outcomes linked to gameplay by focusing on the interrelationship among game mechanics, external situations, and players' mental models. Alignment increases mental model transfer and influences a range of outcomes, notably immersion, involvement, and flow (IP, NF), but also in-game performance, learning, and game transfer phenomena (McGloin, Wasserman, & Boyan, 2018), and can help to reduce extrinsic game elements and extraneous burdens.

'Incentivisation' has been used to identify and dynamically reward different classes of players based on personalised, relative assessments of performance. This helps provide a satisfactory game experience for both experienced and inexperienced players, and incentives that enhance players' engagement in the game could be used in combination with player predictions to prevent a player's choice to quit the session, or frustration that may drive them to quit the game (Sapienza et al., 2018), thereby maintaining interaction and thus involvement and influencing flow (NF), potentially mitigating negative consequences of extrinsic game elements. Many mobile games, such as Candy Crush Saga and Crossy Road, use various devices such as daily gifts or timer-based boosts which last for specific durations and may increase with continued daily participation. However, while they often successfully increase involvement initially, such devices typically serve as extrinsic game elements that are designed to feed extrinsic motivations. They are therefore burdensome to players as they detract from gameplay and do not sufficiently sustain motivation or engagement in the long-term (Pink, 2009); at best they can merely mitigate other extrinsic game elements, e.g., having to wait for some time to gain a new life or having to send help requests to friends.

Many games require players to collaborate. However, game mechanisms to support player collaboration are not always used (Zagal, 2006), which is typically a consequence of them being extrinsic to gameplay. Designing collaborative mechanics which are intrinsic results in 'emergent collaboration' among players because it is embedded into the gameplay. Such mechanics include complementary actions (players' individual tasks need to be synchronised with each other in a timely manner to perform a joint task), indirect actions (some players are given information or a task that requires other players to act), and encrypted information (players have individual, unique information needed in task solving; Hämäläinen, Niilo-Rämä, Lainema, & Oksanen, 2018). To perform complementary actions, players need to collaborate to share knowledge; to perform indirect actions, players need to collaborate to exchange information in order to form a joint understanding on what should be done and how; and to use encrypted information, players need to collaborate to share their knowledge with each other so as to form a shared understanding built on each other's thoughts. Thus, emergent collaboration tends to influence involvement and, where the collaboration is absorbing, flow (NF).

Repeated studies (e.g., Mateas, 1999; Pacheco, Tokarchuk, & Pérez-Liébana, 2018) have demonstrated that 'believable agents' within a game greatly impact on feelings of presence and flow, and thus immersion and involvement antecedently, including the positive reciprocity between the two (IP, NF, IN). Different aspects of such agents would have various impacts on the quality of intrinsic and extrinsic game elements. Gomes, Paiva, Martinho, and Jhala (2013) define nine dimensions to believability according to the agent's awareness, behaviour understandability, personality, visual impact, predictability, behaviour coherence, change with experience, social behaviour, and emotional expressiveness. Believability increases immersion and therefore presence (IP) if the players consider them more human, increasing empathy and supporting the suspension of disbelief. Believability would also affect involvement and flow (NF) since the more believable the agents, the easier they will be to interact with at a suitable pace and the less burdensome the interaction with them will be. Reduction in believability would increase the bureaucracy of the game and thus extrinsicality as the player will need to learn how to interact with these agents in order to progress. For example, various bots (agents) in Counter-Strike try to mimic human behaviour using strategies such as rushing at the opponent team, ambushing and holding the base. However, as a team member they do not coordinate well together, requiring the player to learn their behaviour as a team member in order to play with them effectively. Believable agents also affect the interface layer, primarily through visual impact, although this ultimately affects interaction, e.g., how the agent is visually perceived will influence how they are interacted with.

'Persuasive technologies' can also be used to reduce extrinsicality through enhanced involvement (NF). Using persuasion, digital games may provide compelling experiences that convey specific messages by allowing players to explore cause-effect relationships, motivating them through vicarious experiences, or helping them rehearse a behaviour. They may also persuade players by making activities easier or more efficient to do, or by applying the same persuasion principles that humans use to influence others (de la Hera Conde-Pumpido, 2018), e.g., through believable agents that engage with and encourage, discourage or coerce the player. Persuasion may also use benevolent deception to enhance the player's experience as long as the player is not aware of it, e.g., where games seek to manipulate players for behaviour change and educational purposes (Denisova & Cairns, 2019). Such approaches rely on other technologies, such as player profiling at the interaction layer, and DDA at the core layer, to adapt the interaction to the individual player.

3.3. Interface

The interface layer consists of technological approaches which work in conjunction with the base core and middle interaction layers to reduce extrinsic burdens at the player UI. Here, immersion and presence are influenced by the extent to which immersive cues are provided, such as higher sensory resolution and increased number of senses provided by the game (Procci et al., 2018), e.g., many games enable adjustment of graphical fidelity and detail to improve the experience, according to the capabilities of the available technical resources such as graphics cards. When used in conjunction with personalisation from the interaction layer, the UI may not only be customised for the player, such as in World of Warcraft and Diablo III which allow the player to customise the abilities tree in-game, but may also achieve the notion of a 'fluid UI' (Dyck, Pinelle, Brown, & Gutwin, 2003) to communicate information to players in ways that do not demand their attention and do not interrupt gameplay, thereby reducing extrinsicality and facilitating immersion (IP). Methods that may be commonly used include calm messaging (unobtrusive messages via the use of sound, speech, transient text, or animation that do not require dismissal, acknowledgement or addressal by the player), attention-aware interface elements (automatically modify themselves based on the amount of attention users are paying to them, to reduce visual clutter and increase size of useable gamespace), and context-aware view behaviours (such as automatically zooming, panning and rotating gamespace views to best suit the task at hand, reducing player effort to navigate and adjust, and filtering information to only that which is currently relevant, to avoid overwhelming the player). Being distracted by navigational problems has been shown to be an extrinsic burden, affecting flow and thus involvement (NF), and decreasing game performance (Admiraal et al., 2011).

Although many expert players tend to focus on the HUD, some (Bowman, Elmqvist, & Jankun-Kelly, 2012; Pears, 2016) have commented on how HUDs can often add an additional unnecessary layer that distances players from the gameplay when not carefully implemented. Guidelines to ensure HUDs are accessible and facilitate intrinsic gameplay have been proposed, some of which emphasise the use of 'diegetic interface' components (may be viewed by the player-character, i.e., in-game) instead where possible (Edwards, 2018) or the design of HUDs for peripheral vision to improve game performance (Tilford, 2019). Some studies (Peacocke, Teather, Carette, & MacKenzie, 2015) are starting to reveal a player preference for diegetic interfaces that tend to improve player performance, thus influencing involvement and flow (NF), while other studies (Iacovides, Cox, Kennedy, Cairns, & Jennett, 2015) have found that the removal of non-diegetic interface components (those viewed only by the player and not the player-character) such as HUDs altogether can improve immersion in expert players (IP). However, the feedback interface layer in HACS (Therrien, 2017), which ranges from signaletic (non-diegetic) to diegetic, reveals that signaletic informational elements, notably progression/failure markers and score, cannot be part of the diegesis.

The notion of 'gamespace awareness' (Antunes, Herskovic, Ochoa, & Pino, 2014; Teruel, Navarro, González, López-Jaquero, & Montero, 2016) can facilitate the player's understanding of time (present, past, future) and social and group dynamics, predominantly via the presentation of information at the player UI, within individual, co-operative and collaborative games. For example, in MMORPGs, players must be aware of other players' roles and locations in order to make player-to-player interaction more frequent so that they can successfully undertake game tasks. This results in a large number of design categories that games may utilise such as availability, communication, mobility, navigation, spatiality, virtuality, and sensemaking, and a large number of resultant game elements such as presence, identity, authorship, task, and location to support time-based concerns, and exposed information, role, group goal, and inner/outer communication to support social and group dynamics. The broad nature of such game elements means that those broadly supporting the undertaking of tasks may influence involvement and thus flow (NF), while those that provide heightened stimuli and experience may influence immersion and thus presence (IP). The extensive inter-relationships between the elements also means that the inter-relationship between immersion and involvement (IN) may also be supported. Such influences will be positive where the game elements are implemented in a manner that does not burden the player but supports them in their intrinsic tasks.

Recently (Abbasi, Ting, Hlavacs, Costa, & Veloso, 2019), it has been proposed that the notion of consumption from the field of marketing may be applied to digital games, yielding a 'playful-consumption experience' approach. This focuses on creating intrinsically, motivating, active, and self-based gameplaying behaviour for players' own sake and pleasure, leading to playful hedonic experiences. Using this approach, it is possible to predict game engagement (cognitive, affective, and behavioural) as it arises from imaginal, emotional, and sensory playful-consumption experiences. Sensory experiences are predominantly provided by the interface layer, thus enhanced sensory technological approaches which appeal to a greater number of senses and allow the player to physically 'feel' the game may enhance intrinsic game content and heighten immersion and thus presence (IP). However, any physical impediments, such as cybersickness and awareness of devices, controllers and head-mounted displays would diminish agency and interaction and lead to reduced immersion and presence (Riches et al., 2019), thereby causing them to become highly burdensome.

4. Conclusions

As gaming technology advances and games become more complex, it is important for maintaining engagement that extraneous burdens on players are minimised and core gameplay is preserved. Having reviewed a range of technological approaches within the framework, it can be seen that it may serve as an initial guide for how such reductions in extrinsicality may potentially be achieved: as a lens by which to view emerging digital game technologies, in terms of how they enhance or hinder levels of engagement and subsequently whether they serve to enable intrinsic or extrinsic game elements, or as a lens for considering particular games at each layer of technological approach and engagement. The proposed framework may also be used to guide game design itself to avoid or reduce extrinsic burdens. For example, in designing an improved version of the multiplayer Beer Game (Daylamani-Zad, Agius, & Angelides, 2018), which traditionally does not support communication or collaboration between players, we targeted the interaction layer by introducing multiple reflective intelligent agents in conjunction with personalisation and player profiling and emergent collaboration to facilitate collaboration without creating burdens, thus improving player and team performance and engagement. Similarly, in creating a World of Warcraft add-on (Daylamani-Zad, Angelides, & Agius, 2012), we targeted the interaction and interface layers, using personalisation and player profiling, model matching, gamespace awareness, and fluid UI to reduce extrinsicality when making choices about weapons, armours, quest paths, and character development, and to identify complementary players for co-op raids and suitable players for PvP arena battles. The framework may also potentially be integrated into game analysis and evaluation tools, such as into assessments of player experience (Johnson, Gardner, & Perry, 2018) so that measurement can be related specifically to technologies, game elements, or precise engagement pathways.

Conflict of Interests

The authors declare no conflict of interests.

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